

Environmental and Social Impact Assessment Final Report

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ARM: Yerevan Gas-Fired Combined-Cycle Power Project

Prepared by Fichtner, Stuttgart, Germany

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Yerevan 2 CC Power Plant ArmPower CJSC

Environmental and Social Impact Assessment – Final



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Table of Contents

Table of Contents	I
List of Tables	VI
Acronyms and Abbreviations	VIII
1. Introduction	1-1
1.1 Project Background	1-1
1.2 Objective of the Project	1-3
1.3 Objectives of the ESIA	1-3
1.4 Methodology	1-4
2. Policy, Legal and Administrative Framework	2-2
2.1 National Requirements	2-2
2.2 International Agreements	2-11
2.3 International Requirements	2-12
2.3.1 IFC Sustainability Framework	2-12
2.3.2 IFC/ World Bank EHS Guidelines	2-18
2.3.3 ADB Safeguard Policy Statement	2-18
2.3.4 Other Relevant Guidelines	2-21
2.4 Environmental Standards	2-21
2.5 Gap Analysis between National and International Legislation	2-31
3. Description of the Project	3-1
3.1 Summary Technical Description	3-1
3.2 Project Area and Project Area of Influence	3-10
3.3 Schedule for Project Realization	3-12
4. Analysis of Alternatives	4-1
4.1 The ‘No Project’ Scenario	4-1
4.2 Comparison of Alternatives and Options	4-1
4.2.1 Location	4-1
4.2.2 Alternative Methods of Power Generation	4-1
4.2.3 Design alternatives	4-3
4.3 Summary of the Comparative Assessment of Alternatives	4-4
5. Description of the Environment (Baseline Data)	5-1
5.1 Environmental Conditions	5-1

5.1.1	Flora, Fauna and Biodiversity	5-3
5.1.2	Protected Areas	5-4
5.1.3	Geology and Seismic Situation	5-5
5.1.4	Soil	5-7
5.1.5	Water Resources	5-9
5.1.6	Climate and Air Quality	5-18
5.1.7	Noise	5-21
5.1.8	Landscape	5-24
5.2	Socio-economic Conditions	5-24
5.2.1	Population within the Project Area of Influence	5-24
5.2.2	Sensitive Receptors	5-24
5.2.3	Livelihood and Housing	5-26
5.2.4	Land Usage and Ownership	5-26
5.2.5	Historical and Cultural Sites	5-27
6.	Environmental and Social Impact Assessment	6-1
6.1	Environmental Impacts during Construction Phase	6-1
6.1.1	Fauna, Flora and Biodiversity	6-1
6.1.2	Protected Areas	6-2
6.1.3	Soil	6-2
6.1.4	Water Resources	6-3
6.1.5	Climate and Air Quality	6-5
6.1.6	Landscape and Visual Aspects	6-6
6.1.7	Waste	6-7
6.2	Environmental Impacts during Operation Phase	6-10
6.2.1	Fauna, Flora and Biodiversity	6-10
6.2.2	Protected Areas	6-10
6.2.3	Soil	6-10
6.2.4	Water Resources	6-11
6.2.5	Climate and Air Quality	6-16
6.2.6	Landscape and Visual Aspects	6-19
6.2.7	Waste	6-19
6.3	Social Impacts during Construction Phase	6-20
6.3.1	Local Workforce	6-20
6.3.2	Land Usage and Ownership	6-21
6.3.3	Historical and Cultural Sites	6-21

6.3.4	Occupational and Community Health and Safety	6-22
6.4	Social Impacts during Operation Phase	6-25
6.4.1	Electricity Supply	6-25
6.4.2	Occupational and Community Health and Safety	6-26
6.4.3	Job Opportunities	6-34
6.5	Additional Impacts from new Connection Facilities	6-34
6.5.1	Additional Impacts during Construction Phase	6-35
6.5.2	Additional Impacts during Operation Phase	6-36
6.6	Additional Impacts during Decommissioning Phase	6-36
6.7	Summary of Impacts	6-37
7.	Information Disclosure, Consultation, and Participation	7-1
7.1	Background	7-1
7.2	Results from the 2018 Public Consultation meeting	7-2
7.3	Consultation of nearby temporary residents	7-4
8.	Grievance Redress Mechanism	8-1
8.1	General Public Grievance Mechanism	8-1
8.2	Workers Grievance Mechanism	8-4
9.	Environmental and Social Management Plans (ESMPs)	9-1
9.1	Mitigation Measures	9-2
9.1.1	Mitigation Measures for the Construction Phase	9-2
9.1.2	Mitigation Measures for the Operation Phase	9-11
9.1.3	Mitigation Measures for the Decommissioning Phase	9-17
9.2	Monitoring Measures	9-18
9.2.1	Monitoring during the Construction Phase	9-18
9.2.2	Monitoring during the Commissioning Phase	9-35
9.2.3	Monitoring during the Operation Phase	9-36
9.2.4	Monitoring during the Decommissioning Phase	9-51
9.3	Implementation Arrangements and Capacity Building	9-51
9.4	Reporting requirements	9-52
9.5	Adaptive management	9-53
9.6	Summary of Costs for Implementation of the EMSP	9-53
9.7	Gap Analysis regarding compliance with IFC Performance Standards	9-54
9.8	Environmental and Social Action Plan	9-66
10.	Overall Findings, Conclusion, and Recommendations	10-1

11. References	11-1
12. Annexes	12-3
12.1 Communication from Yerevan Municipality - illegal dwellings	12-3
12.2 Communication from Veolia Djur CJSC on water supply	12-5
12.3 Record of Meetings	12-9
12.4 Analysis of Oil in the Contaminated Soil from Construction Site	12-10
12.5 Report on Groundwater Quality and Possible Soil Contamination from August 2017	12-14
12.6 Noise Impact Study	12-15
12.7 Waste Water Temperature Study (steady state), ArmPower	12-16
12.8 Air Dispersion Calculation	12-17
12.9 Stakeholder Engagement Plan	12-18
12.10 Legal Framework of Earth Cover Pollution Standardization in Armenia and Results of the YCCPP-2 Territory Research, Consecord 2018	12-19
12.11 Report on Soil Analysis, Groundwater and Hrazdan River Water Quality from February 2018	12-20
12.12 Legal Framework of Air Emissions Standardization in Armenia and Assessment of the planned YTPP-2 Emissions, Consecord 2018	12-21
12.13 Public Consultation Meeting at Yerevan 10 th February 2018	12-22

List of Figures

Figure 1-1: Site location (red) of the planned YCCPP-2 (black), next to the existing YCCPP-1; access road (yellow) and temporary laydown area for construction (blue), which are in possession YCCPP-1	1-2
Figure 1-2: Baseline Monitoring Points - Air Quality	1-6
Figure 1-3: Baseline Monitoring Points - Noise	1-7
Figure 1-4: Baseline Monitoring Points - Soil and groundwater (November 2017)	1-8
Figure 3-1: General design of a Combined Cycle Power Plant	3-1
Figure 3-2: YCCPP-2 Key Plan (Source: RENCO SPA)	3-3
Figure 3-3: Overview plan showing the new interconnections of YCCPP-2	3-9
Figure 3-4: Location of existing YCCPP-1 and future YCCPP-2 in the south of Yerevan	3-10
Figure 3-5: Project Area (in red) located south of Yerevan, nearest residential areas and illegal housings	3-11
Figure 3-6: Project Area of Influence with residential areas in a distance of 10 km from the YCCPP-2 that might be impacted by the Project	3-12
Figure 3-7: Preliminary Project Schedule	3-13
Figure 5-1: Ecology and former land use of the construction site (Source: courtesy of ADB)	5-2
Figure 5-2: Typical vegetation at the construction site with some reed and bushes (Source: Fichtner, July 2017)	5-4
Figure 5-3: Hrazdan River in the area of treated waste water final discharge (Source: courtesy of ADB, February 2018)	5-4
Figure 5-4: Oil leakages near to some empty oil drums at YCCPP-2 site (Source: Fichtner, July 2017)	5-7
Figure 5-5: Channels part of the channel network discharging the treated waste water of YCCPP-1 finally to Hrazdan River (Source: courtesy of ADB, February 2018)	5-10
Figure 5-6: Hrazdan River in the area where the channels discharge the treated waste water of YCCPP-1 finally to the river (Source: courtesy of ADB, February 2018)	5-11
Figure 5-7: Final discharge for the treated waste water from YCCPP-1 (and in the future for YCCPP-2 as well)	5-11
Figure 5-8: Average temperatures (min. and max.) and precipitation (mm) in Yerevan (30-year global history with hourly weather data).	5-18
Figure 5-9: The diagram for Yerevan shows how many days within one month can be expected to reach certain wind speeds	5-19
Figure 5-10: Wind rose for the years 2014-2016 (wind blowing from)	5-19
Figure 5-11: Baseline Monitoring Points - Noise	5-22
Figure 5-11: Location of illegal houses located northeast and south of new YCCPP-2 and training center of fire brigade	5-25
Figure 5-12: Illegal houses located northeast of YCCPP-1 and YCCPP-2 (Source: Fichtner, July 2017)	5-26
Figure 6-1: Location of waste on the site found during the site visit of July 2017	6-8
Figure 6-2: Scrap metal	6-9
Figure 6-3: Wooden and metal material	6-9
Figure 6-4: Metal cabin on concreted area	6-9
Figure 6-5: Old toilets and wash basins	6-9
Figure 6-6: Gas cylinders / scrap metal	6-9
Figure 6-7: Old filter	6-9
Figure 6-8: Scrap metal at the temporary laydown area	6-9

Figure 6-9:	Preliminary Water Balance of YCCPP-2 (Source: RENCO)	6-12
Figure 7-1:	Meeting with residents of the nearby temporary houses (source: RENCO, February 2018)	7-5
Figure 8-1:	Flowchart of Grievance Redress Mechanism	8-3

List of Tables

Table 1-1:	Evaluation of impacts using International and National Standards	1-9
Table 2-1:	National laws of RA, implemented to regulate the protection of the environment and expropriation issues	2-2
Table 2-2:	Limit values for noise regarding population (IFC/WB General EHS Guidelines)	2-21
Table 2-3:	Limit values for noise regarding population (Sanitary Norm N2-III-11.3)	2-21
Table 2-4:	Limit values for noise regarding workers	2-22
Table 2-5:	Performance Guarantees of YCCPP-2 - noise (ArmPower, 2017)	2-22
Table 2-6:	IFC air emission guidelines for facilities larger than 50 MW with combustion turbines (IFC, 2008)	2-22
Table 2-7:	Performance Guarantees for YCCPP-2 - air emissions (ArmPower, 2017)	2-22
Table 2-8:	National and ECD Ambient Air Quality Standards	2-23
Table 2-9:	Industrial Effluent Conditions as given in ArmPower Design Data, Effluent Standards for YCCPP-1 set by MNP, and applicable Effluent Guidelines for wastewater from thermal power plants (Source: IFC/WB EHS Guidelines for Thermal Power Plants)	2-25
Table 2-10:	Guideline values for Sanitary Sewage Discharges (Source: IFC/WB General EHS Guidelines)	2-26
Table 2-11:	Dutch Standards for groundwater quality (Soil Remediation Circular, 2009)	2-26
Table 2-12:	German Standards for groundwater quality	2-27
Table 2-13:	Water quality comparative data - RA Decision N75-N (2014)	2-28
Table 2-14:	Dutch Standards for soil quality (Soil Remediation Circular, 2009)	2-29
Table 2-15:	Maximum allowable concentrations (MAC) of chemical substances in soil (Sanitary norms and rules N 2.1.7.003-10)	2-29
Table 2-16:	Proposals for land use based on the degree of pollution (Annex to the Sanitary norms and rules N 2.1.7.003-10)	2-30
Table 2-17:	Limits defined by ICNIRP to manage human exposure to electric and magnetic fields	2-30
Table 3-1:	Planned Site Facilities at YCCPP-2 (source: RENCO)	3-7
Table 5-1:	Surface water quality analysis from November 2017 and comparative data	5-13
Table 5-2:	Groundwater quality comparative data (November 2017 data)	5-17
Table 5-3:	Results of the baseline noise monitoring at the Project site	5-23
Table 6-1:	Predicted noise pressure at Measurement point 'Noise 4'	6-29
Table 6-3:	Summary of impacts during operation phase (incl. associated facilities)	6-37
Table 6-4:	Summary of impacts during decommissioning phase (incl. associated facilities)	6-38

Table 9-1: Summary of Mitigation Measures during Construction Activities concerning Fauna and Flora	9-2
Table 9-2: Summary of Mitigation Measures during Construction Activities concerning Erosion Control	9-2
Table 9-3: Summary of Mitigation Measures during Construction Activities concerning Soil Pollution	9-3
Table 9-4: Summary of Mitigation Measures during Construction Activities concerning Water Pollution	9-4
Table 9-5: Summary of Mitigation Measures during Construction Activities concerning Climate and Air Quality	9-4
Table 9-6: Summary of Mitigation Measures during Construction Activities concerning Landscape and Visual Aspects	9-5
Table 9-7: Summary of Mitigation Measures during Construction Activities concerning Waste Management	9-6
Table 9-8: Summary of Mitigation Measures during Construction Activities concerning Historical and Cultural Sites and Goods	9-7
Table 9-9: Summary of Mitigation Measures during Construction Activities concerning Occupational Health & Safety	9-7
Table 9-10: Summary of Mitigation Measures during Construction Activities concerning Community Health & Safety	9-9
Table 9-11: Summary of Mitigation Measures during Construction Activities concerning Social Aspects	9-10
Table 9-12: Summary of Mitigation Measures during Operation concerning Protection of Flora and Fauna.	9-11
Table 9-13: Summary of Mitigation Measures during Operation concerning Soil and Water Pollution	9-11
Table 9-14: Summary of Mitigation Measures during Operation concerning Climate and Air Quality	9-13
Table 9-15: Summary of Mitigation Measures during Operation concerning Landscape and Visual Aspects	9-13
Table 9-16: Summary of Mitigation Measures during Operation concerning Waste Management	9-14
Table 9-17: Summary of Mitigation Measures during Operation concerning Occupational Health & Safety	9-15
Table 9-18: Summary of Mitigation Measures during Operation concerning Community Health & Safety	9-16
Table 9-19: Summary of monitoring measures during Construction Phase	9-18
Table 9-20: Summary of monitoring measures during Operation Phase	9-36
Table 9-21: Monitoring costs for implementation of the ESMP	9-54
Table 9-22: Compliance of the Project with main requirements of IFC Performance Standards (PS)	9-55
Table 9-23: Environmental and Social Action Plan including the main mitigation topics	9-66

Acronyms and Abbreviations

ADB	Asian Development Bank
ADC	Air Dispersion Calculation
CCPP	Combined Cycle Power Plant
CEMS	Continuous Emissions Monitoring System
CJSC	Closed Joint Stock Company
EIA	Environmental Impact Assessment
EPC	Engineering, Procurement, Construction
ESAP	Environmental and Social Action Plan
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
GIIP	Good International Industry Practice
GLC	Ground Level Concentration
GT	Gas Turbine
GRM	Grievance Redress Mechanism
HHV	Higher Heating Value
HRSG	Heat Recovery Steam Generator
HSE	Health Safety and Environment
HSEMP	Health, Safety and Environment Management Plan
HSEMS	Health, Safety, and Environment Management System
IBA	Important Bird and Biodiversity Area
IFC	International Financing Corporation
IFIs	International Financing Institutions
ILO	International Labor Organization
kV	Kilo Volt
LHV	Lower Heating Value
MNP	Ministry of Nature Protection
MOE	Ministry of Energy and Natural Resources of RA
MPC	Maximum Permissible Concentration
MW	Mega Watt
NGO	Non-Governmental Organization
NPS	Noise Propagation Study
PAP	Project Affected People
PCB	Polychlorinated Biphenyls
PPE	Personal Protective Equipment
PS	Performance Standards
RA	Republic of Armenia
SEP	Stakeholder Engagement Plan
SNCO	State Non-Commercial Organization
ST	Steam Turbine
UHC	Unburned Hydrocarbons
USD	US Dollar
WHO	World Health Organization

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Executive Summary

Project Background and Objectives

The Ministry of Energy (MOE) of the Republic of Armenia plans to improve the total output capacity of its electric energy production, complementing the power units of the existing Yerevan Combined Cycle Thermal Power Plant (YCCPP-1) with a modern and efficient power plant. For this reason a new gas fired Combined Cycle Power Plant of 254 MWe (YCCPP-2) is planned to be built at the site next to the existing YCCPP-1.

To obtain financing from the International Financing Corporation (IFC) and the Asian Development Bank (ADB), a bankable Environmental and Social Impact Assessment (ESIA) Report regarding the YCCPP-2 (“the Project”) on the basis of the relevant IFC/World Bank Group’s guidelines and the ADB Safeguard Policy Statement has to be delivered to the financing institutions for review and approval.

The new CCPP will include a Gas Turbine (GT), a Steam Turbine (ST), a Heat Recovery Steam Generator (HRSG), and all auxiliary equipment and systems that, at local conditions with an ambient temperature of 15°C, will produce 254 MW. Interconnections to gas, water and electrical grid are already planned. The new CCPP shall be connected with the facilities of the existing grid infrastructure.

Along with a rapidly growing economy and a rising population, power demand in Armenia is constantly increasing. The main objective of the construction of YCCPP-2 is to:

- Improve the total output capacity of electric energy production;
- Provide reliable power supply;
- Shift the financial burden for power generation from the government to the private sector;
- Promote commercial development of thermal technology and cost reduction that enables Armenia to become a major net exporter of electricity; and
- Build and sustain local capacity in the development and maintenance of power generation infrastructure.

Objectives and Methodology of the ESIA Study

On the basis of the existing environmental situation and the technical planning of the power plant, FICHTNER determined and evaluated the environmental and social impacts during construction, operation, and decommissioning of the planned YCCPP-2. The impact assessment examined the impacts to physical environment of the Project and the effects for the local population. In a second step, appropriate mitigation measures and monitoring measures were considered to reduce possible adverse impacts and to monitor their implementation.

After public disclosure of the ESIA, including the ESMP, public consultations were executed in order to seek feedback and concerns of stakeholders and people possibly affected by the Project. A Stakeholder Engagement Plan has also been prepared as part of this ESIA study.

A general overview about biophysical settings has been done based on a desktop study, including existing studies about the Project and on field surveys. The first field surveys were conducted by FICHTNER's environmental and social experts in July 2017 and February 2018, visiting the proposed CCPP site. Other surveys have been undertaken consisting of sampling of air, soil and groundwater at the site and its surroundings. The environmental and social impacts of the Project are predicted in relation to environmental and social receptors and natural resources. This is accomplished by comparing baseline conditions with situations ensuing when the Project is implemented. Additional information was gained by consultations of representatives of governmental and non-governmental organizations. New campaigns for monitoring of surface water, groundwater and soil quality have been undertaken with the objective to deepen the knowledge about the existing pollution levels in the area.

To obtain up-to-date data about the ground level concentrations (GLC) of air pollutants in the Project Area of Influence, and help defining the airshed as degraded or non-degraded (according to the WB EHS Guidelines), FICHTNER undertook air quality monitoring campaigns in Summer 2017, Autumn 2017, and Winter 2017/2018 including the measurement of SO₂, NO₂ and PM₁₀. This monitoring campaign will be repeated next Spring in order to cover all seasons of an annual cycle.

To obtain data about the existing noise levels in the Project Area of Influence, FICHTNER undertook a noise monitoring campaign in an area around the YCCPP-2 site at five monitoring points. The results were used as an input for a Noise Propagation Study report.

Soil sampling at the construction site was done in November 2017 for analyses of TPH, PAH, BTEX, and metals. Furthermore analyses of groundwater upstream, at the site, and downstream for content of TPH, PAH, BTEX, metals, as well as pH, mineralization, BOD₅, COD-Cr were performed at the same time. Analyses of water quality parameters of the Hrazdan River upstream and downstream of the discharge point and at the discharge channel close to the discharge point were also performed.

Due to the fact that there is no official international consensus on an agreed approach for assessing the significance of impacts on the environment, FICHTNER uses an own evaluation procedure. This transparent evaluation procedure is based upon FICHTNER's extensive experience over the last fifteen years in performing Environmental and Social Impact Assessments and has proven to be a reliable method for assessing a project's impacts on the environment. It includes identification, prediction and evaluation of the significance of impacts based on IFC/WB guidelines and ADB Safeguard Policy Statement, as well as national legal requirements. Wherever possible,

impacts are quantified. The focus of the used evaluation procedure is to decide whether the Project is likely to cause significant adverse environmental effects resulting from construction, operation, and decommissioning.

Policy, Legal and Administrative Framework

National Requirements

The planned implementation of any activity in Armenia that may cause environmental impacts needs a positive conclusion of an EIA expertise. All environmental impacts of planned physical activities or sectoral/ regional development plans/ programs have to be assessed during the EIA preparation period. The **RA Law on Environmental Assessment and Expertise** of 2014 stipulates provisions regarding environmental impact assessment, realization and terms, thus being the most important national law for carrying out the EIA. **National Environmental Project approval** from Ministry of Nature Protection has been given in July 2017 based on national EIA and geological reports. The national law requires an EIA, while the present draft report is about ESIA, as the Law on the Environmental Impact Assessment and Expertise does require coverage of social aspects of a proposed activity.

International Agreements

Armenia has ratified a number of international agreements and conventions relating to the protection of the environment and biodiversity as there are among others:

- The Convention on the Conservation of European Wildlife and Natural Habitats (Bern)
- Convention on Wetlands of International Importance (Ramsar)
- Conservation of Migratory Species of Wild Animals (Bonn)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (Washington)
- European Landscape Convention (Florence)
- Convention Concerning the Protection of the World Cultural and Natural Heritage (Paris)
- Convention on Biological Diversity (Rio de Janeiro).
- Framework Convention on Climate Change (Rio de Janeiro)
- Kyoto Protocol (linked to the Convention on Climate Change)
- Paris Agreement (linked to the Convention on Climate Change)

With respect to handling of hazardous substances, the Government of the Republic of Armenia ratified the Stockholm Convention and is a party of the Basel Convention. In addition, an important, environmentally relevant international agreement to which Armenia is a signatory is the Aarhus

Convention on access to information, public participation in decision-making and access to justice in environmental matters.

International Requirements

According to IFC's Sustainability Framework (2012) the Project falls into environmental **Category A**. In accordance with ADB Safeguard Policy Statement (2009) the project is categorized as **Category A** for environment, Category C for Involuntary Resettlement and Category C for Indigenous Peoples. This categorization requires preparation of an ESIA study. ADB and IFC define that ESIA shall be conducted in line with national laws and regulations as well as in line with international environmental and social safeguard standards. From the policies, the following are highlighted as of importance for the present ESIA:

- IFC Performance Standards on Social and Environmental Sustainability (2012)
- IFC/ WB Environmental, Health and Safety (EHS) Guidelines (2007)
- ADB Safeguard Policy Statement (2009).

The specific IFC/World Bank Group guidelines applicable to this Project are the following:

- IFC/World Bank Group General EHS Guidelines (2007)
- IFC/World Bank Group EHS Guidelines for Electric Power Transmission and Distribution (2007)
- IFC/World Bank Group EHS Guidelines for Thermal Power Plants (2008)

The IFC Performance Standards (PS) triggered by the Project are given in the table below.

IFC Performance Standards triggered by the Project

IFC PS	Name of PS	Triggered by the Project?
PS 1	Assessment and Management of Environmental and Social Risks and Impacts	yes
PS 2	Labor and Working Conditions	yes
PS 3	Resource Efficiency and Pollution Prevention	yes
PS 4	Community Health, Safety, and Security	yes
PS 5	Land Acquisition and Involuntary Resettlement	no
PS 6	Biodiversity Conservation and Sustainable Management of Living Natural Resources	yes
PS 7	Indigenous Peoples	no
PS 8	Cultural Heritage	(yes)*

* In case of chance finds

ADB's Safeguard Policy Statement (SPS) (2009) sets out the policy objectives, scope and triggers, and principles for three key safeguard areas:

environmental safeguards (triggered by the Project), involuntary resettlement safeguards, and Indigenous Peoples safeguards.

Detailed guidance on environmental and social management of the Project, as well as on ESIA and ESMP preparation is provided in ADB's Safeguards Requirements 1 to 3 in appendices 1 to 3 of ADB's SPS. An EIA report includes the following major elements: (i) executive summary, (ii) policy, legal and administrative framework, (iii) description of the project, (iv) description of the environment (with comprehensive baseline data), (v) anticipated environmental impacts and mitigation measures, (vi) analysis of alternatives, (vii) environmental management plan(s), (viii) consultation and information disclosure, (ix) grievance redress mechanism, and (x) conclusion and recommendations.

Gap Analysis regarding national and International Legislation

The legal framework of the Republic of Armenia does in the essence correspond with the international regulations and safeguards. Gaps however do exist in enforcement of the regulations. There is still a considerable lack of institutional capacities for implementation, monitoring and evaluation.

Project Description

The new YCCPP-2 will consist of a gas turbine with generator (GTG), a Heat Recovery Steam Generator (HRSG), and a steam turbine with generator (STG) which will be installed in a new West East shaft centerline, and related auxiliaries.

The Gross Power output at Design Conditions and 'Base Load' operation mode of the combined cycle (GT Gross Power output + ST Gross Power output), is:

- Guaranteed Gross Power Output: 254 MW (at design conditions)
- Gross Heat Rate (based on LHV: 47,479 kJ/kg): 6,438 kJ/kWh
- Efficiency: 55.91%

The new power plant will be designed for full power generation mode, but will also be capable to run at partial load operation. The design life for YCCPP-2 is set to 20 years.

Interconnections to gas, water and electrical grid are planned. The new CCPP shall be connected with the facilities of the existing grid infrastructure provided below:

- Electricity: A new 220 kV substation is just under construction for YCCPP-1; the connection from the new power plant to the new substation is proposed to be by underground cable (still subject of design, if overhead transmission line or underground cable will be used); the

distance between the new power plant and the new 220 kV substation is approx. 400 m

- New connection to the natural gas supply pipeline system from Gazprom Armenia, approx. 1,500 m (under responsibility of Gazprom Armenia)
- New connection to the city water system managed by Veolia (make-up water), approx. 1,000 m
- New connections to the water sewerage of the city, approx. 450 m
- New connection to the industrial waste water discharge system downstream of YCCPP-1, less than 100 m

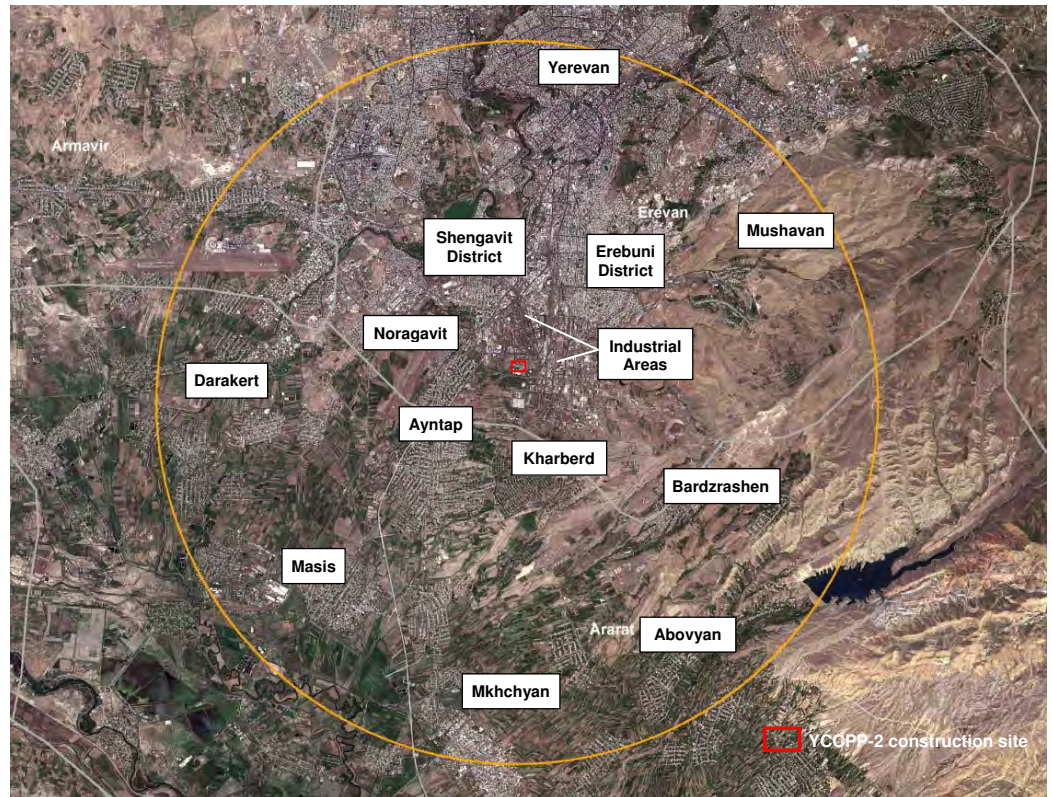
The **Project Area** comprises the YCCPP-2 site which is located at 929 m a.s.l. (average) at the south eastern border of Shengavit, a highly industrialized district in the southern part of Yerevan. There are no people living in the Project Area/YCCPP-2 site. The site is situated approx. 2 km southeast of Erebuni Airport, bordering Erebuni district and has many large industrial plants and factories in its vicinity. Despite their industrial character, Shengavit and Erebuni Districts are home to a high number of residents of Yerevan (see Figure below).



Project Area located south of Yerevan (in red), nearest residential areas and illegal housings

The **Project Area of Influence** comprises the YCCPP-2 site and adjacent residential areas. The closest residential areas are located in a distance between 1,200 m and 1,500 m from the YCCPP-2, and some temporary houses exist close to (but outside) the site. The Project Area of Influence is

determined to extend up to 10 km away from the site in all directions, covering the areas that might be impacted e.g. by air emissions during operation of the new power plant (see Figure below).



Project Area of Influence (circle) with residential areas in a distance of 10 km from the YCCPP-2 that might be impacted by the Project

For the construction of YCCPP-2 approx. 30 months are estimated. Thus, it is expected that the new power plant will be commissioned at the end of 2019.

Analysis of Alternatives

A comparative assessment of alternatives regarding different options for power generation, location and design has been conducted. Considering this assessment, the construction and operation of a gas-fired Combined Cycle Power Plant in an existing industrial site with a sufficient stack height, considerations for mitigation of air and water emissions, and adequate management of waste will have the least environmental and social impacts.

The 'No Project' Scenario describes the situation without implementation of the Project. In this alternative, all environmental and social impacts of the Project would be avoided, but on the other hand the main objectives of the Project would not be achieved, having potentially negative implications on the regional power supply, including also implications for potential business opportunities.

There are basically three different types of energy production: Renewable energy (mainly hydropower, wind, solar and geothermal power); Nuclear

energy; and Thermal energy. The option of gas and steam combined cycle power plant was chosen due to different constraints faced by the other alternatives for power production (factors such as area needed, cost of generation and community H&S play an important role). Gas fired power plants imply in addition less air, noise and waste water emissions and lower generation of solid waste compared to other thermal options of power generation.

The foreseen site location allows to use the pipeline and channel for discharge of treated waste water to Hrazdan River, which is already used by YCCPP-1, as well as using the adjacent substation for power evacuation and main access road to the site. Possible alternative locations for the proposed new YCCPP-2 were considered prior to opting for the foreseen site. On account to minimize environmental impacts and additional costs for newly developing such a site and modifying the transmission network to accommodate the new power plant, the foreseen site was selected together with MOE as a final option.

The initial design of the new YCCPP-2 had foreseen a stack height of 35 meters. The results of the air dispersion calculation show, however, that a stack height of 66 meters (the Good Engineering Practice stack height) is more adequate because this allows the fulfillment of the national and international air quality standards. In addition to this, the project foresees the installation of equipment to mitigate air and water emissions (low NO_x burners, drift eliminators and a waste water treatment plant). Without this equipment, the investment costs would be lower, but the E&S impacts would be higher.

Another design option foreseen as a result of the ESIA is the inclusion of a temporary storage area for hazardous waste to avoid the disposal of this type of waste in a mixed waste landfill. This option has revealed to be advantageous from an environmental point of view because presently there is not a solution for hazardous waste disposal in Armenia.

The new YCCPP-2 is part of the strategic plan for energy production of the Government of Armenia. Design of the new plant reflects the latest available technology.

Description of the Environment (Baseline Data)

The baseline data collection for the Project Area of Influence focused on the subjects of protection: fauna and flora, soil, water, climate, air quality, noise, landscape, historical and cultural sites and socio-economic conditions (including health and safety).

The following documents have already been prepared for the Project:

- RENCO SPA: Armenia 250 MW CCGT Yerevan Capital City. Draft Feasibility Study [CCGT 250 MW – Yerevan /Armenia]

- Ecobarik-Audit LLC (2016): Report of Evaluation of Environmental Impact of the new Steam and Gas Combined Cycle Power Plant in Yerevan
- Geoterproject LTD (2016): Report on engineering-geological survey of Yerevan TPP new energy block area
- ArmPower CJSC (2017): Geological Report of Armhydroenergyproject CJSC
- Consecoard LLC (2017): Report on Monitoring Services

Environmental Conditions

The construction site is part of the Yerevan industrial area. The site itself and the surrounding land are poorly vegetated with much of the area having been disturbed by industrial developments. Only sparse vegetation composed of grass, herbs and some reed and bushes can be found at the construction site. The ecological value of the Project Area is assessed to be low, also considering that vegetation at the area has been cleared in 2008 and that the area has been obviously earth worked in the past. No vegetation is found at the foreseen laydown area for construction of YCCPP-2. The water quality of the Hrazdan River is categorized as bad (5th class of the surface water quality assessment system of RA) in the area south of Yerevan. The ecological value of the river is assessed to be low. The vegetation at the river banks will not be negatively affected by the final discharge of the treated waste water via a network of channels.

No **Protected Areas** are located within or in the vicinity of the Project Area of Influence. This includes Important Bird and Biodiversity Areas (IBA) and Ramsar Sites.

In order to ensure the proper setting of YCCPP-2, two **geotechnical investigation programs** have been performed in 2016 and 2017 including topographic mapping, geophysical and engineering geological works, experimental borehole drilling, piezometer installation in some boreholes to measure the ground water level fluctuation, periodic measurement of water level and sample taking. The main outcomes of these studies include:

- In the study area underground waters have been detected in all the boreholes with 0.5-7.0 m depth and have seasonal fluctuation from 0.5 to 1.0 m. Detected underground waters have strong sulphate aggressiveness against ordinary concrete.
- There are no hazardous physical-geological phenomena and processes (landslides, rock slides, rockfall, erosion, suffosion, etc.) in the study areas.
- The study area is suitable for capital construction.

Earthquake risk has been considered in the design of the new YCCPP-2.

The geological studies which were performed at the construction site found mainly clayey **soils** which are in some places covered by fill up soils.

In August 2017 and in November 2017 two monitoring studies were performed regarding possible historic soil contamination at the construction site. Soil has been found to be not contaminated according to international threshold values (German, Dutch). However, according to the very strict Armenian limits, several MACs of heavy metals are exceeded. Despite these exceedances, and according to calculations made based on the Armenian Decision N 1277-N, the soil in the area is classified as “permissible”. This kind of soil may be used for construction of non-high vulnerability objects¹ without further mitigation measures. This is the case for the YCCPP-2.

The area was used as laydown area during the construction of YCCPP-1. The usage of the area for illegal disposal of different waste materials in the past has been reported. During the site visit in July 2017 some empty oil drums were found at the site. Near to these drums the topsoil was found to be contaminated by an oil leakage. Samples of the contaminated soil taken during the site visit in July 2017 were analyzed by a certified laboratory in Germany for content of PCBs. All PCB concentrations were below the detection limit of 0.2 ppm. During the site visit in February 2018 it was found that the oil drums had been removed to the property of YCCPP-1.

Regarding the Project Area, the nearest **water body**, Artashati Jranst Canal, is located 700 m south east of the construction site. Thus, no risk of flooding of the area is foreseen. No water from the canal will be used for YCCPP-2 and no water will be discharged to it. It is planned that YCCPP-2 will use the pipeline and channel for discharge of treated waste water to Hrazdan River, which is already used by YCCPP-1. YCCPP-2 is located in Hrazdan River basin management area. Water in the lower stream of Hrazdan River is classified as “bad” (5th grade) according to Armenian water quality standards. Samples of the surface water of the Hrazdan River have been taken. The results of the analyses show that applicable European and German limit values are not exceeded. The results show also that the discharge of the treated waste water from YCCPP-1 does not affect the water quality of Hrazdan River negatively, as the analyzed parameters upstream and downstream of the discharge point do not show any qualitative difference.

According to the geological studies **underground waters** have been detected in all the boreholes with 0.5-7.0 m depth and have seasonal fluctuation from 0.5 to 1.0 m. Two monitoring studies were performed in August 2017 and November 2017 regarding groundwater quality at the construction site. The results of all groundwater sampling tests made in August 2017 were within the limits of the 5th grade of water quality; however, limit values for groundwater do not exist in Armenia. Additional analysis of groundwater was undertaken in November 2017 at three sampling sites (upstream of the site, at the site, and downstream of the site) for content of TPH, PAH, BTEX, metals, as well as pH, dissolved oxygen, mineralization, BOD5, and COD5. The chemical analyses were compared to

¹ High vulnerability objects are: school buildings, residential construction areas, sport's and children's playgrounds, health and resort areas, water objects, water mains

German threshold values and Dutch Standards. Analyses show that concentrations of several metals exceed the German and/or Dutch threshold values. Concentrations of organic pollutants have also been analyzed. No PAH were detected in the groundwater samples. Concentrations of BTEX and Benzol were below the respective threshold values. Concentrations of TPH exceed the German limit values at groundwater well No. 1 and especially at well No. 2.

Analyzed concentrations of some metals in the groundwater samples also exceed the limit value of the worst class 5 of the surface water quality assessment system in Armenia: concentrations of Sodium (Na) are 5 to 10-fold higher, Vanadium (V) 10 to 95-fold higher, Manganese (Mn) up to 10-fold higher, Cobalt (Co) up to 5-fold higher, Arsenic (As) 2-fold higher.

Thus, according to the new samples taken in November 2017, the groundwater at the site has to be regarded as contaminated with some heavy metals and organic pollutants. These high values of some heavy metals in the analyzed groundwater are most probably based on the industrial background of the wider area around the construction site. No abstraction, discharge or other use of contaminated groundwater is to occur.

In Yerevan the prevailing **climate** is a mountainous continental climate. It is characterized by hot and arid summers and rather cold winters; in a year there are on average a hundred days with minimum temperatures below freezing. The average temperature in Yerevan is 11.6°C. In summer (July and August) the average temperature exceeds 30°C. The coldest month is January at -4°C. Generally, there is little rainfall throughout the year; precipitation averages 319 mm. The driest months are June to October with an average below 25 mm of rain. The wettest months are February, April and May with an average of 40 mm of rain.

On average, the most wind is seen in July. The strongest wind speed is observed in March and April (> 38 km/h). On average, the least wind is seen in September. The mean monthly wind speed over the year is 6.1 km/h. The wind mainly blows from NE, SSW and S.

The results of the air quality baseline monitoring show that the **airshed** in the Project Area of Influence surrounding the future YCCPP2 can be classified as **non-degraded** regarding the pollutants PM₁₀, SO₂ and NO₂.

The results of the noise baseline monitoring show that some receptors in the area **are presently affected by noise levels that exceed the limits** due to the presence of industrial facilities and traffic.

The Project Area is located in a highly industrialized area in southern Yerevan. Here, the existing YCCPP-1, chemical plants, metal factories and other industrial infrastructure dominate the **landscape**.

Socio-Economic Conditions

The **population** in the Project Area of Influence can be differentiated into urban population of the districts of Shengavit (approx. 140,000 inhabitants) and Erebuni (approx. 117,000 inhabitants); and the village population of Ayntap (approx. 11,000 inhabitants) and Kharberd (approx. 17,000 inhabitants).

Sensitive receptors which might be affected by noise and air emissions during construction, operation, and decommissioning of YCCPP-2 have been identified in the residential areas up to several kilometers away from the site of the new power plant. There are groups of people living in illegal housings adjacent to the YCCPP-1 site. There are no persons living within the YCCPP-2 site/Project Area.

Despite economic reforms and some recent growth, unemployment and poverty remain widespread in Armenia. Agriculture is the country's largest labor sector, followed by services and industry. The poorest Armenians are found in rural areas with the least favorable conditions for agricultural activities. There is a stark contrast between the city of Yerevan and the remote rural areas in terms of socio-economic opportunities.

The Project Area is part of a highly industrialized region of Yerevan. Only the area west of the foreseen construction site is used for pasture and/or agricultural purposes. The whole area of the construction site has already been acquired by ArmPower CJSC and local population does not inhabit or **use the land** in any way.

As the history of human settlement in Armenia goes back to the Neolithic age and the area has since then been important as settlement, trade and agricultural area, numerous historical and cultural sites exist. No known **historical or cultural sites** are located within the Project Area. The Ministry of Culture shall be informed by the EPC Contractor about the Project prior to construction, in order to allow the Ministry to perform a proof of occurrence/absence of any cultural or historical goods at the Project site, including a preconstruction field survey, if deemed necessary by the Ministry.

Environmental and Social Impact Assessment

Possible environmental and social impacts from the construction, operation, and decommissioning of YCCPP-2 and auxiliary facilities are analyzed. Potential impacts of the Project in relation to environmental and social receptors are characterized and the Significance of Impact (after implementation of mitigation measures) is assessed.

Environmental Impacts during Construction Phase

As the ecological value of the construction site is assessed to be low, there are only low impacts on **flora and fauna** expected during the construction phase. No **protected or sensitive areas** will be influenced by the Project.

The Project Area is not prone to soil erosion. **Soil** use is restricted to the area of the planned construction activities. Analyses of possible historic soil contamination at the construction site have been performed in August 2017 and November 2017. According to international threshold standards the soil is not contaminated. However, according to national Armenian limits, the concentrations of some heavy metals in the analyzed soil samples exceed national MACs. Despite these exceedances, and according to calculations undertaken based on the Armenian Decision N 1277-N, the soil is classified as “permissible”. This kind of soil may be used for construction of non-high vulnerability objects² without further mitigation measures. This is the case for the YCCPP-2.

Soil contamination during construction works can arise from improper waste disposal and accidental leakage from tanks of lubricants, solvents, paint, oil, diesel, chemicals, etc.

Surface water will not be influenced during the construction period. Contamination of the soil can indirectly lead to a pollution of the **groundwater**. Two groundwater investigations have been undertaken. An evaluation is currently ongoing regarding the management of groundwater during construction and operation. No abstraction, discharge or other use of contaminated groundwater is to occur. The current proposal is to install sub-surface drainage to permanently deviate groundwater around the site. The Client will conduct further hydrological assessment and implement appropriate environmental management of this solution, to be approved by IFC and ADB before construction, including: impacts and mitigation measures for changes to the groundwater profile, both within the site and on neighboring properties; study of water treatment options in the unlikely event that groundwater rises to the surface or needs to be removed from the site and discharged in a different receptor (river or public network).

Dust generation from transportation and construction activities, as well as emissions from vehicles and construction machinery will be the main impacts on **air quality** during the construction phase of the proposed Project.

Construction of the new power plant will add further highly visible structures (e.g. stacks and buildings) to the Project Area of Influence. Due to the already existing industrial infrastructure in the area, the construction of YCCPP-2 will not enhance the contrast between the industrial site and the surrounding areas significantly.

² High vulnerability objects are: school buildings, residential construction areas, sport's and children's playgrounds, health and resort areas, water objects, water mains

Possible impacts on soil and water can be prevented and mitigated by a professional handling and storage of hazardous substances and a proper handling of waste. The EPC Contractor shall develop a **Waste Management Plan** for the construction period containing among others the waste management hierarchy of avoidance, preparing for reuse, recycling as much as possible, recovery, and proper disposal of remaining waste. Hazardous waste shall be stored in adequate storage sites (lockable, roofed, ventilated, concreted and bunded floor) at the new YCCPP-2 site, clearly identified by labels, and Materials Safety Data Sheets (MSDS) shall be provided for each kind of hazardous waste. If any asbestos containing material (ACM) will be found at the construction site, all ACM has to be securely double bagged and sealed. All bags shall be clearly labeled and stored in a bunded and locked storage room with a warning sign installed. The final disposal of hazardous waste is subject to medium to long term national-level solutions to be decided upon and provided by the Government of RA.

Social Impacts during Construction Phase

During the construction period **local workforce** (mainly unskilled workers) from the nearby villages and Yerevan shall be employed for the construction works. This will contribute to much needed monetary income in the region. Special attention shall be laid on the recruitment of women, wherever possible. However, the income generation opportunity is not of long term duration, as it will be mostly limited to the construction period.

No one lives at the YCCPP-2 site and there is no **land use** by the local population, as the area has already been acquired, fenced, and is foreseen for construction of the YCCPP-2. ArmPower/RENCO have entered a land purchase agreement with the seller (Yerevan Thermal Power Plant CJSC) in March 2017. No acquisition of further land will be necessary for this Project. There are no houses located inside the construction site, so that no project-related physical relocation is foreseen.

Within the construction site and the Project Area of Influence no cultural or historic sites are known. The Ministry of Culture shall be informed by the EPC Contractor about the Project prior to construction, in order to allow the Ministry to perform a proof of occurrence/absence of any cultural or historical goods at the Project site, including a preconstruction field survey, if deemed necessary by the Ministry. For the case of an unexpected encounter of Cultural and Historical Sites or Goods, a **Chance Find Procedure** has to be implemented. In case of any chance finds, the construction has to be stopped immediately and the Agency of Protection of Historical and Cultural Monuments/ Ministry of Culture has to be informed to agree on further steps (as according to Armenian Law).

For construction of YCCPP-2 a site-specific Health, Safety and Environment Management Plan (**HSEMP**) will be developed by RENCO as EPC Contractor and a Health, Safety and Environment Management System

(HSEMS) will be implemented during construction. An **H&S manager** of RENCO shall be on duty all the time during construction period. These HSEMP and HSEMS shall also be valid for any third parties or subcontractors in the supply chain.

Working personnel from abroad will be accommodated in RENCO's guesthouse or at hotels in Yerevan. Local workforce shall be employed from Yerevan and the adjacent villages. No workers' camps will have to be established as local workers will return to their homes daily. Transfer to and from the construction site will be carried out by private means or public transport, and in addition by means managed by the EPC Contractor. A Traffic Management Plan shall be developed and implemented by the EPC Contractor.

Adequate security measures to prevent accidents and injuries have to be taken when transporting construction equipment on trucks as this might be dangerous to residents, when trucks drive through residential areas or small villages (to be included in a Traffic Management Plan). The construction site itself will be fenced and the entrance gates will be guarded by security staff in order to prevent any unauthorized access to the site, thus also minimizing possible impacts on **community health & safety**. Development and implementation of a Security Force Management Plan include training and monitoring of security personnel regarding the use of force and conduct towards the community is foreseen.

The EPC Contractor shall develop an **Emergency Preparedness and Response Plan** for the construction period based on robust Quantitative Risk Assessment (QRA) / Hazard Identification Study (HAZID), and assist and collaborate with the potentially affected communities and local government agencies in their preparation to respond effectively to emergency situations.

Construction workers will wear ear protection devices as part of their Personal Protective Equipment (PPE), if they are exposed to **noise levels** higher than 80 dB (A), according to Armenian legislation. Residential areas up to several kilometers away from the site, which are located near to major roads, will be exposed to higher noise levels due to a greater volume of heavy truck traffic passing by on the main roads. Thus, truck movements shall only be allowed during daylight, but not between 7 pm and 6 am.

Environmental Impacts during Operation Phase

No sensitive **species** and no **protected areas** occur in the Project Area. All waste water coming from the power plant operation will be duly collected and routed to an onsite waste water treatment plant at YCCPP-2 (which is still in the detailed design phase). It will include an API and, if necessary, a CPI oil separator, as well as a biological treatment of the waste water. The treated water will be discharged to the existing discharge pipeline and channels downstream of YCCPP-1. The treatment system will be suitably selected and implemented to meet the environmental limits and the good

industry practice. The utility sewerage will be connected to the city's sewerage system.

Soil contamination can be possible due to spillages from oil/ fuel/ paint/ chemicals used during operation of the power plant.

All **water** will be taken from the Yerevan potable water grid and will be used for all civil utilities like cooking, drinking, etc. It will also be used as process water which is connected to the raw water storage tank and for all other uses (e.g. cooling tower make up, HRSG blow-down tank quench, firewater tank and network, utility water network, etc.). A monthly monitoring program shall be established to be performed by ArmPower and results shall be reported to the "Environmental Monitoring and Information Center" SNCO at the Ministry of Nature Protection and the project financiers (ADB and IFC) in order to guarantee the adherence of all wastewater, sanitary water and drainage water to the effluent standards still to be set for YCCPP-2 or international limit values, whichever are more stringent. Calculations of the waste water temperature show that the treated waste water from YCCPP-2 will have no significant impact on the water of Hrazdan River as ultimate receiver, after passing a pipeline and an open channels system of 7-9 km length.

Contamination of the soil can indirectly lead to a pollution of the **groundwater**. An evaluation is currently ongoing regarding the management of groundwater during construction and operation. No abstraction, discharge or other use of contaminated groundwater is to occur. The current proposal is to install sub-surface drainage to permanently deviate groundwater around the site. The Client will conduct further hydrological assessment and implement appropriate environmental management of this solution, to be approved by IFC and ADB before construction, including: impacts and mitigation measures for changes to the groundwater profile, both within the site and on neighboring properties; study of water treatment options in the unlikely event that groundwater rises to the surface or needs to be removed from the site and discharged in a different receptor (river or public network).

The results of the ADC show that the national and international **air quality** standards are expected to be fulfilled in the area if a stack height of 66 meters is considered in the design. A Continuous Emissions Monitoring System (CEMS) will be installed at the stack of the new power plant. Adherence to the limit values at the stack shall be checked continuously by ArmPower and the results shall be reported monthly to the "Environmental Monitoring and Information Center" SNCO at the Ministry of Nature Protection and the project financiers (ADB and IFC). Cooling towers' particulate emissions will be controlled through the use of drift eliminators, in order to have low drift phenomena (0.01 % drift loss).

Noise calculation outcomes of the model for YCCPP-2 have shown that the operation of the new plant will not produce any significant increase of the noise pressure at the sensitive receptors. It has also to be underlined that,

although at the YCCPP-2 fence no sensible receivers are present, the sound level contribution of the plant will be significantly below the applicable international industrial areas noise limits (70 dB(A)). Noise levels will have to be measured regularly during the operation phase of the new power plant and their compliance with the Performance Guarantees will be monitored.

The planned new power plant will add further highly visible structures (e.g. stacks and buildings). However, due to the already existing industrial infrastructure in the area, the realization of the project will not enhance the contrast between the industrial site and the surrounding areas.

Domestic **waste** produced by the plant staff shall be collected in provided bins and picked up by a contracted waste collector for disposal at Yerevan dumping site. All hazardous waste shall be stored in adequate storage sites (lockable, roofed, ventilated, concreted and bunded floor) at new YCCPP-2 site for future disposal. Materials Safety Data Sheets (MSDS) shall be provided for each kind of hazardous waste. The final disposal of hazardous waste is subject to medium to long term national-level solutions to be decided upon and provided by the Government of RA. The Waste Management Plan for operation of the power plant shall also include a risk assessment. Sizing of the storage area for hazardous waste shall be adapted to the projected volume of hazardous material and the anticipated storage duration.

Social Impacts during Operation Phase

Power demand in Armenia is constantly rising due to rapidly growing economy and a rising population. Operation of YCCPP-2 with a guaranteed gross power output of 254 MW will improve the total output capacity of electric energy production and provide a more reliable power supply.

For operation of YCCPP-2 a site-specific Health, Safety and Environment Management Plan (**HSEMP**) will be developed by ArmPower as Operator and a Health, Safety and Environment Management System (**HSEMS**) implemented for operation. An **H&S manager** of ArmPower shall be on duty all the time.

The area of the new power plant will be fenced and the entrance gates will be guarded by security staff in order to prevent any unauthorized access to YCCPP-2 site, thus also minimizing possible impacts on **community health & safety**. Security arrangements shall be guided by principles of proportionality, good international practice and Armenian law, and include training and monitoring of security personnel regarding the use of force and conduct towards the community. A Security Force Management Plan shall be prepared for the operation phase.

The operator shall develop an **Emergency Preparedness and Response Plan** based on robust Quantitative Risk Assessment (QRA) / Hazard Identification Study (HAZID) for the operation period, and assist and

collaborate with the potentially affected communities and local government agencies in their preparation to respond effectively to emergency situations.

Performance Guarantees for the new power plant provide **noise levels** which comply with IFC/ World Bank Group General EHS Guidelines for workers and for the public, as well as with national legislation. The calculation outcomes of the noise study for YCCPP-2 have shown that the operation of the new plant will not produce any significant increase of the noise pressure at the sensitive receptors (there is compliance with the IFC standard of not exceeding an increase of 3 dB in the background levels).

During operation most **jobs** at YCCPP-2 will be for skilled workers like engineers which will require specific power plant training and will not be readily found in Armenia. Graduated people (with electrical and mechanical training) from Yerevan, who could potentially work at the new plant, would need extensive training on the job, as well as theory training. A few simpler jobs (e.g. food supply, housekeeping, etc.) however, will also be available for people which shall be employed from the adjacent residential areas (if possible) in order to create some additional income.

Additional Impacts from the new Connection Facilities

The impacts and mitigation measures mentioned in the sections above concerning the construction and operation of the Project also apply to the necessary additional connection facilities. **Additional aspects** to be considered are related to eventual fell of trees, soil erosion, eventual chance finds of historical and cultural goods, possible damages to existing gas and water infrastructures and possible impacts on public health and safety.

Additional Impacts during Decommissioning Phase

If the power plant will be dismantled after closedown, environmental and social impacts will be mainly the same as during the construction phase. Dismantling works will have to adhere to the latest editions of national and international laws and guidelines, or even to new ones that will be relevant at this time. A Decommissioning Plan shall be prepared by the operator at least 5 years before closure of the plant, and a Detailed Decommissioning Plan shall be developed by the operator at least 18 months in advance of the closure of the plant.

A large amount of waste will have to be managed, if the plant will be dismantled. This will also include different types of hazardous waste. A detailed Waste Management Plan will have to be developed by ArmPower following the same principles as for the construction phase, respecting the waste management hierarchy.

Summary of Impacts

The assessment of environmental and social impacts **after implementation of the mitigation measures** presented in the ESMP is given in the following tables.

Summary of impacts during construction phase (incl. associated infrastructures)

Impact of/on	Significance of Impact on/by
Fauna, Flora and Biodiversity	■
Protected Areas	○
Soil Use and Soil Erosion	■
Soil Contamination	■
Surface Water	○
Groundwater deviation	(still unknown - see ESAP)
Groundwater contamination	■
Climate and Air Quality	■
Landscape and Visual Aspects	■
Waste	■■
Local Workforce	+
Land Use and Ownership	○
Historical and Cultural Sites	■ (if any)
Occupational Health and Safety	■
Community Health and Safety	■
Noise	■

Summary of impacts during operation phase (incl. associated infrastructures)

Impact of/on	Significance of Impact on/by
Fauna, Flora and Biodiversity	■
Protected Areas	○
Soil Contamination	■
Water Courses	■
Groundwater deviation	(still unknown - see ESAP)
Groundwater contamination	■
Climate and Air Quality	■
Landscape and Visual Aspects	○
Waste	■
Electricity Supply	++
Occupational Health and Safety	■
Community Health and Safety	■
Noise	■
Job opportunities	+

Summary of impacts during decommissioning phase (incl. associated infrastructures)

Impact of/on	Significance of Impact on/by
Fauna, Flora and Biodiversity	■
Protected Areas	○
Soil Use and Soil Erosion	■
Soil Contamination	■
Surface Water	○
Groundwater contamination	■
Climate and Air Quality	■
Landscape and Visual Aspects	■
Waste	■■
Local Workforce	+
Land Use and Ownership	○
Historical and Cultural Sites	○
Occupational Health and Safety	■
Community Health and Safety	■
Noise	■

Significance of Impact:

■■■	=	high
■■	=	medium
■	=	low
○	=	nil
+	=	locally positive
++	=	regionally positive

In conclusion, from the results of the impact assessment it can be seen that the environmental and social impacts will be low or medium, if all proposed mitigation measures of the ESMPs are implemented. Positive impacts are related to creating of job opportunities especially during construction. The additional power generation will increase the total output of electric energy, providing a more reliable power supply countrywide.

Information Disclosure, Consultation, and Participation

During the site visit in July 2017 FICHTNER's environmental and social specialists performed stakeholder meetings with mayors of the adjacent villages Kharberd and Ayntap, with the Heads of Departments of Erebuni and Shengavit Administrative Districts, with the Environmental Monitoring and Information Center, with the Environmental Department of the Municipality of Yerevan, and with the Aarhus Center. Mayors of Kharberd and Ayntap had no concerns regarding the implementation of the Project. As both villages suffer under a high unemployment rate (> 70%), the mayors hope that the Project will create jobs for the local population. These statements have also been supported during the discussions with the Heads of Departments of Erebuni and Shengavit Administrative Districts.

The Draft Final ESIA, including the ESMP, and the Non Technical Executive Summary were disclosed to the public in English and Armenian versions. Interested people have been provided real access to the documents, which were therefore not only posted on ArmPower's website, but were also delivered in printed copies to the local administration offices; advertisements in local media about their availability were made. Also Aarhus Center Yerevan received printed copies and ensured their sharing to representative civil society organizations. According to national Armenian requirements, the disclosure period is only 7 days, but disclosure of the documents for at least two weeks was recommended. After disclosure of the documents, one public consultation meeting on the Draft Final ESIA was held. The consultation meeting concentrated on interpreting the ESIA report to the stakeholders and seeking their feedback and concerns, which were then considered in the Final ESIA report. A SEP (Stakeholder Engagement Plan) providing further details is presented as an Annex to this ESIA Report.

To avoid that the people living in temporary houses nearby the site would be left unaware of the consultation process, RENCO organized a personal meeting on the 12th of February 2018. These residents are hopeful that the project will bring new business opportunities, jobs during construction, and improved public transportation. The temporary situation of the housing is unrelated to the YCCPP-2 project.

Grievance Redress Mechanism

In the course of the construction process, **project affected people (PAP)** may feel treated unjustly, for which case ArmPower shall maintain a viable grievance redress mechanism. PAPs are encouraged to proceed in the following way:

- a) Contact the contractor's designated grievance staff in the following way: in person via designated telephone number, via email, via regular mail. Alternatively, PAPs can contact their community leader, who would convey their grievance to the contractor's designated grievance staff.
- b) Lodge complaint and provide information on the case. Each complaint will be registered and a tracking number will be assigned to it. Responses to all complaints should be provided within 15 days (or 25 days in cases where complaint resolution requires special efforts).
- c) Agree with the contractor on mitigation measure.
- d) Sign if the mitigation measure has been implemented as agreed
- e) Seek redress from ArmPower if not satisfied with above mentioned procedure though designated telephone numbers, in person, or via email or regular mail. ArmPower should register all grievances and provide response within 15 days.
- f) Seek redress from court if all else fails.

Nevertheless, the above mentioned grievance mechanism does not limit the citizen's right to submit the case straight to the court of law just in the first

stage of grievance process. The grievance mechanism is designed to avoid lengthy court procedures.

The EPC Contractor RENCO and the future operator of YCCPP-2 ArmPower are requested to implement an independent grievance management system to enable the workers (and their organizations, where they exist) to raise reasonable workplace concerns. This includes complaints related to non-compliance with Health & Safety matters, discrimination cases and non-consideration of equal opportunities. **The workers' grievance mechanism** shall follow the same principles as the one created for the general public: complaints must be answered in a timely and effective manner without fear of retribution; the access to the grievance mechanism shall not replace or impede the subsequent access to other redress mechanisms; the promoter will inform workers of the grievance mechanism at the time of hire and make it accessible to them.

Environmental and Social Management Plans (ESMPs)

The negative environmental and social impacts of the Project can be avoided, minimized or mitigated by performing suitable measures. The ESMPs deal with the concrete mitigation measures and the monitoring measures to be taken during the construction, operation, and decommissioning phases of YCCPP-2. They summarize the anticipated environmental and social impacts and provide details on the measures, responsibilities to mitigate these impacts, the costs of mitigation, and the ways in which implementation and effectiveness of the measures will be monitored and supervised.

Mitigation Measures for the Construction Phase

The main possible impacts during construction period will be contamination of soil and water, and impacts on health and safety of workers and the public.

Contamination of soil and groundwater can be avoided e.g. by regular maintenance of all vehicles and machines at regular service stations, maintenance and re-fueling of the construction equipment only on sealed and enclosed areas, providing spill control material and training of workers regarding handling of oil, fuel, etc. and how to avoid and clean up spills.

The construction site has to be equipped with toilets and sanitary rooms separately for men and women. Sewage water shall be led to the city's sewage water system or septic tanks for collecting sewage water have to be used, which have to be emptied by a specialized company from time to time.

Soil has been found to be not contaminated according to international threshold values (German, Dutch). However, according to Armenian limits, several MACs of heavy metals are exceeded. Despite these exceedances, and according to calculations undertaken based on the Armenian Decision N

1277-N, the soil is classified as “permissible”. This kind of soil may be used for construction of non-high vulnerability objects³ without further mitigation measures. This is the case for the YCCPP-2.

An evaluation is currently ongoing regarding the management of groundwater during construction and operation. No abstraction, discharge or other use of contaminated groundwater is to occur. The current proposal is to install sub-surface drainage to permanently deviate groundwater around the site. The Client will conduct further hydrological assessment and implement appropriate environmental management of this solution, to be approved by IFC and ADB before construction, including: impacts and mitigation measures for changes to the groundwater profile, both within the site and on neighboring properties; study of water treatment options in the unlikely event that groundwater rises to the surface or needs to be removed from the site and discharged in a different receptor (river or public network).

The EPC Contractor shall develop a site-specific Health, Safety and Environment Management Plan (HSEMP) and implement a Health, Safety and Environment Management System (HSEMS) for construction phase. An H&S manager of EPC Contractor shall be on duty all the time during construction period. The HSEMP shall also include a Waste Management Plan as well as an Emergency Preparedness and Response Plan.

Mitigation Measures for the Operation Phase

The main possible impacts during the Operation Phase will be the air and noise emissions as well as effluents from the new power plant.

The stack of the new power plant will be equipped with a Continuous Emissions Monitoring System (CEMS). The foreseen emissions at the stack are below the relevant national and international limit values. Compliance of air emissions with the Performance Guarantees of ArmPower and IFC/ World Bank limits for air emissions shall be monitored by the operator and reported to national authorities, e.g. "Environmental Monitoring and Information Center" SNCO, as well as the financing agencies IFC and ADB. Based on the ADC results, a Good Engineering Practice stack height of 66 meters (GEP stack height) will be built for the power plant to guarantee the compliance with the air quality standards at the ground level (instead of the originally foreseen 35 meters stack).

All waste water from the power plant's operation will be collected and routed to a waste water treatment plant (including API and, if needed, CPI oil separators) before being discharged to recipient existing system of YCCPP-1 discharging to Hrazdan River. Rain water which may be potentially oily will be routed to the same system; other rain water collected

³ High vulnerability objects are: school buildings, residential construction areas, sport's and children's playgrounds, health and resort areas, water objects, water mains

from the paved areas will be collected for irrigation purposes inside the power plant.

HRSG blow down and other drainage from steam/water system will be neutralized at the chemical shop of the power plant to meet relevant water quality standards and will then be discharged using the existing discharge system. The utility sewerage will be connected to the already existing city sewerage system. A monthly monitoring program shall be established to be performed by the operator and reported e.g. to "Environmental Monitoring and Information Center" SNCO and the financing agencies in order to guarantee the adherence of all wastewater, sanitary water and drainage water to Performance Guarantees of ArmPower, national Armenian effluent limits (still to be defined specifically for the YCCPP-2 by the national authorities) and/or IFC/ World Bank limits, whichever are more stringent.

An evaluation is currently ongoing regarding the management of groundwater during construction and operation. No abstraction, discharge or other use of contaminated groundwater is to occur. The current proposal is to install sub-surface drainage to permanently deviate groundwater around the site. The Client will conduct further hydrological assessment and implement appropriate environmental management of this solution, to be approved by IFC and ADB before construction, including: impacts and mitigation measures for changes to the groundwater profile, both within the site and on neighboring properties; study of water treatment options in the unlikely event that groundwater rises to the surface or needs to be removed from the site and discharged in a different receptor (river or public network).

ArmPower as operator of the new power plant will have to develop and implement an Emergency Preparedness and Response Plan as part of its site-specific Health, Safety and Environment Management Plan (HSEMP).

Mitigation Measures for the Decommissioning Phase

Environmental and social impacts during the decommissioning phase will be mainly the same as during the construction phase. Thus, mitigation measures for the construction phase will be also valid for the dismantling works, which will have to adhere to the latest editions of national and international laws and guidelines.

Implementation Arrangements and Capacity Building

RENCO SPA as EPC Contractor has to implement the ESMP within its own site-specific Health, Safety and Environment Management System (HSEMS) in a proper way and shall have an HSE manager on duty throughout the construction period. This HSE officer shall prepare monthly reports of all HSE relevant incidents and accidents and send these reports to the Health, Safety and Environment Manager of ArmPower and the relevant national authorities as well as to the external internationally experienced auditor.

An external internationally experienced auditor shall perform quarterly supervision of the implementation of the ESMP and monitor the implementation of the mitigation measures during construction phase. The aim of the audits will be to ensure that all mitigation measures are implemented adequately. In case of any discrepancies, the specialist shall implement proper actions to establish compliance with the ESMP. If this is not possible and if the discrepancy is considered to be severe, the person(s) in charge shall be empowered to stop the work immediately until compliance is achieved again. Based on his quarterly supervision and the monthly reports provided by the Health, Safety and Environment Manager of RENCO, the external auditor will produce narrative analytical quarterly reports on environmental and social performance in the course of the Project and furnish these reports to ADB/ IFC and to ArmPower. Additional site investigations shall be performed by the external auditor during the commissioning (once) and operation phases (once per year).

Measures for capacity building at “Environmental Monitoring and Information Center SNCO” shall be considered. These measures should include employment of additional staff or contracting outside resources for monitoring purposes (or both). Existing staff shall be trained in effective monitoring procedures including knowledge about national and international (ADB, IFC/World Bank) guidelines and limit values.

Reporting requirements

The results of the monitoring measures shall be compiled in the form of HSE monitoring reports. During the construction and decommissioning stages, a daily HSE log, HSE incidents and chance finds reports, internal HSE audit reports, and monthly HSE reports compiling all the previous shall be prepared. During operation, HSE incidents reports, internal HSE audit reports, and monthly HSE reports shall be prepared.

Adaptive management

The monitoring of the works may reveal the necessity to adapt the mitigation and monitoring measures of the ESMP to specific site conditions not known at the time of preparation of this ESIA.

Summary of Costs for Implementation of the EMSP

A total cost of **255,000 USD** is foreseen for implementation of the ESMP. This value includes quarterly supervision of construction sites and one additional site investigation during the commissioning phase to be performed by an internationally experienced auditor. Furthermore the total cost includes monitoring of air quality during commissioning and of noise during construction and commissioning. Expenses for other measures are included in the regular construction/ operational/ decommissioning works.

Additional costs of 10,000 USD per year will arise for each of the yearly audits of the external auditor during the operation phase of YCCPP-2.

Gap Analysis regarding compliance with IFC Performance Standards

After implementation of the mitigation measures and the ESAP, the Project complies with the requirements of all applicable IFC Performance Standards and ADB Safeguard Requirements.

Environmental and Social Action Plan

An Environmental and Social Action Plan (ESAP) is presented in order to highlight the most urgent steps for implementation of the mitigation measures given in the ESMPs, according to the relevant IFC Performance Standards and ADB Safeguard Requirements as well as other international guidelines and standards.

Overall Findings, Conclusion and Recommendations

The main possible impacts of the Project will be contamination of soil and water, impacts on health and safety of workers and the public, air and noise emissions, and liquid effluents from the new power plant.

Negative environmental and social impacts of the Project will be low or medium, if all proposed mitigation measures of the ESMPs and ESAP are implemented. There will be no severe social impacts from the Project; no land acquisition or project-related resettlement will be necessary. Regular **monitoring of noise, ground level concentrations of air pollutants and air emissions as well as liquid effluents** during construction and /or operation phase shall be performed, in order to guarantee adherence to relevant national and/or international limit values.

Calculations of the Noise Propagation Model for YCCPP-2 have shown that the operation of **the new plant will not produce any significant increase of the noise pressure at the sensitive receptors**. The indicative cumulative impacts of the power plant on air quality are foreseen to be kept below the national and international standards if a **stack height with 66 meters** is installed.

Positive impacts are related to creating job opportunities, especially during construction. New job opportunities during operation may be created if investment on training of qualified workers is done. The additional power generation will increase the total output of electric energy, providing a more reliable power supply countrywide.

An evaluation is currently ongoing regarding the management of groundwater during construction and operation. No abstraction, discharge or other use of contaminated groundwater is to occur. The current proposal is to install sub-surface drainage to permanently **deviate groundwater**

around the site. The Client will conduct further hydrological assessment and implement appropriate environmental management of this solution, to be approved by IFC and ADB before construction.

In summary, it can be concluded that the proposed Project of Yerevan Steam and Gas Combined Cycle Power Plant (YCCPP-2) **can be implemented without having significant adverse impacts on the ecological and social environment**, if all mitigation measures proposed in the ESMPs and the ESAP are implemented.

1. Introduction

This report is the Final version of the Environmental and Social Impact Assessment (ESIA) report for the Yerevan-2 CC Power Plant Project. This version reflects the status quo at February 2018.

1.1 Project Background

The Ministry of Energy (MOE) of the Republic of Armenia plans to improve the total output capacity of its electric energy production, complementing the power units of the existing Yerevan Combined Cycle Power Plant (YCCPP-1) with a most modern and efficient power plant. For this reason a new gas fired Combined Cycle Power Plant of 254 MW (YCCPP-2, or “the Project”) is planned to be built at the uninhabited site next to the existing YCCPP-1 (see Figure 1-1) in an already industrialized region in the south of Yerevan. The implementation of the Project is urgent in consideration of the closure of the Metsamor Nuclear Power Plant that will strongly reduce the capacity of electric energy production for the next years (US AID, 2010).

The new CCPP will include a Gas Turbine (GT), a Steam Turbine (ST), a Heat Recovery Steam Generator (HRSG) and all auxiliary equipment and systems that, at local conditions with an ambient temperature of 15°C, will produce 254 MW electrical output.

Interconnections to gas, water and electrical grid are planned. The new CCPP shall be connected with the facilities of the existing grid infrastructure provided below (see Figure 3-3):

- Electricity: A new 220 kV substation is just under construction for YCCPP-1; the connection from the new power plant to the new substation is proposed to be by underground cable (still subject of design, if overhead transmission line or underground cable will be used); the distance between the new power plant and the new 220 kV substation is approx. 400 m
- New connection to the natural gas supply pipeline system from Gazprom Armenia, approx. 1,500 m (under responsibility of Gazprom Armenia)
- New connection to the city water system managed by Veolia (make-up water), approx. 1,000 m
- New connections to the water sewerage of the city, approx. 450 m
- New connection to the industrial waste water discharge system (pipeline and channels) downstream of YCCPP-1, less than 100 m



Figure 1-1: Site location (red) of the planned YCCPP-2 (black), next to the existing YCCPP-1; access road (yellow) and temporary laydown area for construction (blue), which are in possession YCCPP-1

The construction site is part of the Yerevan industrial area and has been earth worked in the past. No industrial activities have been performed on the site in the past, but it has been used as temporary laydown area for construction of the adjacent YCCPP-1. An existing road grants access to the construction site and an area belonging to the property of YCCPP-1 will be used as temporary laydown area for the construction (see Figure 1-1). There is an agreement in place between ArmPower/Renco and YCCPP-1 for using the access road and the temporary laydown area. Material that is stored at the moment in this area will be moved to another site inside the property of YCCPP-1.

The foreseen site location allows to use the pipeline and channel for discharge of treated waste water to Hrazdan River, which is already used by YCCPP-1, as well as using adjacent substation for power evacuation and main access road to the site. Possible alternative locations for the proposed new YCCPP-2 had been considered prior to opting for the foreseen site. On account to minimize the additional costs for newly developing such a site and modifying the transmission network to accommodate the new power plant, the foreseen site was selected together with MOE as a final option.

As the energy sector development has a critical impact on the economic development of the entire country, the Government of Armenia considers this project to be of utmost significance with the highest priority for execution (fast-track project).

The following documents have already been prepared for the Project:

- RENCO SPA: Armenia 250 MW CCGT Yerevan Capital City. Draft Feasibility Study [CCGT 250 MW – Yerevan /Armenia]
- Ecobarik-Audit LLC (2016): Report of Evaluation of Environmental Impact of the new Steam and Gas Combined Cycle Power Plant in Yerevan
- Geoterproject LTD (2016): Report on engineering-geological survey of Yerevan TPP new energy block area

These documents have been the basis for issuance of the **national environmental approval** to the planned Project, which is documented in the following Conclusion: *“RA Minister of Nature Protection (11.01.2017): State Expert Examination Conclusion on Expert Examination of Influence on the Environment BP 02. Report of evaluation of influence on environment of the new power station in Yerevan with combined cycle of steam and gas”*.

1.2 Objective of the Project

Along with a rapidly growing economy and a rising population, power demand in Armenia is constantly increasing. The main objective of the construction of the 254 MW Combined Cycle Power Plant (YCCPP-2) is to:

- Improve the total output capacity of electric energy production;
- Provide reliable power supply;
- Shift the financial burden for power generation from the government to the private sector;
- Promote commercial development of thermal technology and cost reduction that enables Armenia to become a major net exporter of electricity; and
- Build and sustain local capacity in the development and maintenance of power generation infrastructure.

1.3 Objectives of the ESIA

The overall aim of the ESIA is to give an overview of the present situation in the area of implementation of the Project (“the Project Area”) and its wider area (“the Project Area of Influence”), to assess the potential (positive and negative) impacts of the Project, and to name appropriate mitigation measures and monitoring approaches. This shall be for the benefit of the plant owner, the concerned public and the future sponsors of the Project.

The main objectives of the ESIA Study are to:

- (i) explain the Project framework including the current design and key technical aspects;
- (ii) analyze the environmental and social baseline in the Project Area of Influence and the resulting requirements for impact assessment

in compliance with all relevant international policies (e.g. ADB's Safeguard Policy Statement, IFC/World Bank EHS Guidelines, EU EIA Guideline) as well as Armenian national environmental guidelines and requirements;

- (iii) perform a detailed environmental and social impact assessment on the basis of the technical design, available data and field surveys with the purpose of understanding the current environmental and social situation in the Project Area of Influence and to assess the potential positive and negative impacts of the Project;
- (iv) identify and recommend measures to avoid, minimize or mitigate adverse environmental and social impacts of the Project during the construction, operation, and decommissioning phases, and recommend referring monitoring measures to be addressed during Project implementation through the preparation of an ESMP (Environmental and Social Management Plan).

On the basis of the existing environmental situation and the technical planning FICHTNER determined and evaluated the environmental and social impacts during construction, operation, and decommissioning of the planned YCCPP-2. The impact assessment examined the impacts to physical environment of the Project and the effects for the local population. In a second step, appropriate mitigation measures and monitoring measures were considered to reduce possible adverse impacts.

After public disclosure of the ESIA, including the ESMP, public consultations were executed on 10th February 2018 in order to seek feedback and concerns of stakeholders and people possibly affected by the Project (see also Stakeholder Engagement Plan in Annex 12.9).

1.4 Methodology

The following documents have already been prepared for the Project:

- RENCO SPA: Armenia 250 MW CCGT Yerevan Capital City. Draft Feasibility Study [CCGT 250 MW – Yerevan /Armenia]
- Ecobarik-Audit LLC (2016): Report of Evaluation of Environmental Impact of the new Steam and Gas Combined Cycle Power Plant in Yerevan
- Geoterproject LTD (2016): Report on engineering-geological survey of Yerevan TPP new energy block area
- ArmPower CJSC (2017): Geological Report of Armhydroenergyproject CJSC
- Consecord LLC (2017): Report on Monitoring Services

A **general overview** about the Project site's biophysical settings has been done based on a desktop study, including a review of the existing studies about the Project (see above) and on a field surveys. The first field survey was conducted by FICHTNER's environmental and social experts in July 2017, including visiting the proposed CCPP site. Between July 2017 and

January 2018 further surveys (air, noise, soil, surface water and groundwater baseline monitoring) have been undertaken.

To obtain up-to-date data about the ground level concentrations (GLC) of **air pollutants** in the Project Area of Influence, and help defining the airshed as degraded or non-degraded (according to the WB EHS Guidelines), Fichtner undertook an air quality monitoring campaign including the measurement of SO₂, NO₂ and PM₁₀. For gases (SO₂ and NO₂), the Consultant performed a 7 days, a 10 days, and a 30 days campaign with diffusion tubes at five sampling points, followed by a laboratory analysis in Summer 2017, Autumn 2017 and Winter 2017/2018. The monitoring campaign will be repeated next Spring in order to cover all seasons of an annual cycle. Figure 1-2 below shows the sampling points. Measurement point Air 1 is situated in an industrial area near the southeast border of YCCPP-1. Measurement point Air 2 is placed approx. 1,700 m to the south-west of YCCPP-2; it is located near the northeast border of Ayntap community. Air 1 and Air 2 are located downwind the main wind direction. Measurement point Air 3 is placed in an industrial area near the northern border of the YCCPP-2. Two additional sampling points have been defined after one test model run, being located in the areas where the highest GLC of NO₂ resulting from the operation of YCCPP-2 are expected. For particulates (PM₁₀), the Consultant performed two 5 day campaigns and one 30 days campaign in Summer and Autumn 2017 and Winter 2017/2018. The dust concentration was measured by using the dust particle meter DT-96 in accordance with the GOST 17.2.4.05-83 - "Environmental protection. Atmosphere. Gravimetric method for determination of suspended dust particles". The equipment has collected 5 daily measurements of 5 minutes along all the days in each campaign.



Figure 1-2: Baseline Monitoring Points - Air Quality

The air quality baseline data have been used as an input for an **Air Dispersion Calculation (ADC)** whose complete report can be read in Annex 12.8. The ADC was performed using the dispersion modeling software BREEZE AERMOD, version 8.0.39 (2017), which predicts pollutant concentrations from continuous point, flare, area, line, volume and open pit sources. 3 scenarios were simulated: baseline scenario, or Scenario A; one where only YCCPP-2 is operating (Scenario B); and Scenario C for assessing cumulative impacts.

To obtain data about the existing **noise levels** in the Project Area of Influence, FICHTNER undertook a noise monitoring campaign in an area around the YCCPP-2 site at five monitoring points (Figure 1-3 below). The campaign used the Sound Level Meter WS1361, a high precision instrument in line with the International Committee TYPE 2 ANSI S1.4 and the United States National Standard TYPE 2 IEC 651. Measurement point Noise 1 is at the same location as Air 2 (see above). Measurement point Noise 2 is situated approx. 1,750 m to the west of YCCPP-2. This point is located on the eastern border of Noragavit settlement in front of the highway. Measurement points Noise 3 and Noise 5 are located in Kharberd horticultural settlement. Both points are situated along the northern border

of the settlement. Noise 5 is located at a distance of approx. 1,100 m, while the distance between Noise 3 and YCCPP-2 is 1,500 m. Measurement point Noise 4 is at the same location as Air 3 (see above).



Legend
● Baseline monitoring - Noise □ YCCPP-2 construction site

Figure 1-3: Baseline Monitoring Points - Noise

The results of the monitoring campaign were used as an input for a **Noise Propagation Study** whose complete report can be read in Annex 12.6. On the basis of the Project data, the sound contribution of the YCCPP-2 during operation at the most exposed sensors was calculated. The calculation was performed using the software SoundPlan (open field propagation simulation software) after setting the model parameters. The predictive noise pressure at the sensitive receptors has been calculated by adding the value of the background noise sound pressure to sound level contribution calculated by the model.

Soil sampling at the construction site was done in November / December 2017 for analyses of TPH, PAH, BTEX, and metals. Furthermore analysis of groundwater upstream, at the site, and downstream for content of TPH, PAH, BTEX, metals, as well as pH, mineralization, BOD5, COD-Cr was performed at the same time (see Figure 1-4 below for sampling points). An

analysis of water quality parameters of Hrazdan River upstream and downstream of the discharge point and at the discharge channel close to the discharge point was also performed.

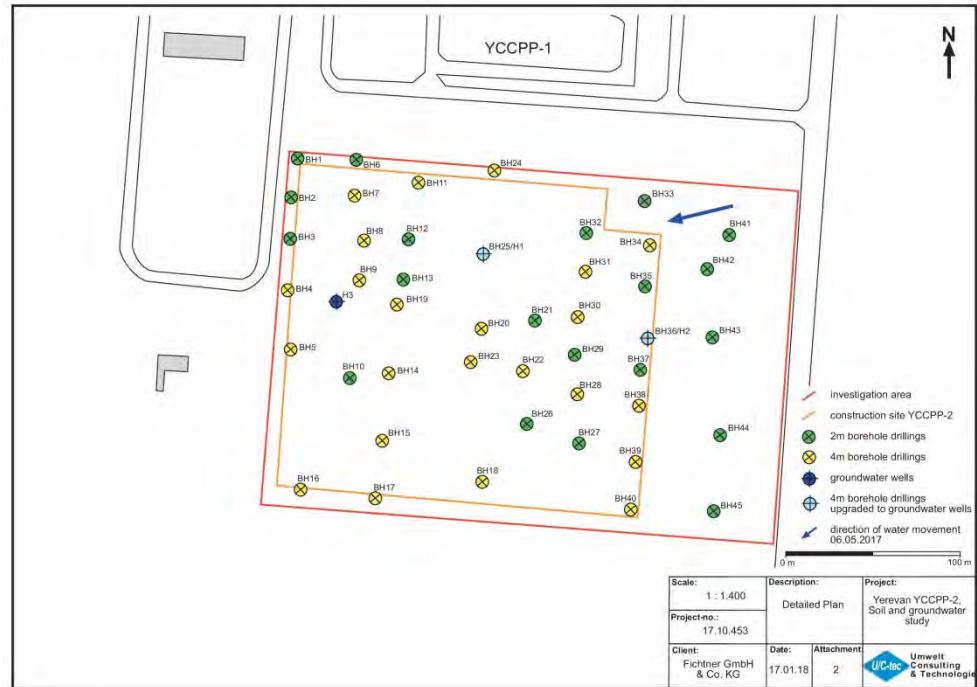


Figure 1-4: Baseline Monitoring Points - Soil and groundwater (November 2017)

The **environmental and social impacts** of the Project are predicted in relation to the environmental and social receptors (fauna and flora, land use, residents of villages, etc.) and natural resources. This is accomplished by comparing the baseline conditions with situations ensuing when the Project is implemented. Additional information was gained by consultations of representatives of governmental organizations (e.g. Yerevan Municipality, Environmental Monitoring and Information Center at the Ministry of Nature Protection), non-governmental organizations (NGOs) and other organizations (e.g. Aarhus Centers of Armenia).

Due to the fact that there is no official international consensus on an agreed approach for **assessing the significance of impacts** on the environment, FICHTNER uses an own evaluation procedure. This transparent evaluation procedure is based upon FICHTNER's extensive experience over the last fifteen years in performing Environmental and Social Impact Assessments and has proven to be a reliable method for assessing a project's impacts on the environment. It includes identification, prediction (e.g. long or short term, direct or indirect, avoidable or unavoidable, reversible or irreversible) and evaluation of the significance of impacts based on the IFC/WorldBank guidelines and ADB Safeguard Policy Statement, as well as on legal requirements. Wherever possible, impacts are quantified. The focus of the used evaluation procedure is to decide whether the Project is likely to cause significant adverse environmental effects resulting from construction, operation, and decommissioning. The criteria used in this study for assessing negative impact significance are extent, duration and intensity.

Three classes of significance/ importance are used: high, medium, or low negative. The more an impact is extended, durable or intense, the more significant/ important it will be. **Significance of Impacts** is mainly measured on basis of the impacted area: the more the impact has limited extent or is local, the more that impact is considered to be low. **Intensity** of an impact is measured based on the extent of modifications observed on the component affected by a project's activity. For a physical component, intensity of modification refers to the level of disturbance caused by the project; while for biological components, it additionally refers to specialists' value judgement that takes into consideration the ecological and social context of the relevant environment and the component's value. Regarding the **duration** of an impact, the construction of a power plant implies long-term impacts and temporary impacts. Long-term impacts may occur as long as the plant exists, such as aesthetic impacts. Temporary impacts occur during the construction or at less frequent intervals. The **significance** of an impact is therefore the result of an overall judgment on the effect of an activity of the project in regards with a component of the environment, based on the described criteria.

For the purpose of a transparent presentation and evaluation, a tabulated evaluation matrix is applied. On the basis of a point scale, the significance of the particular environmental or social impact together with its general trend - that is, negative or positive - is described. The following evaluation scale is applied:

Significance of Impact:	
■■■	= high negative
■■	= medium negative
■	= low negative
	= nil
+	= locally positive
++	= regionally positive

For final judgment of the significance of an impact, international standards like standards from the World Bank, World Health Organization (WHO), etc. are used (see Section 2.3), supported by Armenian standards (see Section 2.1). According to these standards, the evaluation of impacts is done as follows (Table 1-1):

Table 1-1: Evaluation of impacts using International and National Standards

Significance of impact	Reason
High	International and national standards are exceeded
Medium	Between international and national standards, international and national standards are barely met
Low	International and national standards are met

2. Policy, Legal and Administrative Framework

This Chapter presents the policy, legal and administrative framework for environmental and social management in the Republic of Armenia (RA), with particular reference to the provisions for conducting an ESIA. The Project will conform to applicable local/ national and international environmental and social legislation, regulations and guidelines as well as specific procedures and policies of State Authorities, the Asian Development Bank (ADB) and the International Financing Cooperation (IFC), and other available best practices. These require that an ESIA of the designed works is carried out, and the ESIA report reviewed and approved in the light of prevailing environmental and social policies and regulations.

2.1 National Requirements

Following independence in 1991, the environmental legislation was reviewed with the aim of developing a more comprehensive state policy towards ecological protection and sustainable use of resources. To this end, a series of laws have been developed, including regulations relating to protected areas, a land code (both 1991) and a forest statute (1994). From 1999 to today, a number of national laws of RA were implemented to regulate the protection of the environment. Key laws/ regulations related to the Project are given in Table 2-1 below and their relevance for the Project is indicated.

Table 2-1: National laws of RA, implemented to regulate the protection of the environment and expropriation issues

Law/ Policy	Year	Main scopes	Relevance for the Project
Decree of RA Supreme Council on Adoption of Fundamentals of the Nature Protection Legislation of RA	1991	RA nature protection policy is based on fundamentals dedicated to maintain protection and using arrangement of the natural environment in the territory of Armenia, as well as creation of the necessary legal basis to develop nature protection legislation to regulate relationships regarding mining; use and protection of forest and water, flora and fauna, atmospheric air protection.	Relevant for the Project, as this law provides fundamentals on use and protection of water, flora and fauna, as well as air protection.

Law/ Policy	Year	Main scopes	Relevance for the Project
RA Law on Protection of Atmospheric Air	1994	<p>Subjects of that law are prevention and elimination of atmospheric air pollution and realization of international cooperation within protection of atmospheric air. The main legislative issues in this domain are:</p> <ul style="list-style-type: none"> - maintenance of improvement of purity and quality of atmospheric air - prevention and reduction of chemical, physical, biological and other influences over atmospheric air conditions - regulation of public relationships within that sphere - strengthening of legality within that sphere. 	Relevant due to the air emissions from the planned power plant
RA Law on Environmental Protection and Environmental Usage Fees	1998	<p>That law provides definition of environmental protection and environmental usage fees, scope of payers, types of fees, calculation and payment rules, and liabilities against breach of that law as well regulates other relationships on fee payments.</p> <p>Types of environmental protection fees are payments:</p> <ul style="list-style-type: none"> - against emission of hazardous substances at environment (air and water basin) - for industrial waste and household refuse disposal within adopted regulation - against environmentally harmful products. <p>Types of environmental usage fees are payments:</p> <ul style="list-style-type: none"> - for water use - for resources of extracted minerals, - for bio-resources use. 	This law is relevant for the Project regarding emissions to air and water, waste disposal and water use.

Law/ Policy	Year	Main scopes	Relevance for the Project
RA Law on Conservation and Use of Historical and Cultural Monuments and Historic Environment	1998	<p>The subjects of that law are:</p> <ul style="list-style-type: none"> - provision of legal basis within domain of protection and use of monuments and - regulation of relationships, which are begotten within those activities. - The main issues of that law are: - envisaging of general provisions of the state policy within domain of protection and use of monuments - envisaging of regulation principals of recording, conservation, research, restoration, repair, restoration and use of monuments - envisaging of authorities of the state governmental and local self-governmental bodies, legal entities and natural persons within domain of protection and use of monuments - envisaging of special features of ownership rights to possess, use and dispose monuments, which are specific type of real estate. 	This law will only be relevant to the Project if during construction any historical or cultural goods will be found (Chance Find Procedure).

Law/ Policy	Year	Main scopes	Relevance for the Project
RA Law on Fauna	1999	<p>That law provides RA state policy regarding conservation, protection, reproduction and use of species of wild fauna.</p> <p>The subjects of that law are:</p> <ul style="list-style-type: none"> - conservation, protection, natural reproduction of genetic and species diversity - prevention of infringement of comprehensiveness of animals' living environment - protection of comprehensiveness of animal species, their populations and relatives - protection of animals migration routes - regulation of relationships regarding using of objects of fauna. <p>Responsibilities of different organizations, including government, ministries, state bodies, local self-governmental bodies are envisaged by that law.</p>	As biodiversity values at the construction site and in Hrazdan River are rated to be low, this law will not be relevant for the Project
RA Law on Flora	1999	Law on flora provides RA state policy regarding approved science-based protection, conservation, use and reproduction of natural flora.	Biodiversity value at the construction site is rated to be low, thus this law will not be relevant for the Project

Law/ Policy	Year	Main scopes	Relevance for the Project
RA Land Code	2001	<p>That Code provides legal basis of land relationships (regarding improvement of the state regulation, development of the land management in various organizational-legal forms, soil fertility, increment of the efficiency of land use, protection and improvement of favorable environment for human life and health, protection of rights to land) by taking into consideration significant environmental, economic and social essence of land, due to which the land is used and maintained as a condition of life for population in RA.</p> <p>According to the Code, possession, using and disposal of land must not damage the environment, security and defensibility of the state as well as must not violate rights and interests of citizens and other persons that are protected by the law.</p>	Not relevant for the Project as no additional land will have to be acquired and no project-related relocation will occur

Law/ Policy	Year	Main scopes	Relevance for the Project
RA Water Code	2002	<p>By this legal act, the relationships regarding using of water are mainly regulated. Article 3 of the Code envisages that RA Government through appropriate state authorized bodies realizes purposes of the code, maintain water saving, protection from harmful influence, using of water for public interests aimed at conserving security of each person.</p> <p>Vital principals of water resources management are:</p> <ul style="list-style-type: none"> - satisfaction of main vital needs of present and future generations - maintenance and increase of the volume of the national water resources - protection of water and related ecosystems and their biological diversity - recognition of complete and coherent relationship of land, air, water and biological diversity - regulation of water use through water use permission. 	Relevant for wastewater effluents from the planned power plant to surface water bodies, and for water use during operation
RA Law on Waste	2004	This law shall regulate relations on waste collection, transportation, storage, processing, recycling, removal, volume reduction and other relations regarding the before mentioned activities, as well as legal and economical bases for prevention of adverse effects of waste on human health and environment.	Relevant for waste management during construction, operation, and decommissioning, as well as for handling of existing material on the site.

Law/ Policy	Year	Main scopes	Relevance for the Project
Resolution N160-N of the Government of Armenia on the approval of the normatives of environmental air polluting substances threshold limit values in residential areas	2 February 2006	This resolution defines the threshold limit values for NO ₂ and CO concentrations in residential areas.	Relevant for compliance of ground level concentrations of NO ₂ and CO produced by the emissions of YCCPP-2 with national standards
Order N27-N on determining the chemicals threshold limit values in the work zone air of workplaces of organizations	6 December 2010	This order defines the threshold limit values for NO ₂ concentration in industrial areas.	Relevant for compliance of ground level concentrations of NO ₂ produced by the emissions of YCCPP-2 with national standards
Resolution N1673-N of the Government of Armenia on defining the development and approval procedure of environmental air polluting substances emission limits normatives	27 December 2012	This resolution defines the approval procedure of environmental air polluting substances emission limits normatives, including as an annex the “Guideline of the composition and content of the emission limits values normatives” for different projects.	Defining the national limit values of emissions to be used for the Project
RA Law on Environmental Assessment and Expertise	21 June 2014	This law regulates environmental impact assessment (through legal, economic and organizational principles) of proposed activities and concepts.	Most important law for carrying out EIA studies and therefore relevant for the Project

The planned implementation of any activity in Armenia that may cause environmental impacts needs a positive conclusion of an EIA expertise. All environmental impacts of planned physical activities or sectoral/ regional development plans/ programs have to be assessed during the EIA preparation period. The **RA Law on Environmental Assessment and Expertise** of 2014 stipulates provisions regarding environmental impact assessment, realization and terms, thus being the most important national law for carrying out an EIA. In this law “*Thermo power plants, heat and hot water producing plants*” are listed requiring an EIA process.

The consequent steps for obtaining environmental approval, as set forth in the national legislation, are given below:

- 1) Preliminary stage: During this stage preliminary information regarding the project (activity) is presented to the head(s) of the affected community(ies), and public hearings are organized by the project proponent jointly with the head(s) of community(ies). The general information about the project and the notice should be published on the websites of the project owner and the affected community(ies) or other public media seven days prior to the date of the public hearing. According to the Draft Government Decree on organization of public hearings the notice should be published on the web sites not less than 7 days prior, and the project information not less than three days before.
- 2) An application is then to be submitted to the Ministry of Nature Protection (not to the *Nature Protection Expertise* SNCO directly). This request includes general description of the project, measures for mitigation/ compensation and the results of a first public hearing organized by the community(ies) head(s) and the project owner.
- 3) Within 30 days the Ministry of Nature Protection, 1) makes a decision about the a necessity of state environmental expertise, 2) provides an impact category to the project (e.g. a thermal power plant = Cat A), 3) provides a list of activities, and volume and depth of the works for the development of an Environmental Impact Assessment Report (provides the ToRs for the EIA). Within this period, the execution of a second public hearing is needed to be jointly performed by project proponent, head(s) of affected municipality(ies) and the Ministry of Nature Protection. The same rules for dissemination as for the first public hearing shall be applied.
- 4) The Project proponent prepares the draft EIA Report and submits it to the Ministry of Nature Protection.
- 5) The next stage is the main stage of the environmental expertise. During this stage, which lasts 40 days for Projects of Category B and 60 days for those of Category A, the Ministry of Nature Protection submits the draft EIA report to all involved and specialized parties (e.g. to its departments, to the relevant departments of Academy of Science, the Ministry of Healthcare, the Ministry of Emergency Situations, State Committee for

Water Resources, etc.) as an internal procedure of the Ministry. The Project proponent is not involved in this. During this stage the Project proponent, jointly with the head(s) of community(ies) and the Ministry, organizes the 3rd public hearing, during which the whole draft EIA report is introduced to the general public. The Ministry provides all the comments and recommendations of all parties involved in the revision of the draft EIA, as well as main comments and recommendations which were arisen during the 3rd public hearing. The Project proponent either makes amendments to the draft or justifies the rejection of amendments.

- 6) At the end, the Ministry organizes the final public hearing, during which it represents all the comments and recommendations provided, the results of these comments and recommendations (if the proposed changes were adopted or not), and gives an opinion on the EIA report (approval or rejection).
- 7) Based on this, the Ministry provides the final approval or rejection of the project, signed by the Minister. Steps 5-7 are included in the total duration (40 days for Category B and 60 days for Category A).

The above procedure is generally consistent with ADB's and IFC's environmental safeguard policies. The national law requires an EIA, at the same time that it requires coverage of the social aspects of a proposed activity. This is included in this report, which is denominated ESIA and not EIA for this motive. The **National Environmental Project Approval** from the Ministry of Nature Protection has been given in July 2017 based on the national EIA and geological reports. The Approval is documented in the Conclusion: *"RA Minister of Nature Protection (11.01.2017): State Expert Examination Conclusion on Expert Examination of Influence on the Environment BP 02. Report of evaluation of influence on environment of the new power station in Yerevan with combined cycle of steam and gas"*.

ADB's and IFC's policies require that once a draft ESIA report is disclosed, sufficient time is allowed for stakeholders to get acquainted with the document prior to participating in a consultation meeting or otherwise communicating their feedback. According to ADB's Safeguard Policy Statement (2009) and ADB's Public Communication Policy (2011), a draft EIA report for a category A project shall be publicly disclosed for at least 120 days on ADB's website before Board consideration. IFC's Sustainability Framework (IFC 2012) requires a disclosure of 60 days for a category A project.

2.2 International Agreements

Armenia has ratified a number of international agreements and conventions relating to the protection of the environment and biodiversity, including:

- The Convention on the Conservation of European Wildlife and Natural Habitats (Bern)
- Convention on Wetlands of International Importance (Ramsar)
- Conservation of Migratory Species of Wild Animals (Bonn)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (Washington)
- European Landscape Convention (Florence)
- Convention Concerning the Protection of the World Cultural and Natural Heritage (Paris)
- Convention on Biological Diversity (Rio de Janeiro)
- Framework Convention on Climate Change (Rio de Janeiro)
- Kyoto Protocol (linked to the Convention on Climate Change)
- Paris Agreement (linked to the Convention on Climate Change).

With special respect to handling of hazardous substances:

- Stockholm Convention “On Persistent Organic Pollutants” (ratified by the Government of the Republic of Armenia 2003)
- Basel Convention “On the Control of Transboundary Movements of Hazardous Wastes and their Disposal” (being a party since 1999).

In addition Armenia is a signatory to the Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters.

International agreements and conventions triggered by the Project are especially: Convention Concerning the Protection of the World Cultural and Natural Heritage (if any cultural or historical goods will be found at the construction site by chance); Framework Convention on Climate Change + Kyoto Protocol and Paris Agreement (due to air emissions including GHG emissions); Stockholm Convention On Persistent Organic Pollutants + Basel Convention On the Control of Transboundary Movements of Hazardous Wastes and their Disposal (due to necessary handling of hazardous material and waste); and Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (regarding all aspects of public consultations). These guidelines and conventions are the basis for related mitigation measures given in the ESMP.

2.3 International Requirements

ADB and IFC define that ESIA shall be conducted in line with national laws and regulations as well as in line with international environmental and social safeguard standards. To this end, projects financed by these institutions must meet the respective environmental, social and disclosure policies. From the policies, the following are highlighted as of importance for the present ESIA:

- IFC Performance Standards on Social and Environmental Sustainability (IFC, 2012)
- IFC/ WB Environmental, Health and Safety (EHS) Guidelines (IFC, 2007)
- ADB Safeguard Policy Statement (SPS, 2009).

In sectors where no appropriate IFC/ADB policies or guidelines exist, the banks apply “good international industry practice”.

2.3.1 IFC Sustainability Framework

IFC adopted eight Performance Standards (PS) on Social and Environmental Sustainability (IFC, 2012) in order to manage social and environmental risks and impacts and to enhance development opportunities.

Performance Standard 1 establishes the importance of (i) integrated assessment to identify the environmental and social impacts, risks, and opportunities of projects; (ii) effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and (iii) the client’s management of environmental and social performance throughout the life of the project.

Performance Standards 2 to 8 establish objectives and requirements to avoid, minimize, and where residual impacts remain, to compensate/ offset for risks and impacts to workers, affected communities, and the environment. While all relevant environmental and social risks and potential impacts should be considered as part of the assessment, Performance Standards 2 to 8 describe potential environmental and social risks and impacts that require particular attention. Where environmental or social risks and impacts are identified, the client is required to manage them through its Environmental and Social Management System (ESMS) consistent with Performance Standard 1.

A number of cross-cutting topics such as climate change, gender, human rights, and water, are addressed across multiple Performance Standards.

IFC PS 1: Assessment and Management of Environmental and Social Risks and Impacts

Performance Standard PS 1 **applies to all projects** that have environmental and social risks and impacts. It underscores the importance of managing environmental and social performance throughout the life of a project. Its objectives are:

- To identify and evaluate environmental and social risks and impacts of the project.
- To adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimize, and, where residual impacts remain, compensate/ offset for risks and impacts to workers, affected communities, and the environment.
- To promote improved environmental and social performance of clients through the effective use of management systems.
- To ensure that grievances from affected communities and external communications from other stakeholders are responded to and managed appropriately.
- To promote and provide means for adequate engagement with affected communities throughout the project cycle on issues that could potentially affect them and to ensure that relevant environmental and social information is disclosed and disseminated.

IFC PS 2: Labor and Working Conditions

Performance Standard PS 2 recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers. The requirements set out in PS 2 have been in part guided by a number of international conventions and instruments, including those of the International Labour Organization (ILO) and the United Nations (UN).

Its objectives are:

- To promote the fair treatment, non-discrimination, and equal opportunity of workers.
- To establish, maintain and improve the worker-management relationship.
- To promote compliance with national employment and labor laws.
- To protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the client's supply chain.
- To promote safe and healthy working conditions, and the health of workers.
- To avoid the use of forced labor.

Workers will be employed especially during the construction phase of the Project, thus **triggering this Performance Standard**. This PS also applies to the operational and decommissioning phases of the Project.

IFC PS 3: Resource Efficiency and Pollution Prevention

Performance Standard PS 3 recognizes that increased economic activity and urbanization often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels. There is also a growing global consensus that the current and projected atmospheric concentration of greenhouse gases (GHG) threatens the public health and welfare of current and future generations. PS 3 outlines a project-level approach to resource efficiency and pollution prevention and control in line with internationally disseminated technologies and practices. In addition, it promotes the ability of private sector companies to adopt such technologies and practices as far as their use is feasible in the context of a project that relies on commercially available skills and resources.

Its objectives are:

- To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities.
- To promote more sustainable use of resources, including energy and water.
- To reduce Project-related GHG emissions.

As the new Combined Cycle Power Plant will have emissions to the air from burning gas for power generation and as certain amounts of waste water and different types of waste will be produced during construction, operation, and decommissioning of the plant, **this Performance Standard is triggered.**

IFC PS 4: Community Health, Safety, and Security

Performance Standard 4 recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts. While acknowledging the public authorities' role in promoting the health, safety, and security of the public, PS 4 addresses the client's responsibility to avoid or minimize the risks and impacts to community health, safety, and security that may arise from project related-activities, with particular attention to vulnerable groups.

Its objectives are:

- To anticipate and avoid adverse impacts on the health and safety of the affected community during the project life from both routine and non-routine circumstances.
- To ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the affected communities.

Community health, safety and security **will be a topic during all phases of the Project.**

IFC PS 5: Land Acquisition and Involuntary Resettlement

Performance Standard 5 recognizes that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. Involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or other means of livelihood) as a result of project-related land acquisition and/or restrictions on land use.

Its objectives are:

- To avoid, and when avoidance is not possible, minimize displacement by exploring alternative project designs.
- To avoid forced eviction.
- To anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by (i) providing compensation for loss of assets at replacement cost and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected.
- To improve, or restore, the livelihoods and standards of living of displaced persons
- To improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure at resettlement sites.

This **Performance Standard will not be triggered by the Project**, as all land necessary for the construction, operation, and decommissioning of YCCPP-2 has already been acquired. ArmPower/RENCO has entered a land purchase agreement with the seller (Yerevan Thermal Power Plant CJSC) in March 2017. According to this agreement, the Seller guarantees that the land is free of any form of occupancy or any other possession by any third party and there are no current and, to the best of its knowledge, threatened or pending actions, suits or other proceedings which may affect the Seller's rights to dispose of the Project Land, and the Purchaser's title to the Project Land. The designated purpose of the Land is "for energy, transport, communication, utility infrastructure objects", as stated in the title certificate 18042017-01-0184. A legal opinion has been emitted by an Armenian lawyers company, which stated that the preliminary agreement is legally binding and enforceable. Existing access roads will be used and no physical relocation will be necessary for implementation of the Project.

IFC PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources

Performance Standard 6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. The

requirements set out in PS 6 have been guided by the Convention on Biological Diversity.

Its objectives are:

- To protect and conserve biodiversity.
- To maintain the benefits from ecosystem services.
- To promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.

Due to air emissions from the planned power plant as well as due to the production of waste water and wastes during construction, operation, and decommissioning, this Performance Standard is **triggered by the Project**.

IFC PS 7: Indigenous Peoples

Performance Standard 7 recognizes that Indigenous Peoples, as social groups with identities that are distinct from mainstream groups in national societies, are often among the most marginalized and vulnerable segments of the population. In many cases, their economic, social, and legal status limits their capacity to defend their rights to, and interests in, lands and natural and cultural resources, and may restrict their ability to participate in and benefit from development.

Its objectives are:

- To ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of Indigenous Peoples.
- To anticipate and avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not possible, to minimize and/or compensate for such impacts.
- To promote sustainable development benefits and opportunities for Indigenous Peoples in a culturally appropriate manner.
- To establish and maintain an ongoing relationship based on Informed Consultation and Participation (ICP) with the Indigenous Peoples affected by a project throughout the project's life-cycle.
- To ensure the Free, Prior, and Informed Consent (FPIC) of the Affected Communities of Indigenous Peoples when the circumstances described in this Performance Standard are present.
- To respect and preserve the culture, knowledge, and practices of Indigenous Peoples.

This **Performance Standard will not be triggered by the Project** as no groups of Indigenous People are living in the Project Area of Influence.

IFC PS 8: Cultural Heritage

Performance Standard 8 recognizes the importance of cultural heritage for current and future generations. Consistent with the Convention Concerning the Protection of the World Cultural and Natural Heritage, PS 8 aims to ensure that clients protect cultural heritage in the course of their project activities. In addition, the requirements of this PS on a project's use of cultural heritage are based in part on standards set by the Convention on Biological Diversity.

Its objectives are:

- To protect cultural heritage from the adverse impacts of project activities and support its preservation.
- To promote the equitable sharing of benefits from the use of cultural heritage.

There is no cultural heritage known to be located in the Project Area of Influence. Thus, this Performance Standard would only be **triggered** if any unexpected cultural or archeological goods were found during construction. In this case a Chance Find Procedure would take effect.

In its Sustainability Framework (IFC, 2012) IFC uses a process of environmental and social **categorization** to reflect the magnitude of a Project's risks and impacts. These categories are:

- Category A. Business activities with potential significant adverse environmental or social risks and/or impacts that are diverse, irreversible, or unprecedented.
- Category B. Business activities with potential limited adverse environmental or social risks and/or impacts that are few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures.
- Category C. Business activities with minimal or no adverse environmental or social risks and/or impacts.
- Category FI. Business activities involving investments in FIs or through delivery mechanisms involving financial intermediation.

According to IFC's Sustainability Framework (2012) the Project falls into environmental **Category A**, due to its likelihood of causing significant adverse environmental impacts by air pollution. Thus the Project requires an ESIA.

2.3.2 IFC/ World Bank EHS Guidelines

The IFC/ WB Environmental, Health and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). The General EHS Guidelines contain a series of specific guidelines for different projects. They are designed to be used together with the relevant Industry Sector EHS Guidelines which provide guidance to users on EHS issues in specific industry sectors. The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent.

The specific guidelines applicable to this Project are the following:

- IFC/World Bank Group General EHS Guidelines (2007)
- IFC/World Bank Group EHS Guidelines for Electric Power Transmission and Distribution (2007)
- IFC/World Bank Group EHS Guidelines for Thermal Power Plants (2008)

2.3.3 ADB Safeguard Policy Statement

The ADB requires environmental assessment of all project loans, program loans, sector loans, sector development program loans, financial intermediation loans, and private sector investment operations. Environmental assessment is a process rather than a one-time report, and includes necessary environmental analyses and environmental management planning that take place throughout the project cycle.

The objectives of ADB's safeguards are to:

- avoid adverse impacts of projects on the environment and affected people, where possible;
- minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible; and
- help borrowers/clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks.

ADB's SPS (2009) sets out the policy objectives, scope and triggers, and principles for three key safeguard areas:

- environmental safeguards,
- involuntary resettlement safeguards, and
- Indigenous Peoples safeguards.

ADB staff, through their due diligence, review, and supervision, will ensure that borrowers/clients comply with safeguard requirements during project

preparation and implementation. These safeguard requirements are as follows:

- Safeguard Requirements 1: Environment,
- Safeguard Requirements 2: Involuntary Resettlement,
- Safeguard Requirements 3: Indigenous Peoples, and
- Safeguard Requirements 4: Special Requirements for Different Finance Modalities.

ADB uses a classification system to reflect the significance of a project's potential impacts through three types of impacts of the proposed projects: environmental impacts, probable involuntary resettlement and potential impacts on Indigenous Peoples. ADB categorizes projects separately under environmental and social impacts.

- **Category A.** A proposed project is classified as category A if it is likely to have significant involuntary resettlement impacts, significant impacts on Indigenous Peoples and/or significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment (EIA), including an environmental management plan (EMP), an Indigenous Peoples plan (IPP), including assessment of social impacts and a resettlement plan, including assessment of social impacts are required, if the Project is categorized A both under environmental and social impacts.
- **Category B.** A proposed project is classified as category B if it includes involuntary resettlement impacts that are not deemed significant, if it is likely to have limited impacts on Indigenous Peoples, and/or if its potential adverse environmental impacts are less adverse than those of category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination (IEE), including an EMP, a resettlement plan, including assessment of social impacts and an IPP, including assessment of social impacts, are required, if the Project is categorized B both under environmental and social impacts.
- **Category C.** A proposed project is classified as category C if it has no involuntary resettlement impacts, if it is not expected to have impacts on Indigenous Peoples, and if it is likely to have minimal or no adverse environmental impacts. An EIA or IEE is not required, although environmental implications need to be reviewed.
- **Category FI.** A proposed project is classified as category FI if it involves the investment of ADB funds to, or through, a financial intermediary.

A project's category is determined by the category of its most environmentally sensitive component, including direct, indirect, induced, and cumulative impacts, its most sensitive component in terms of involuntary resettlement impacts and its most sensitive component in terms of impacts on Indigenous Peoples.

The Project subject to this ESIA is classified as of **Category A** for environment, as impacts will affect an area larger than the site itself (due to air and water pollution). Neither resettlement impacts, nor impacts on Indigenous Peoples are expected. Thus, the Project is categorized as Category C for Involuntary Resettlement and Category C for Indigenous Peoples. An ESMP is included in Section 9.8.

Detailed guidance on environmental and social management of the Project, as well as on ESIA and ESMP preparation is provided in ADB's Safeguards Requirements 1 to 3 in appendices 1 to 3 of ADB's SPS. As a summary, the following items are of importance for the Project and are included in this report:

- Analysis of alternatives;
- Appropriate environmental and social baseline data;
- All potential impacts and risks of the project on physical, biological, socioeconomic (occupational health and safety, community health and safety, vulnerable groups and gender issues, and impacts on livelihoods through environmental media) and physical cultural resources in an integrated way and in the context of the project's area of influence;
- Preparation of an environmental management plan (EMP) including:
 - proposed mitigation and compensation measures, environmental monitoring and reporting requirements, emergency response procedures, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates, and performance indicators;
- Principles to monitor and measure the progress of implementation of the EMP;
- Information Disclosure, Consultation and Participation;
- A Grievance Redress Mechanism;
- Application of pollution prevention and control technologies and practices consistent with international good practice;
- Occupational and Community H&S.

Still according to ADB's SPS (2009), an EIA report includes the following major elements: (i) executive summary, (ii) policy, legal and administrative framework, (iii) description of the project, (iv) description of the environment (with comprehensive baseline data), (v) anticipated environmental impacts and mitigation measures, (vi) analysis of alternatives, (vii) environmental management plan(s), (viii) consultation and information disclosure, (ix) grievance redress mechanism, and (x) conclusion and recommendations.

2.3.4 Other Relevant Guidelines

Other international guidelines relevant for the Project are:

- EU EIA-Directive (2011/92/EU amended by Directive 2014/52/EU)
- EU Directive 2013/35/EC on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields)
- EU Directive 2008/98/EC on waste (Waste Framework Directive)
- ICNIRP (International Commission on Non-Ionizing Radiation Protection): Guidelines for Limiting Exposure to time-varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz)

The three named EU Directives are for comparison of the Project's necessities on EU level. The ICNIRP Guidelines are triggered by the Project due to possible exposure of workers to electric, magnetic and electromagnetic fields. These Guidelines are the basis for the development of the related mitigation measures in the ESMP.

2.4 Environmental Standards

This Section presents a summary of the environmental standards applicable to the project, including national, international and performance guarantee standards/limits. The standards are to be applied according to the ESMP's instructions.

Table 2-2: Limit values for noise regarding population (IFC/WB General EHS Guidelines)

Receptor	One Hour L_{Aeq} (dB A)	
	Daytime 7:00 – 22:00	Night-time 22:00 – 7:00
Residential; institutional; educational	55	45
Industrial; commercial	70	70
Noise impacts should not exceed the levels given above, or result in a maximum increase in background levels of 3 dB (A) at the nearest receptor location off-site.		

Table 2-3: Limit values for noise regarding population (Sanitary Norm N2-III-11.3)

Receptor	One Hour L_{Aeq} (dB A)	
	Daytime 7:00 – 22:00	Night-time 22:00 – 7:00
Residential areas	55	45
Industrial activities/buildings	80	
The limits refer to the total environment noise (the power plant contribution + the current sound pressure ("ante operam" sound pressure))		

Table 2-4: Limit values for noise regarding workers

<p>IFC/WB General EHS Guidelines: No employee should be exposed to a noise level greater than 85 dB (A) for a duration of more than 8 hours per day without hearing protection’.</p>
<p>Armenian legislation: Construction workers will wear ear protection devices as part of their Personal Protective Equipment (PPE), if they are exposed to noise levels higher than 80 dB (A).</p>

Table 2-5: Performance Guarantees of YCCPP-2 - noise (ArmPower, 2017)

The average A-weighted sound pressure level of the turbine halls 1.5 m above ground level and at 1 m from the turbine installation shall not exceed 80 dB(A).
The A-weighted sound pressure level of the overall plant at the plant boundary 1.5 m above ground will not exceed 50 dB(A) the noise occurring in the free field (before construction is started).
A maximum of 3 dB(A) measured as incremental noise from the base line measured before plant is completed at plant fence

Table 2-6: IFC air emission guidelines for facilities larger than 50 MW with combustion turbines (IFC, 2008)

Pollutant	EG for combustion turbines; facilities > 50 MWth
	Natural Gas
NO ₂	51 mg/Nm ³
Dry gas, excess O ₂ content	15%
Temperature flue gas	0°C

Table 2-7: Performance Guarantees for YCCPP-2 - air emissions (ArmPower, 2017)

Pollutant	Performance Guarantees
CO	30 mg/Nm ³
NO ₂	51 mg/Nm ³
UHC	10 mg/Nm ³
Dry gas, excess O ₂ content	15%
Temperature flue gas	0°C
Load	From 60% to 100%

UHC: Unburned Hydrocarbons

Table 2-8: National and ECD Ambient Air Quality Standards

Pollutant	Averaging period	Air Quality Standards [$\mu\text{g}/\text{m}^3$]		
		National MAC	ECD	
CO	Short-time	5,000	-	
	24 hours	3,000	-	
	Max. daily 8 hour mean	-	10,000	
NO ₂	1 hour	-	200 Not to be exceeded more than 18 times per year	
	Short-time for residential areas	200	-	
	Short-time for industrial areas	2,000	-	
	24 hours	40	-	
	1 year	-	40	
UHC	Methane	-	-	
	Ethane	-	-	
	Propane	-	-	
	Butane	Short-time	200,000	-
	Pentane	Short-time	100,000	-
		24 hours	25,000	-
PM10	Maximum	300	-	
	24 hours	60	50 Not to be exceeded more than 35 times per year	
	1 year	-	40	
SO ₂	Maximum	500	-	
	1 hour	-	350 Not to be exceeded more than 24 times per year	
	24 hours	50	125 Not to be exceeded more than 3 times per year	

ECD: European Council Directives

UHC: Unburned Hydrocarbons

MAC: Maximum Allowable Concentration

The ECD 2008/50/EC does not set a limit for the type of UHC that are expected from natural gas operation (methane, ethane, propane, butane, and pentane). The limits shown in Table 3-3 for butane and pentane are based on the national legislation, but seem to be overly permissive. In fact, the national air quality monitoring network does not measure hydrocarbons (WHO, 2003), for what there is not a real experience on the application of the standards for UHC. Given this, these standards will not be used in the present ADC, and focus will be provided on CO and NO₂.

Although PM₁₀ and SO₂ are not expected to be emitted by the YCCPP - 2, these standards are mentioned as they are of importance for the air quality baseline assessment.

It shall be noted that the national MAC for 24 hr NO₂ of 40 µg/m³ corresponds to the ECD limit for annual averages. This shows implies that this national MAC is very stringent when compared to the international standards.

According to the RA Regulation Nr. 1673-N of 27 December 2012, to determine the specific emission limits for projects such as power plants, an air dispersion calculation shall be undertaken that evaluates the compliance with the short time MACs. The short time MAC for CO is 5,000 µg/m³ and for NO₂ is 200 µg/m³ (for residential areas). Therefore, in what regards compliance with national requirements, focus is only provided in this study to the short-time MACs (see also Annex 12.12 for the legal background on this particular issue). To evaluate compliance with international requirements, compliance with all applicable ECD air quality standards is also assessed.

Table 2-9: Industrial Effluent Conditions as given in ArmPower Design Data, Effluent Standards for YCCPP-1 set by MNP, and applicable Effluent Guidelines for wastewater from thermal power plants (Source: IFC/WB EHS Guidelines for Thermal Power Plants)

Parameter	mg/l (except pH, temp. and total coliform bacteria)		
	Effluent conditions as given in ArmPower Design Data	Effluent Standards for operation of YCCPP-1	IFC/WB Effluent Guidelines (to be applicable at relevant wastewater streams) ⁴
pH	6.5 – 8.5	6.5 – 8.5	6 – 9
Total suspended solids	50	40	50
Biochemical oxygen demand (BOD)	6	6	
Chemical oxygen demand (COD)	30	30	
Dissolved O ₂	> 4	> 4	
Smells, odors	1 level	should not exist	
Coloring	shall not exist in 10 cm column	shall not exist in 10 cm column	
Oil	10	0.3	10
Cu	0.1	0.1	0.5
Fe	0.5	0.3	1.0
Chlorides		350	
Sulfates		500	
Total coliform bacteria		< 1000 MPN/l	4000 MPN/l*
Temperature increase by thermal discharge from cooling system		Temperature of waste water: 5° C – 23° C	< 3°C increase of ambient water temperature*

* according to IFC/World Bank Group General EHS Guidelines
MPN = Most Probable Number

⁴ as defined in IFC/WB EHS Guidelines for Thermal Power Plants (2008): Effluent guidelines (to be applicable at the relevant wastewater stream: e.g. from FGD system, wet ash transport, washing boiler / air preheater and precipitator, boiler acid washing, regeneration of demineralizers and condensate polishers, oil-separated water, site drainage, coal pile runoff, and cooling water)

Table 2-10: Guideline values for Sanitary Sewage Discharges (Source: IFC/WB General EHS Guidelines)

Parameter	Unit	IFC/WB Effluent Guidelines
pH	pH	6-9
BOD	mg/l	30
COD	mg/l	125
Total N	mg/l	10
Total Ph	mg/l	2
Oil and grease	mg/l	10
Total suspended solids	mg/l	50
Total coliform bacteria	MPN*/100 ml	400

*MPN = Most Probable Number

Table 2-11: Dutch Standards for groundwater quality (Soil Remediation Circular, 2009)

Substance	Dutch Standards	
	Target value [$\mu\text{g/l}$]	Intervention value [$\mu\text{g/l}$]
Antimony (Sb)	0.15	20
Arsenic (As)	10	60
Barium (Ba)	50	625
Beryllium (Be)	0.05	15
Cadmium (Cd)	0.4	6
Chromium (Cr)	1	30
Cobalt (Co)	20	100
Copper (Cu)	15	75
Nickel (Ni)	15	75
Lead (Pb)	15	75
Molybdenum (Mo)	5	300
Selenium (Se)	0.07	160
Tin (Sn)	2.2	50
Vanadium (V)	1.2	70
Zinc (Zn)	65	800

Table 2-12: German Standards for groundwater quality

Substance	German Standards	
	BBodSchG [$\mu\text{g/l}$]	GrwV [$\mu\text{g/l}$]
Arsenic (As)	10	10
Cadmium (Cd)	5	0.5
Chromium (Cr)	50	
Cobalt (Co)	50	
Copper (Cu)	50	
Nickel (Ni)	50	
Lead (Pb)	25	10
Molybdenum (Mo)	50	
Selenium (Se)	10	
Tin (Sn)	40	
Zinc (Zn)	500	
BETX	20	
Benzol	1	
TPH	200	
PAH	0.2	

Table 2-13: Water quality comparative data - RA Decision N75-N (2014)

Parameter	Unit	Water Quality Standards and Classes				
		I	II *	III	IV	V
pH	-	6.5 - 9	6.5 - 9	6.5 - 9	6.5 - 9	<6.5 / >9
Dissolved oxygen	mg O ₂ /l	>7	>6	>5	>4	<4
Mineralization	mg/l	74	148	1000	1500	>1500
BOD ₅	mg O ₂ /l	3	5	9	18	>18
Lithium	µg/l	-	-	-	<2500	>2500
Beryllium	µg/l	0.014	0.028	0.056	100	>100
Boron	µg/l	9	450	700	1000	>2000
Sodium	mg/l	5	10	20	40	>40
Magnesium	mg/l	2,8	50	100	200	>200
Aluminum	µg/l	65	130	260	5000	>5000
Total phosphorus	mg/l	0.025	0.2	0.4	1	>1
Potassium	mg/l	1.5	3.0	6.0	12.0	>12.0
Calcium	mg/l	9.7	100	200	300	>300
Vanadium	µg/l	1	2	4	8	>8
Chrome	µg/l	1.0	11.0	100	250	>250
Iron	mg/l	0.08	0.16	0.5	1	>1
Manganese	µg/l	5	10	20	40	>40
Cobalt	µg/l	0.14	0.28	0.56	1.12	>1.12
Nickel	µg/l	1.0	11.0	50	100	>100
Copper	µg/l	3.0	23.0	50	100	>100
Zinc	µg/l	3.0	100	200	500	>500
Arsen	µg/l	0.13	20	50	100	>100
Selene	µg/l	0.5	20	40	80	>80
Molybdenum	µg/l	7	14	28	56	>56
Cadmium	µg/l	0.02	1.02	2.02	4.02	>4.02
Tin	µg/l	0.09	0.18	0.36	0.72	>0.72
Antimony	µg/l	0.2	0.38	0.76	1.52	>1.52
Barium	µg/l	9	18	36	1000	>1000
Lead	µg/l	0.3	10.3	25	50	>50

* The Scale Value “II” is considered as the Armenian Surface Water Quality Standard; the other values are used as a reference for classifying the water into levels.

Table 2-14: Dutch Standards for soil quality (Soil Remediation Circular, 2009)

Substance	Dutch Standards	
	Target value [mg/kg]	Intervention value [mg/kg]
Arsenic (As)	29	55
Barium (Ba)	160	625
Cadmium (Cd)	0.8	12
Chromium (Cr)	100	380
Cobalt (Co)	9	240
Copper (Cu)	36	190
Nickel (Ni)	35	210
Lead (Pb)	85	530
Molybdenum (Mo)	3	200
Selenium (Se)	0.7	100
Tin (Sn)	-	900
Vanadium (V)	42	250
Zinc (Zn)	140	720

Table 2-15: Maximum allowable concentrations (MAC) of chemical substances in soil (Sanitary norms and rules N 2.1.7.003-10)

Substance	Maximum Allowable Concentration [mg/kg]
Vanadium (V)	150
Mercury (Hg)	2.1
Antimony (Sb)	4.5
Cobalt (Co)	5.0
Manganese (Mn)	400 – 700 (depending on pH)
Copper (Cu)	3
Nickel (Ni)	4
Lead (Pb)	6
Zinc (Zn)	23
Chromium (Cr)	6

Table 2-16: Proposals for land use based on the degree of pollution (Annex to the Sanitary norms and rules N 2.1.7.003-10)

Category of contamination	Summary indicator of contamination	Proposals for land use
“Clean”	-	Using without any limitation
“Permissible” (allowable)	Less than 16	Use without restriction, with the exception of high vulnerability objects: school buildings, residential construction areas, sport’s and children's playgrounds, health and resort areas, water objects, water mains
Moderately dangerous	16 - 32	For filling of trenches and pits during construction, in the areas intended for landscaping, adding 0.2m layer of clean ground
Dangerous	32 - 128	Restricted use for the filling of scrapers during construction, adding no less than 0.5m layer of clean ground. In the event of an epidemic hazard, by the recommendation of the hygienic anti-epidemic supervision body, disinfection (dezinvasion) is carried out with further laboratory supervision.
Extremely dangerous	More than 128	Transfer and handling in special polygons. In the event of an epidemic hazard, by the recommendation of the hygienic anti-epidemic supervision body, disinfection (disinvasion) is carried out with further laboratory supervision.

The „Indicator of Contamination“ described in the table above is established by the Armenian Decision N 1227-N “On establishment of technical regulations for general requirements for protection of lands from pollution, list of substances polluting the lands, and assessment of level of land pollution”. It is calculated as follows (see also Annex 12.10 for the legal framework on this issue):

$$\text{Indicator of Contamination} = \frac{\text{Average concentration}}{\text{National MAC}}$$

Table 2-17: Limits defined by ICNIRP to manage human exposure to electric and magnetic fields

Source	El. Field strength [V/m]	Magn. flux density [μT]
<u>ICNIRP recommends for 50/60 Hz:</u>		
Reference levels for exposure to time-varying electric and magnetic fields (unperturbed r.m.s. values)		
occupational exposure	10,000	500
general public exposure	5,000	100
<u>Limit values according to the European Directive 2013/35/EC</u>		
exposure of workers	10,000	500

r.m.s. = root mean square (value)

ICNIRP=International Commission on Non-Ionizing Radiation Protection

These limits also conform to the values given in European Directive 2013/35/EC for the exposure of workers. In some countries of the former USSR a formula is used to calculate the allowed exposure time of workers, that is:

- $T_{[\text{hrs}]} = 50/E - 2$
- $E = \text{electric field [kV/m]}$

That means that the exposure time in an electric field of 25 kV/m is 0 hrs. Working in an electric field of 25 kV/m or more is not allowed without special protecting clothing.

2.5 Gap Analysis between National and International Legislation

The legal framework of the Republic of Armenia does in the essence correspond with the international regulations and safeguards. Gaps however do exist in enforcement of the regulations. There is still a considerable lack of institutional capacities for implementation, monitoring and evaluation.

There have been improvements during recent years, compared to the analysis of CENN (2004) on Effectiveness of Environmental Impact Assessment (EIA) System in Armenia, but some problematic issues still persist. There is a lack of specific Social and Environmental (S&E) qualification of governmental staff and a specific S&E department does often not exist in the implementing institutions, partly the existing structures are overloaded with work and staff is not sufficiently remunerated. In some cases, power relations are unfavorable to guarantee an effective enforcement. To some extent, the number of highly qualified staff is not sufficient to cope with the amount of work to guarantee an effective enforcement of the regulations.

The lack of access to legal support and lack of trust in the institutions, especially for weaker sections of the society may create further gaps concerning implementation of compensation and resettlement. Additional training would be a necessity but however not sufficient component to improve implementation and monitoring performance. Compliance with international safeguards could be increased with independent monitoring by internationally experienced auditors/ consultants.

The following tables have been prepared for comparison of the IFC Performance Standards (2012), the concerning conventions stipulated by the International Labor Organization (ILO), and the related IFC/ WB General EHS Guidelines (2007), as well as the EHS Guidelines for Thermal Power Plants (2008) with the current legislation of the Republic of Armenia (RA).

The Performance Standards are to be cross-read and refer to each other. Only applicable standards have been considered. Additionally, the concerning international conventions ratified by Armenia are considered, as they are converted into a constituent part of the legal system of RA. The

focus was laid on the project relevant guidelines and laws. The relevant Armenian Legislation was compiled by national legal experts.

The comparison results in the following conclusions:

- The Constitution has the supreme legal force in Armenia. Article 6 sets the keystones of the Armenian Legislation, stipulating that laws shall conform to the Constitution, whereas other legal acts (mainly Decrees of the President and Decisions of the Government) have to conform both to the Constitution and the laws.
- International agreements come into force after being ratified or approved, being then converted into a constituent part of the legal system of the Republic of Armenia. They supersede Armenian Legislature. International agreements not complying with the Constitution cannot be ratified.
- The Law of the Republic of Armenia on Environmental Assessment and Expertise (2014) defines the framework for the Project, covering environmental and social aspects of the proposed activities.
- In Armenia, the Labor Code is the general legal act that regulates labor relationship. The specific features for regulating particular spheres of labor relations may be determined by other laws.
- The IFC Performance Standard 2 on Labor and Working Conditions is based on a number of international conventions and instruments, including those of the International Labor Organization (ILO) and the United Nations (UN). All of them are ratified by the Republic of Armenia, except “UN - International Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families”, which has only been signed and ratification is still pending.
- The remaining IFC Performance Standards are covered by a range of Laws, Government Decisions, Decrees and Orders.

As can be seen in the following tables, there are no known significant gaps relevant for the Project, i.e, the related national legislation addresses the requirements of the IFC Performance Standards (2012).

Covering the IFC Performance Standards does also imply adherence to the ADB Safeguard Requirements as given in the ADB Safeguard Policy Statement (SPS 2009).

IFC Performance Standard 1 and related Armenian Legislation

IFC Performance Standard	Ratified International Treaties (ILO / EHS guidelines)	Armenian Legislation
PS 1 - Assessment and Management of Environmental Risks and Impacts		
<p>Conduct a social and environmental assessment and establish and maintain an Environmental and Social Management System (ESMS) including: Policy, Identification of risks and impacts, Management programs, Organizational capacity and competency, Emergency preparedness, Monitoring and Review, Stakeholder engagement, External Communication and Grievance Mechanisms for Affected Communities.</p> <p>The Impact assessment and the ESMS apply to all the project activities. Corresponding details are given for each applicable Performance Standard.</p>		<ul style="list-style-type: none"> • Law of the Republic of Armenia on Environmental Assessment and Expertise (2014)

IFC Performance Standard 2 and related Armenian Legislation

IFC Performance Standard	Ratified International Treaties (ILO / EHS guidelines)	Armenian Legislation
PS 2 - Labor and Working Conditions		
<p>Social risks and impacts are assessed and necessary actions are managed through the ESMS (see Performance Standard 1).</p> <p>The scope of application is direct workers (engaged by the client) as well as contracted workers (engaged by third parties).</p>		<ul style="list-style-type: none"> • Law of the Republic of Armenia on Environmental Assessment and Expertise (2014); covering environmental and social aspects of proposed activities • "Civil relationship contracts" with third parties (companies providing appropriate services, having appropriate certificates and licenses required by RA law) can be signed. Within those contracts parties may envisage necessary requirements.
<p>Provide reasonable working Conditions and Terms of Employment (eventually regarding collective bargaining agreements)</p>	<ul style="list-style-type: none"> • ILO – Convention On Collective Bargaining 	<ul style="list-style-type: none"> • RA Constitution, Article 48 • RA Labor Code, Article 2 and 3 • RA Constitution, Article 35 : special protection for maternity • RA Government Decree N201-N (2007): schedule features of work and rest for workers of power supply sector. • RA Government Decree N1223-N (2005): workers that can be involved in works with 24 hours working day

IFC Performance Standard	Ratified International Treaties (ILO / EHS guidelines)	Armenian Legislation
PS 2 - Labor and Working Conditions		
Provide workers with documented information (clear and understandable) regarding national labor and employment laws	<ul style="list-style-type: none"> EHS - 2.2 Communication and Training 	<ul style="list-style-type: none"> RA Labor Code Chapter 7, Article 43
If accommodation services are provided, a reasonable policy regarding their quality is provided		<ul style="list-style-type: none"> There is no equivalent requirement within RA legislation. Employer pays employee for accommodation during business trip according to RA Government Decree N2335-N (2005)
Compliance with national law regarding workers' Organizations, adequate collaboration with their representatives	<ul style="list-style-type: none"> ILO – Convention on Freedom of Association and Protection of the Right to Organise 	<ul style="list-style-type: none"> RA Labor Code Chapter 3
Assure non-discrimination and equal opportunity to all the workers (regarding age, origin, gender, health etc., in concern to employment, wages, benefits, etc.), compliance with national laws regarding this concern	<ul style="list-style-type: none"> ILO - Convention on Discrimination in Respect of Employment and Occupation ILO - Convention on Equal Remuneration for Men and Women Workers ILO - Convention on Labor Inspection 	<ul style="list-style-type: none"> RA Constitution, Article 32 RA Labor Code Chapter 19, Article 180: Organization of Remuneration for Work RA Law on Remuneration (2003) RA Labor Code Chapter 5: control and supervision over compliance with labor legislation
Retrenchment only after an analysis of possible alternatives, a timely notice of dismissal and after elaboration of a retrenchment plan, considering pack pays and social security benefits		<ul style="list-style-type: none"> RA Labor Code Chapter 15
Provision of a Grievance Mechanism for workers	<ul style="list-style-type: none"> ILO - Convention on Labor Administration 	<ul style="list-style-type: none"> If the right of the employee is breached, a claim can be submitted to the court Some mechanisms can be envisaged by collective agreement as well. However, collective agreement will not deter an employee to submit a claim to the court. An employee may submit any grievance to employer for consideration and hearing. Also, grievance mechanisms may be stipulated by collective agreement.
Not employ children in any manner that is economically exploitative or could be harmful to them	<ul style="list-style-type: none"> ILO - Convention on Worst Forms of Child Labor ILO – Convention On Minimum Age UN – Convention on the Rights of the Child 	<ul style="list-style-type: none"> RA Constitution, Article 32
Not employ forced labor	<ul style="list-style-type: none"> ILO - Convention on the Forced Labor ILO - Convention on Abolition of Forced Labor 	<ul style="list-style-type: none"> RA Constitution, Article 32

IFC Performance Standard	Ratified International Treaties (ILO / EHS guidelines)	Armenian Legislation
PS 2 - Labor and Working Conditions		
Occupational Health and Safety: provide a safe and healthy work environment	<ul style="list-style-type: none"> • EHS - 2.3 Physical Hazards • EHS - 2.4 Chemical Hazards • EHS - 2.7 Personal Protective Equipment (PPE) • EHS - 2.8 Special Hazard Environments • EHS - 2.9 Monitoring • EHS Guidelines for Thermal Power Plants: 1.2 Occupational Health and Safety • ICNIRP Guidelines for Limiting Exposure to time-varying Electric, Magnetic, and Electromagnetic Fields 	<ul style="list-style-type: none"> • RA Constitution, Article 32: right to working conditions in compliance with the safety and hygiene requirements • RA Labor Code Chapter 23 • RA Government Decree N1698-N (2010): heavy, harmful, especially heavy and especially harmful productions, works, professions and positions.

IFC Performance Standard 3 and related Armenian Legislation

IFC Performance Standard	Ratified International Treaties (ILO / EHS guidelines)	Armenian Legislation
PS 3 - Resource Efficiency and Pollution Prevention		
The principles and techniques applied during the project life-cycle will be tailored to the hazards and risks associated with the nature of the project and consistent with good international industry practice (see Performance Standard 1)		<ul style="list-style-type: none"> • Law of the Republic of Armenia on Environmental Assessment and Expertise (2014) • RA Constitution, Article 10
Resource Efficiency (Greenhouse Gases): Implement technically and financially feasible and cost-effective options to reduce project-related GHG-emissions during design and operation (e.g. reduction of fugitive emissions)	<ul style="list-style-type: none"> • EHS - 1.1 Air Emissions and Ambient Air Quality • EHS Guidelines for Thermal Power Plants: 1.1 Air Emissions, GHG Emissions • Convention on Climate Change (+ Kyoto Protocol, Paris Agreement) 	<ul style="list-style-type: none"> • RA Law on Protection of Atmospheric Air (1994) • RA Decree No. 160-N: Norms of maximum permissible concentrations of atmospheric air pollutants in residential areas

IFC Performance Standard	Ratified International Treaties (ILO / EHS guidelines)	Armenian Legislation
PS 3 - Resource Efficiency and Pollution Prevention		
<p>Resource Efficiency (Water Consumption): adopt measures that avoid or reduce water usage so that the project's water consumption does not have significant adverse impacts on others</p>	<ul style="list-style-type: none"> • EHS - 1.3 Wastewater and Ambient Water Quality • EHS - 1.4 Water Conservation • EHS Guidelines for Thermal Power Plants: 1.1 Water Consumption, Effluents 	<ul style="list-style-type: none"> • RA Water Code (2002) • The RA Law "On National Water Program" • The RA Law "On the Fundamentals of National Water Policy (2005) • RA Government Decision N 1147-N (2005): On the Regulations of Defining Water Standards • RA Government Decision N 982-N (2003): On Approving the Procedure for Use of Absorbent Pits, Exhausted Mines and Open Shafts for Discharge of Wastewater and Drainage Water and Outflow Permission • RA Government Decision N 75-N (2011): On Defining the Norms for Securing Water Quality of Each Basin Management Area Depending on the Features of the Specific Area • RA Government Decision N 118-N (2010) "On Defining The Measures for Application of Advanced Technologies, Improvement of Monitoring, Reduction and Prevention of Pollution of Water Resources" • RA Government Decision N 354-N (2003)" On Approving the Procedure for Determination of Quantities and Regimes of Water intake from Water Resources for Water Users" • Order of RA Minister of Nature Protection N 464-N (2003) "On Approving the Methodology of Calculation of Allowed Marginal Outflow Quantities Discharged onto Water Resources"
<p>Resource Efficiency (Waste): Generation of waste is avoided where possible. If not, reduction and reuse are considered. Where waste cannot be recovered or reused, the client will treat, destroy, or dispose of it in an environmentally sound manner</p>	<ul style="list-style-type: none"> • EHS - 1.6 Waste Management • EHS Guidelines for Thermal Power Plants: 1.1 Solid Wastes 	<ul style="list-style-type: none"> • RA Law "On Waste" (2004) • RA Law "On Refuse Collection and Sanitary Cleaning" • RA Government Decision No 47-N "On Defining Procedure for Waste Passportization (2006) • Order No 19-N of RA Minister of Nature Protection(2007): On Defining the Form of Sample Passport of Waste • Order No 342-N of RA Minister of Nature Protection (2006): On Approving the List of Industrial (Including Mining) and Consumption Waste Generated in the Territory of the Republic of Armenia • Order N 430-N of RA Ministry of Nature Protection (2006): On Defining the List of Waste Classified by Risk Level • Order No 112-N (2002) of the Ministry of Nature Protection

IFC Performance Standard	Ratified International Treaties (ILO / EHS guidelines)	Armenian Legislation
PS 3 - Resource Efficiency and Pollution Prevention		
<p>Resource Efficiency (Hazardous Materials Management): If the generated waste is considered hazardous, the client will adopt alternatives for its environmentally sound disposal while adhering to the limitations applicable to its transboundary movement.</p> <p>The production, transportation, handling, storage, and use of hazardous materials for project activities should be assessed</p>	<ul style="list-style-type: none"> • EHS - 1.5 Hazardous Materials Management • EHS Guidelines for Thermal Power Plants: 1.1 Hazardous Materials and Oil • Stockholm Convention "On Persistent Organic Pollutants" (ratified 2003) • Basel Convention "On the Control of Transboundary Movements of Hazardous Wastes and their Disposal" (being a party since 1999) 	<ul style="list-style-type: none"> • RA Government Decision No 874-N (2004) On Approving the List of Hazardous Wastes of the Republic of Armenia • Government Decree N97(1995): "Regulating the Import, Export and Transboundary Movement of Hazardous and Other Types of Waste in the Territory of the Republic of Armenia" • RA Government Decision N 546-N (2015): On Approving the Technical Regulation for Lubrication Substances, Oil and Special Liquids • Decree No 1483-N On Fulfillment of the obligations of the Republic of Armenia proceeding from UN Stockholm Convention

IFC Performance Standard 4 and related Armenian Legislation

IFC Performance Standard	Ratified International Treaties (ILO / EHS guidelines)	Armenian Legislation
PS 4 - Community Health, Safety, and Security		
The client will identify risks and impacts and propose mitigation measures that are commensurate with their nature and magnitude. These measures will favor the avoidance of risks and impacts over minimization (see Performance Standard 1)	<ul style="list-style-type: none"> • EHS Guidelines for Thermal Power Plants: 1.3 Community Health and Safety 	<ul style="list-style-type: none"> • Law of the Republic of Armenia on Environmental Assessment and Expertise (2014); covering environmental and social aspects of proposed activities
Design, construction, operation, and decommission of the structural elements or components is done considering safety risks to third parties or Affected Communities	<ul style="list-style-type: none"> • EHS - 3.2 Structural Safety of Project Infrastructure • EHS - 3.3 Life and Fire Safety (L&FS) 	<ul style="list-style-type: none"> • The Law of the RA On Fire Safety (2001)
Potential for community exposure to hazardous materials and substances that may be released will be avoided or minimized	<ul style="list-style-type: none"> • EHS - 3.5 Transport of Hazardous Materials 	<ul style="list-style-type: none"> • RA Law On Waste (2004) chapter 2, article 9 • Order N 20-N of the Minister of Healthcare (2009): On Defining Sanitary Rules and Norms N 2.1.7.001-09 "Hygienic Requirements to the Management of Hazardous Waste and Storage and Transportation of Hazardous Chemical Substances" • RA Government Decision N 546-N (2015): On Approving the Technical Regulation for Lubrication Substances, Oil and Special Liquids

IFC Performance Standard	Ratified International Treaties (ILO / EHS guidelines)	Armenian Legislation
PS 4 - Community Health, Safety, and Security		
Identify risks and potential impacts on priority ecosystem services (incl. those that may be exacerbated by climate change). Adverse impacts should be avoided, and if these impacts are unavoidable, the client will implement mitigation measures	<ul style="list-style-type: none"> EHS - 3.1 Water Quality and Availability 	<ul style="list-style-type: none"> RA Government Decision N 927-N (2011) "On Defining Assessments of the Demand of Water Used for Drinking-Household and Agricultural Purposes as well as Environmental Flows for Water Basin Areas of the Republic of Armenia"
Emergency Preparedness and Response to concerns of Affected Communities, local government agencies, and other relevant parties	<ul style="list-style-type: none"> EHS - 3.7 Emergency Preparedness and Response 	<ul style="list-style-type: none"> The Law of the RA On Protection of the Population in Emergency Situations (1998)

IFC Performance Standard 6 and related Armenian Legislation

IFC Performance Standard	Ratified International Treaties (ILO / EHS guidelines)	Armenian Legislation
PS 6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources		
Any significant residual impact must be assessed including: Relevant threats to biodiversity and ecosystem services, especially focusing on habitat loss, degradation and fragmentation, invasive alien species, overexploitation, hydrological changes, nutrient loading, and pollution. It will also take into account the differing values attached to biodiversity and ecosystem services by Affected Communities and, where appropriate, other stakeholders. (see Performance Standard 1)		<ul style="list-style-type: none"> Law of the Republic of Armenia on Environmental Assessment and Expertise (2014)
Impacts on biodiversity and ecosystem services will be avoided where possible. If not avoidable, the impacts will be minimized and mitigation measures that aim to maintain the value and functionality of priority services will be implemented	<ul style="list-style-type: none"> Convention on the Conservation of European Wildlife and Natural Habitats (Bern) Convention on Wetlands of International Importance (Ramsar) Conservation of Migratory Species of Wild Animals (Bonn) Convention on Biological Diversity (Rio de Janeiro) 	<ul style="list-style-type: none"> RA Constitution, Article 10 Law of the Republic of Armenia on Environmental Assessment and Expertise (2014) RA Government Decision N 927-N (2011) "On Defining Assessments of the Demand of Water Used for Drinking-Household and Agricultural Purposes as well as Environmental Flows for Water Basin Areas of the Republic of Armenia"

3. Description of the Project

3.1 Summary Technical Description

A combined-cycle plant produces electricity and captures waste heat from the gas turbine to increase efficiency and electrical output (see Figure 3-1). The compressed air is mixed with fuel that is heated to a very high temperature. The hot air-fuel mixture then moves through the gas turbine blades, making them spin. A generator is driven by the fast-spinning turbine and converts the spinning-energy partly into electricity. A Heat Recovery Steam Generator (HRSG) captures exhaust heat from the gas turbine that would otherwise escape through the exhaust stack. The heat is used to produce high pressure steam which is delivered to the steam turbine to produce additional electricity. In a multi-shaft CCPP, in contrary to a single-shaft CCPP, each gas turbine and each steam turbine has its own generator.

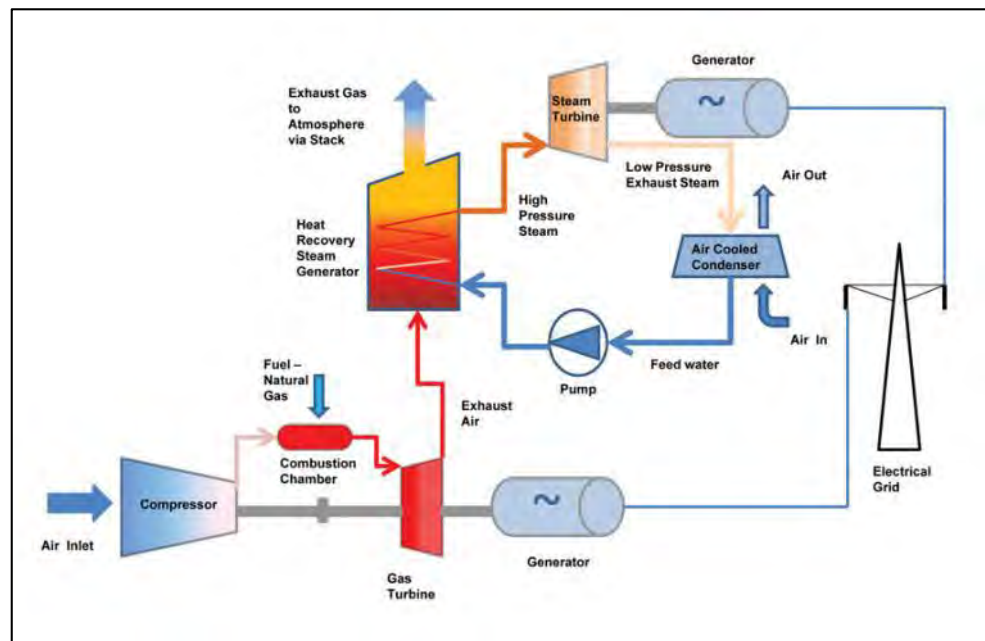


Figure 3-1: General design of a Combined Cycle Power Plant⁵

Sophisticated design will minimize operational and maintenance working load and so increase the reliability and availability of the total plant. For optimizing the layout of the new power plant, coordinated building and plant area location and orientation are considered to minimize influences due to meteorological conditions and to realize better accessibility during construction, installation and maintenance. Special attention is paid to the power plant internal roads, interconnecting route and access requirements for construction, erection, operation and maintenance to minimize interference and crossing of main routes and to obtain short connection paths of main piping and cabling ways.

⁵ <http://www.wrexham-power.com/wrexham-energy-centre-eng.html>

The new power plant, owing to its multi-shaft design, will have the immense advantages of higher efficiency, wider flexibility, higher availability to the maximum extent with simple piping arrangement.

The following technical description and the components specifications are taken from the Basic Engineering Design Data (ArmPower, 2017):

The new power plant will consist of a gas turbine with generator (GTG), a Heat Recovery Steam Generator (HRSG), and a steam turbine with generator (STG) which will be installed in a new West East shaft centerline (see Figure 4-2), and related auxiliaries.

The Gross Power output at Design Conditions and 'Base Load' operation mode of the combined cycle (GT Gross Power output + ST Gross Power output) is:

- Guaranteed Gross Power Output: 254 MW (at design conditions)
- Gross Heat Rate (based on LHV: 47,479 kJ/kg): 6,438 kJ/kWh
- Efficiency: 55.91%

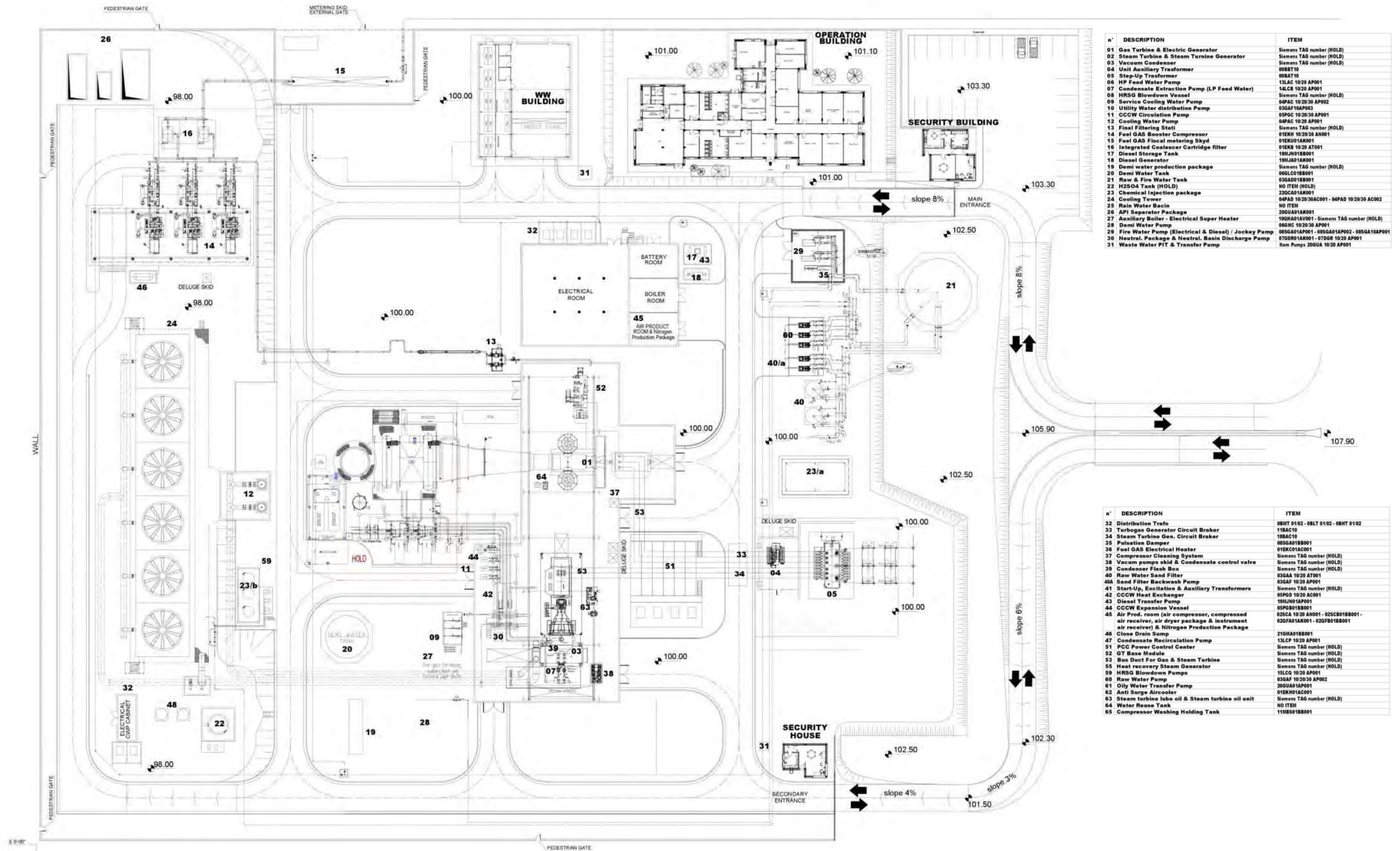


Figure 3-2: YCCPP-2 Key Plan (Source: RENCO SPA)

The new power plant will be designed for full power generation mode, but will also be capable to run at partial load operation. The design life for YCCPP-2 is set to 20 years. YCCPP-2 will include the following main elements:

Gas Turbine

The gas turbine package will mainly be composed by:

- Air compressor (axial type driven directly by the gas turbine, coupled at the same shaft)
- Burner (dry low NO_x)
- Gas Turbine (installed into a dedicated enclosure)
- Gas Turbine Air Preheater System
- Anti-icing System
- Evaporative Cooler
- High Fogging System
- Fuel Gas Filtration Skid
- Main Lube Oil System

The highly efficient gas turbine with the dry low NO_x combustion system is coupled with a generator. The gas turbine will convert the fuel energy into mechanical energy to drive the generator. The gas turbine will be designed to be continuously operated at loads from 75% up to full load rating. It will be out of service only for periodical maintenance. The combustor will be designed of low NO_x type to keep NO_x emission level low. A part of compressor flow will be extracted for cooling turbine blades. The gas turbine will be provided with an air inlet system both filtering and silencing of the combustion air. Dust laden outside air will flow into a field of two stage high efficiency filter system.

Heat Recovery Steam Generator

The exhaust gas flows inside the HRSG in counter current with the high pressure boiling feed water. It shall be an outdoor, two pressure level type with a main stack, condensate preheater, low pressure drum, low pressure evaporator, low pressure super heater, high pressure economizer, high pressure drum, high pressure evaporator and high pressure super heater. A Blow Down vessel will collect all continuous and non-continuous drains from HP and LP drums. A stack provided with a Continuous Emissions Monitoring System (CEMS) will be installed at the end of the HRSG. The height of the stack was first foreseen to be of 35 meters, but will be changed to a height of 66 m according to Good Engineering Practice.

Steam Turbine

The steam, produced and superheated in the HRSG, is supplied at two different pressure levels to the Steam Turbine stages (High pressure stage and Low pressure stage). The turbine is provided also with a high pressure and low pressure bypass. The exhaust steam discharged by the turbine is condensed by a cooling water exchanger. The condensed mixture of steam and air will be discharged to a suitable drain, leading to the wastewater treatment plant.

Main Generators

Two generators will be provided to the new plant:

- Generator for the gas turbine: nominal capacity 205 MVA at 15.0 kV
- Generator for the steam turbine: nominal capacity 100 MVA at 11.5 kV

The two generators will be capable of operating at power factor of 0.9 lagging to 0.9 leading. They shall be connected by MV bus duct through No. 1 three winding step up transformer (15-11,5/220 kV) for the connection to the new 220 kV substation. The connection between the transformer and the substation shall be provided by high voltage power underground cables or by overhead transmission line (underground cable is the proposed option).

Emergency Diesel Generator System

Emergency Diesel Generator System shall be 400V, 50 Hz connected to LV Power Center in the electrical building. The emergency Diesel Generator will be deigned to feed all emergency load in case of power failure.

Instrument/ Service Air Stream

The instrument air compressor package shall be provided with 2x100% + 10% extra capacity screw compressors oil free type. Two air dryers heatless type designed for 100% (+10 % overdesign) of the maximum compressor capacity shall be foreseen. Between compressors and dryers one buffer vessel of appropriately designed volume shall be foreseen in order to dump the pulsation. Downstream the dryer a storage vessel of sufficient capacity to assure 15 minutes shall be provide the instrument air consumption for plant shutdown scenario.

Auxiliary Boiler

A fired auxiliary boiler shall be provided, in order to guarantee the start-up activities of power train and the building heating during the Plant Shutdown. The boiler will be fed by fuel gas. The required design duty shall be evaluated.

Main Cooling System

The main cooling system will consist of a system of six closed-looped evaporative towers designed for 110% of maximum flow rate and duty. Evaporative towers shall be designed also to have a low drift phenomena (0.01% drift loss) to limit the water make up. Number three 50% capacity (+ 10% overdesign) vertical pumps shall be provided to pump water to Steam Turbine condenser; three (each at 50% capacity) other pumps shall be installed to provide the water circulation in closed cooling water circuit.

Fuel Gas Supply System

The Plant shall be operated on the specified fuel gas without any backup of fuel oil. The Centrifugal compressors shall be designed for the available fuel gas composition and quality. The compressor, without the use of a bypass, shall be suitable for continuous operation at any capacity at least 10% greater than the predicted surge capacity.

Demineralized Water System

The Demineralized water production package is part of TP supply and will provide the necessary make up for Combined Cycle consumption.

The demi water system will use the reverse osmosis (RO) technology and ion exchange resin and will include:

- Multimedia Filters;
- Coagulant and Antiscalant dosing package;
- Cartridge Filters;
- Reverse Osmosis Unit;
- Deionization unit;
- Demineralized Water Storage Tank and pumps

The demineralized water is distributed to the users by three 50% Demineralized Feeding Water Pumps which supply the water to the expected pressure. The capacity of the whole system shall foresee a 10% margin; the raw water pumps and the demi water pump shall follow the sparing philosophy.

Waste Water System

The onsite wastewater treatment system is still under design to treat the oily wastewater (API and CPI separators, if needed) and chemical wastewater (neutralization system) generated at the plant to meet the following effluent conditions, which fulfill the standards of IFC/ World Bank Group EHS Guidelines for Thermal Power Plants (to be confirmed during detailed engineering):

- Total suspended solids: 50 mg/l
- Biochemical oxygen demand (BOD): 6 mgO₂/l
- Iron: 0.5 mg/l
- Copper: 0.1 mg/l
- Smells, odors: 1 level
- Coloring: shall not be in 10 cm column
- pH: 6.5 - 8.5
- Dissolved O₂ not less than 4 mg/l
- COD: 30 mg/l
- Oil : 10 mg/l

According to RENCO the **site facilities** will include the following:

Table 3-1: Planned Site Facilities at YCCPP-2 (source: RENCO)

Description	Size [m²]
Office Project Management	29.16
Office Employer	17.26
Office ArmPower – Independent Engineer	14.40
Office Construction Management	28.74
Office TP - Construction Management	30.23
First Aid Room	39.14
Office Secretaries + DCC + Translator	Open Space
Office Health, Safety and Environment (HSE)	Open Space
Commissioning	Open Space
General Archivium	Open Space
Toilette 1	25.16
Toilette 2	18.70
Office Site Engineering	Open Space
Printers Room	18.69
Office IT Room	19.00
Office TP – Specialists	Open Space
Office Planning + Cost Control + Quantity Surveyor	Open Space
Dining Room	116.90
Kitchen	17.26
Meeting Room - 12 Attendants	27.84
Meeting Room - 6/8 Attendants	18.75
Office Procurement	Open Space
Office Logistic + Material Managment	Open Space
Office QA/QC	Open Space
Civil Prefabrication Area	195.00
Batching Plant	3558.00
Storage Area – Mech. & Piping	5620.00
Warehouses	1585.00
Open Storage Area	1564.00
Piping Prefabrication Area	4624.00
Toilettes	144.00
35 kV Electrical Substation	-
Vehicles Parking Lot	1660.00
Vehicles Workshop + Diesel Storage	775.00
Subcontractor Office Area	1587.00
I&C Workshop	262.00
TP Warehouse	804.00
Available Area – 1	2840.00
Available Area – 2	1976.00
Available Area – 3	264.00
Available Area – 4	2560.00

Interconnections to gas, water and electrical grid are planned. The new CCPP shall be connected with the facilities of the existing grid infrastructure provided below (see Figure 3-3):

- Electricity: A new 220 kV substation is just under construction for YCCPP-1; the connection from the new power plant to the new substation is proposed to be by underground cable (still subject of design, if overhead transmission line or underground cable will be used); the distance between the new power plant and the new 220 kV substation is approx. 400 m
- New connection to the natural gas supply pipeline system from Gazprom Armenia, approx. 1,500 m (under responsibility of Gazprom Armenia)
- New connection to the city water system managed by Veolia Djur CJSC (make-up water), approx. 1,000 m
- New connections to the water sewerage of the city, approx. 450 m
- New connection to the industrial waste water discharge system downstream of YCCPP-1, less than 100 m



Figure 3-3: Overview plan showing the new interconnections of YCCPP-2

3.2 Project Area and Project Area of Influence

The **Project Area** comprises the site of YCCPP-2 which is located at 929 m a.s.l. (average) at the south eastern border of Shengavit, a highly industrialized district in the southern part of Yerevan (see Figures 4-3 and 4-4). The Project Area is uninhabited. The coordinates of the site center are approximately:

- Northing: 40° 6'48.06"N;
- Easting: 44°29'49.55"E;
- Zone: 38T (WGS 84).

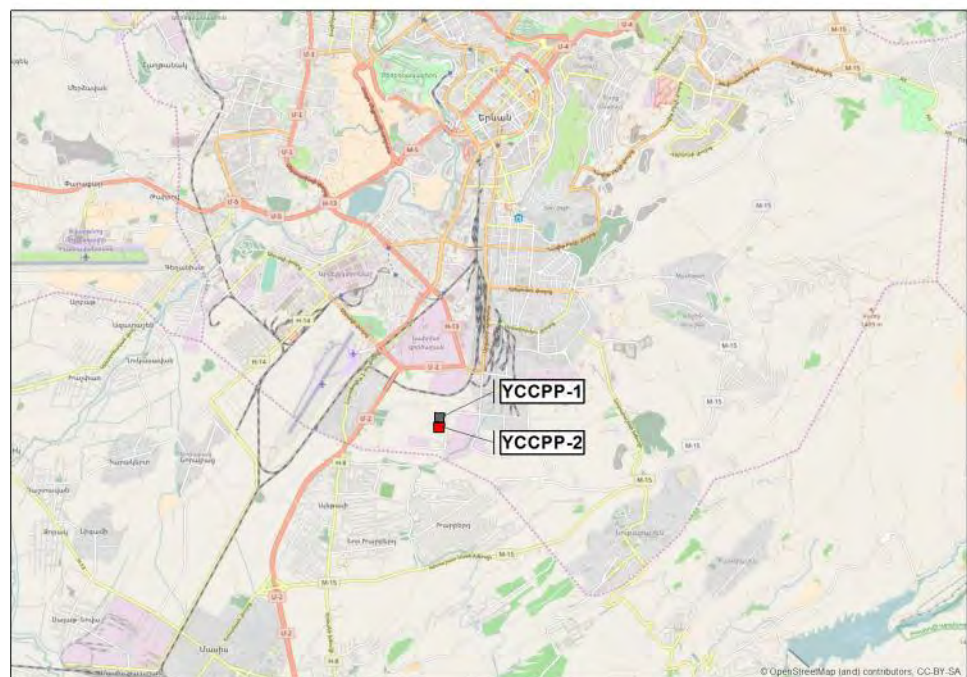


Figure 3-4: Location of existing YCCPP-1 and future YCCPP-2 in the south of Yerevan

The Project Area is situated approx. 2 km southeast of Erebuni Airport, bordering Erebuni district and has many large industrial plants and factories in its vicinity. Despite their industrial character, Shengavit and Erebuni Districts are home to a high number of residents of Yerevan.

The following residential complexes are found in a distance between 1,200 m and 1,500 m from YCCPP-2 site:

- the nearest residential area of Shengavit District (Noragavit village) is located approx. 1,350 m to the west
- Ayntap, a major village in the Ararat Province is located approx. 1,500 m to the south west
- Kharberd, another major village in the Ararat Province is located approx. 1,200 m to the south

- the nearest residential area of Erebuni District is located approx. 1,200 m to the north east.

Some temporary houses exist close to (but outside) the site. Further details are provided in Section 5.2.2.



Figure 3-5: Project Area (in red) located south of Yerevan, nearest residential areas and illegal housings

The **Project Area of Influence** thus comprises the uninhabited YCCPP-2 site and the residential areas (temporary and permanent) located up to 10 kilometers away from the site, as those might be impacted e.g. by air emissions during operation of the new power plant.

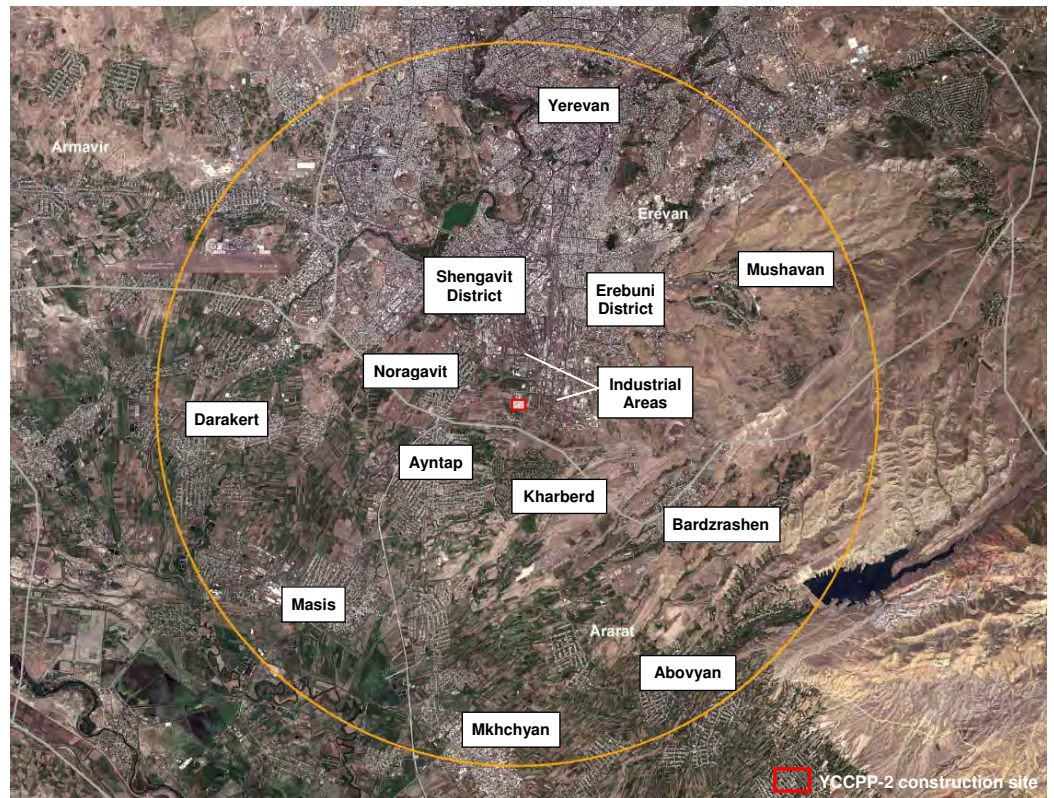


Figure 3-6: Project Area of Influence with residential areas in a distance of 10 km from the YCCPP-2 that might be impacted by the Project

3.3 Schedule for Project Realization

For the construction of the YCCPP-2, approx. 30 months are estimated (see Figure 3-7 below). Thus, it is expected that construction works for the new power plant will start in April 2018 and it will be commissioned at the end of 2019.

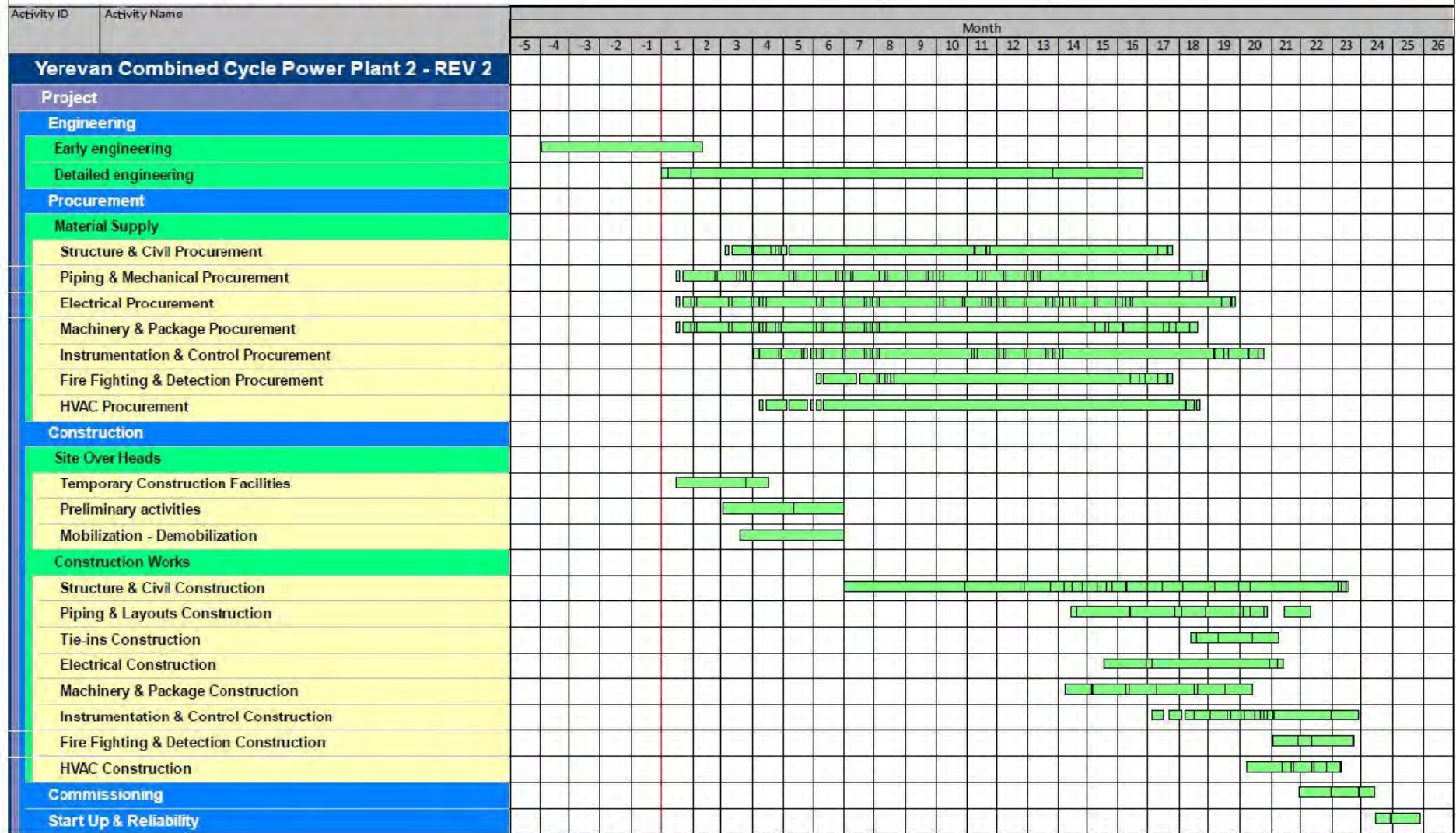


Figure 3-7: Preliminary Project Schedule

4. Analysis of Alternatives

4.1 The ‘No Project’ Scenario

The ‘No Project’ Scenario describes the situation without implementation of the Project. In this alternative, all environmental and social impacts of the Project would be avoided but it would potentially have negative implications on the regional power supply, as well as on potential business opportunities. In this case main objectives of the Project would not be achieved, like e.g. improving the total output capacity of electric energy production; providing reliable power supply; and promoting commercial development of thermal technology and cost reduction in order to enable Armenia to become a major net exporter of electricity.

4.2 Comparison of Alternatives and Options

4.2.1 Location

The site for YCCPP-2 is located in an industrial area south of Yerevan city which is foreseen for further industrial development. In the neighborhood an old thermal power plant that is no longer working and will be dismantled in the near future can be found, and other industrial plants are located in the vicinity. Directly north of the foreseen site, the YCCPP-1 is located that was constructed in 2010. In the foreseen area no protected or ecologically sensitive zones are found which could be the case at a potential greenfield construction site. The land was previously owned by the government and by Yerevan Thermal Power Plant CJSC since the 1960s, so that no additional land acquisition from private land owners will be necessary. Furthermore, the foreseen site location allows utilizing the pipeline and channel for discharge of treated waste water to Hrazdan River, which is already used by YCCPP-1, as well as using adjacent substation for power evacuation and main access road to the site, which is an advantage compared to a greenfield site.

Possible alternative locations for the proposed new YCCPP-2 were considered prior to opting for the foreseen site. On account to minimize environmental impacts and additional costs for newly developing such a site and modifying the transmission network to accommodate the new power plant, the foreseen site was selected together with MOE as the final option.

4.2.2 Alternative Methods of Power Generation

There are basically three different types of energy production:

- Renewable energy: common resources used are water (hydropower), wind, solar and geothermal power;
- Nuclear energy;
- Thermal energy.

Renewable energy

Special regard is taken on the renewable energy sources, because they are considered as the basis for a sustainable future power system development. Nonetheless, they face several constraints:

In order to produce the same amount of electricity as the YCCPP-2 using hydropower, a large dam would need to be build. The environmental and social impacts of large dams may be difficult to mitigate and manage. Alternatively, a cascade of medium sized dams would need to be build, or the energy production of several independent hydropower plants would need to be combined. This would spread the environmental impacts through several locations, making them more difficult to handle and control. In addition, according to SREP (2014), the identified potential for HPP investment in Armenia is of only up to 90 MW. This is not sufficient to compete with the energy output of the YCCPP-2.

In the dry climate of Armenia, solar energy is quite favorable. The potential for development of the photovoltaic industry in Armenia has been studied in the framework of the project “Assistance for Development of Actual Solar PV Energy in Armenia”. Based on this, a Renewable Energy Investment Plan for Armenia was approved, in accordance to which resources are being allocated to develop up to 110 MW utility-scale photovoltaic plants.⁶ However, some constrains are imposed: high land consumption, the need for great investments and, based on SREP (2014), the limited capacity for equipment acquisition and installation, together with a lack of experience with the technology in Armenia. Given the above, solar energy is not considered at this stage to be an alternative to thermal generation in Armenia, but instead a complementary energy source which is being planned under parallel programs, and which faces different challenges to be overcome in the right instances.

Wind is an unsteady energy resource. Both its varying direction and intensity do not allow guarantying that energy is always produced, which would be a disadvantage in comparison to thermal production, especially at a time when the pressing need to replace the nuclear power generation emerged in Armenia. Besides, the Ministry of Energy and Natural Resources plans to develop up to 500 MW of its wind energy potential by the year 2025. 500 MW is the amount that can be economically feasible for commercial utility scale presently (US AID, 2010). This implies that further investments in this technology are presently not feasible.

In the field of geothermal energy, big advances were made to spread the usage of these technologies as a source of power. They are generally considered as reliable, cost effective and sustainable. Nonetheless, there are still serious and long-term researches required for the arrangement of geothermal energy production, making it a disadvantageous source for the

⁶ <http://www.minenergy.am/en/page/416>

case at hand, where a pressing energy demand requires a solution which is readily and easily implementable.

Nuclear energy

Nuclear power is electric power generated in a nuclear reactor. Nuclear power stations generally work in a similar way as conventional fossil fuel-burning stations. The main difference is the fuel. Nuclear fuel is typically uranium-based rods, instead of coal or gas. Nuclear Power plants do not create smoke or carbon dioxide and are more reliable compared to above mentioned renewables. Although power generation does not produce much waste, the residual radiation of the waste is very dangerous and requires sophisticated handling for years and centuries to come. Nuclear reactors are discussed controversial, with many people categorizing them as inherently unsafe. Despite laying in a seismically active zone, Armenia has one operating nuclear reactor (Metsamor) and there are plans to build another. There are many controversies and concerns about its security. Given the environmental, health and safety risks derived from an eventual failure of the power plant, as well as the difficulties in the management of the waste, this is considered a disadvantageous alternative.

Thermal energy

Thermal energy uses organic fossils for energy production, therefore releasing formerly stored greenhouse gases which contribute to climate change. This makes it generally unfavorable from an environmental point of view. It has to be considered that power stations working on the basis of natural gas have far less impact on the environment than stations working on the basis of other fuel types. Modern gas turbines allow to significantly increase the efficiency and to reduce the generation of combustion outcome.

Conclusion

Given these considerations the option of gas and steam combined cycle power plant was chosen. The new YCCPP-2 is part of the strategic plan for energy production of the Government of Armenia⁷ in order to improve the total output capacity of its electric energy production with a most modern and efficient power plant. The Government of RA considers this project to be of utmost significance with highest priority for execution (fast-track project), due to the fact that the energy sector development has a critical impact on the economic development of the entire country.

4.2.3 Design alternatives

The initial design of the new YCCPP-2 had foreseen a stack height of 35 meters. The results of the air dispersion calculation (Annex 12.8 to this report) show, however, that a stack height of 66 meters is more adequate because this corresponds to the Good Engineering Practice (GEP) stack height. Installation of a low NOx burner and a drift eliminator at the cooling towers will reduce the emissions of YCCPP-2. The new power plant will

⁷ <http://minenergy.am/en/page/493>

furthermore include an onsite waste water treatment plant at state of the art technology to reduce the liquid emissions from the power plant. Finally, as a result of the ESIA, a decision has been made to build a specific area for storage of hazardous wastes at the construction and future YCCPP-2 site. This option has been considered because presently there is not a solution for disposal of hazardous waste in Armenia, and the disposal of this type of waste in a mixed/general landfill shall not be undertaken.

4.3 Summary of the Comparative Assessment of Alternatives

The tables below provide an overview of the comparative assessment of alternatives regarding options for power generation, location options and design options. The potential E&S impacts are comparatively assessed as being “high”, “medium”, or “low”. Considering this assessment, the construction and operation of a gas-fired Combined Cycle Power Plant in an existing industrial site with a GEP stack height, considerations for mitigation of air and water emissions, and proper management of waste will have the least environmental and social impacts.

Power Generation Options - comparative assessment				
Alternatives E&S impacts	Renewable energies (wind, solar, hydro-power, geothermal)	Nuclear energy	Coal fired PP	CC Gas fired PP (the Project)
Resettlement	High - larger area needed for the installations or reservoir	Medium - limited area needed for the installations, but a population exclusion area may apply *	Low - limited area needed for the installations	Low - limited area needed for the installations
Economic displacement	High - larger area needed for the installations or reservoir	Medium - limited area needed for the installations, but a population exclusion area may apply *	Low - limited area needed for the installations	Low - limited area needed for the installations
Community H&S	Medium - risk of HPP reservoir break if not well maintained; risk due to unannounced / sudden water releases; ice throw in wind farms; increase in seismic risk for HPP and geothermal	High - although considered a safe technology, an accident may have serious impacts on CHS; no air and noise emissions, but hazardous waste generation	Medium - air and noise emissions; larger quantities of waste are generated than in other thermal alternatives	Low - air, noise emissions and waste generation are lower than in other thermal alternatives

Power Generation Options - comparative assessment				
Alternatives E&S impacts	Renewable energies (wind, solar, hydro-power, geothermal)	Nuclear energy	Coal fired PP	CC Gas fired PP (the Project)
Degradation of terrestrial habitat	High - larger area needed for the installations or reservoir	Low - limited area needed for the installations	Low - limited area needed for the installations	Low - limited area needed for the installations
Degradation of aquatic habitat	Medium - in the case of large HPP, negative impacts on water quality and quantity may be observed	High - hazardous emissions to water may be present	Medium - several liquid effluent streams are present	Low - limited liquid effluent streams are present
Air and GHG emissions	Low - no air emissions directly associated	Low - no air emissions directly associated	High - higher stack GHG emissions than natural gas; emissions of particulates and SO ₂ are critic	Medium - lower air and stack GHG emissions than in other thermal alternatives
Generation of solid waste	Low - Very low amounts of solid waste are generated	High - Hazardous waste generation with difficult management is unavoidable	Medium - Larger quantities of waste are generated than in other thermal alternatives	Low - Very low amounts of solid waste are generated
Dependency on imported fuel	Low - No imported fuel is necessary	High - The fuel for the existing nuclear plant is supplied externally +	High - Armenia has no proven reserves of coal ++	High - Armenia has no proven reserves of natural gas **
Cost of generation §	High - up to 18 Euro ct/kWh	Low - up to 8,4 Euro ct/kWh	Medium - up to 11,6 Euro ct/kWh	High - up to 16,8 Euro ct/kWh
SUMMARY	High - 4 Medium - 2 Low - 3	High - 4 Medium - 2 Low - 3	High - 2 Medium - 4 Low - 3	High - 2 Medium - 1 Low - 6

* For example, according to USNRC regulations 10CFR Part 100.21

** <https://www.cia.gov/library/publications/the-world-factbook/geos/am.html>

+ <http://www.world-nuclear.org/information-library/country-profiles/countries-a-f/armenia.aspx>

++ <https://www.worldenergy.org/data/resources/country/armenia/coal/>

§ Based on European real case studies by VGB, 2015
(<https://www.vgb.org/en/lcoe2015.html?dfid=74042>)

The comparison table for power generation options above shows that the option for a gas fired power plant implies the highest number of “low” E&S impacts. The options for renewable energies and nuclear power show the

highest number of “high” E&S impacts, for which factors such as area needed, cost of generation and community H&S play an important role.

Regarding location options, the comparative summary table below shows that opting for the Yerevan industrial site instead of a greenfield or undeveloped site implies a larger number of “low” E&S impacts and “low” investment costs, due to the characteristics of the industrial site chosen.

Location Options - comparative assessment		
Alternatives E&S impacts	Greenfield / undeveloped site	Industrial / Brownfield site (the Project)
Resettlement	Low - greenfield sites are not, per definition, inhabited sites	Low - the site is not inhabited
Economic displacement	Potentially high - greenfield sites may be agricultural fields or pastures in private possession	Low - the site is not owned or used by any private persons
Degradation of terrestrial habitat	Potentially high - greenfield sites are undeveloped sites whose ecological value may be high	Low - the site has a low ecological value
Investment costs	High - need to develop infrastructure for supply and export of fuel, water, effluents, and electricity	Low - infrastructure for supply and export of fuel, water, effluents, and electricity is available
<i>SUMMARY</i>	High - 3 Medium - 0 Low - 1	High - 0 Medium - 0 Low - 4

When comparing design options for the stack in the below table (with the support of the results of the Air Dispersion Calculation - see Annex 12.8), it can be concluded that the highest number of “low” E&S impacts is achieved when building a stack with a GEP height. This option is still preferable even when considering the comparatively “high” construction costs.

Design Options (1) - comparative assessment			
Alternatives E&S impacts	Stack height - 35 meters	Stack height - 42 meters	Stack height - 66 meters (the Project)
Community H&S	High - highest ground level concentrations of NO ₂ ; no compliance with IFC's recommendation for future sustainable development	Medium - lower ground level concentrations of NO ₂ ; no compliance with IFC's recommendation for future sustainable development	Low - lowest ground level concentrations of NO ₂ ; compliance with IFC's recommendation for future sustainable development
Air quality impacts			
Investment costs	Low - lowest construction costs	Medium - lower construction costs	High - highest construction costs
<i>SUMMARY</i>	High - 2 Medium - 0 Low - 1	High - 0 Medium - 3 Low - 0	High - 1 Medium - 0 Low - 2

The YCCPP-2 project foresees the installation of equipment to mitigate air and water emissions (low NO_x burners, drift eliminators and a WWTP). Without this equipment, the investment costs would be comparatively “low”, but the E&S impacts would be “high” (see table below).

Design Options (2) - comparative assessment		
Alternatives E&S impacts	No air or water emissions mitigation equipment	Installation of low NO _x burners, drift eliminators and an own WWTP (the Project)
Community H&S	High - without low NO _x burners or a waste water treatment plant, the air and water emissions would potentially contribute to a contamination of surface waters and the airshed above the legal limits/international standards.	Low - the installation of emissions reduction equipment allows the project to fulfill the legal limits/international standards.
Environmental impacts (water, air)		
Investment costs	Low - less investment costs would be needed	High - investment costs associated with designing, installing, operating and maintaining the equipment are applicable
<i>SUMMARY</i>	High - 2 Medium - 0 Low - 1	High - 1 Medium - 0 Low - 2

Another design option foreseen as a result of the ESIA is the inclusion of a temporary storage area for hazardous waste (table below). This option has revealed to be advantageous from an environmental point of view (2 “low” impacts, and no “high” impacts) because presently there is not a solution for hazardous waste disposal in Armenia (further details can be consulted in Section 6 of this report).

Design Options (3) - comparative assessment		
Alternati- ves E&S impacts	No site storage of hazardous wastes; sending these to a mixed landfill	On-site storage of hazardous wastes (the Project)
Community H&S	High - hazardous wastes require special landfills or landfill cells, which are not readily available in Armenia.	Low - a temporary storage with specific characteristics is foreseen, while a solution for the hazardous wastes at national level is procured
Environmental impacts (water, groundwater, soil)	Therefore, potential contamination of groundwater, soil and surface waters cannot be excluded.	
Investment costs	Low - no need for special storage locations, waste would be disposed off together with other (mixed) waste	Medium - a small storage space following specific recommendations is foreseen
<i>SUMMARY</i>	High - 2 Medium- 0 Low - 1	High - 0 Medium- 1 Low - 2

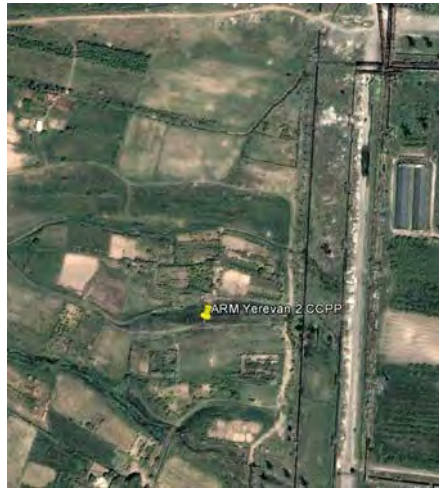
5. Description of the Environment (Baseline Data)

The following chapter provides baseline data for the Project Area of Influence focusing on the subjects of protection: fauna and flora, soil, water, climate, air quality, noise, landscape, historical and cultural sites and socio-economic conditions. The documents already prepared for the Project (see Section 1.4) have been used, among others, as a basis for writing this Section.

5.1 Environmental Conditions

The foreseen construction area of YCCPP-2 is bordering the already existing YCCPP-1 in the south. The construction site is part of the Yerevan industrial area and has been used for agricultural and pasture purposes in the past. Since 2008 the vegetation at the area was cleared and the site was visibly earth worked (see historical pictures in Figure 5-1). No industrial activities have been performed on the site in the past, but it has been used as temporary laydown area for construction of the adjacent YCCPP-1 since 2009. Some parts of the area are now covered with gravel, some concreted areas can also be found at the site, and an old pipeline crosses the area in the eastern part. Some old material like scrap metal, old metal cabins, old toilets and wash basins are found on the site.

An area belonging to the property of YCCPP-1 will be used as temporary laydown area for the construction of YCCPP-2 (see Figure 1-1 in Section 1). There is an agreement in place between ArmPower/RENCO and YCCPP-1 for using the temporary laydown area. Material that is stored at the moment in this area will be moved to another site inside the property of YCCPP-1.



2006



2008



2009



2012



2014



2017

Figure 5-1: Ecology and former land use of the construction site (Source: courtesy of ADB)

5.1.1 Flora, Fauna and Biodiversity

The Republic of Armenia is a mountainous country characterized by a rich diversity of plants and animals, as well as landscapes and vegetation types. More than 3,800 species of vascular plants and more than 17,700 animal species including 549 species of vertebrates are found on the territory of Armenia. The biodiversity of Armenia is notable for its high endemism: about 500 species of fauna and 144 species of flora are considered endemics (MNP 2014).

The construction site itself and the surrounding land are poorly vegetated with much of the area having been disturbed by industrial developments in the past. Only sparse vegetation composed of grass, herbs and some reed and bushes can be found at the construction site (see pictures below). The ecological value of the Project Area is assessed to be low, also considering that the area has been obviously cleared of vegetation and earth worked in the past. No vegetation is found at the foreseen laydown area for construction of YCCPP-2. The water quality of the Hrazdan River is categorized as bad (5th class of the surface water quality assessment system of RA⁸) in the area south of Yerevan. This bad water quality could be empirically confirmed during a site visit in February 2018 by visual impression and a bad smell of the river water. Samplings undertaken in November 2017 confirm the classification of the river water as “bad” (see Section 5.1.5 below). The ecological value of the river is assessed to be low. In the area where the treated waste water will be finally discharged to the river via a network of man-made channels, the river is bordered by a narrow reed area along its bank and also shows areas with poor vegetation disturbed by human activities (see photos below). This vegetation will not be negatively affected by the final discharge of the treated waste water via the network of channels.

⁸ Source: RA Decision N75-N (2014) on the definition of the norms of ensuring water quality of management zone of each water basin based on peculiarities of the area



Figure 5-2: Typical vegetation at the construction site with some reed and bushes (Source: Fichtner, July 2017)



Figure 5-3: Hrazdan River in the area of treated waste water final discharge (Source: courtesy of ADB, February 2018)

5.1.2 Protected Areas

Biodiversity conservation in Armenia is implemented mainly in the specially protected natural areas, where 60-70% of the species composition of the flora and fauna is concentrated including the overwhelming majority of rare, critically endangered, threatened and endemic species.

According to MNP (2014) at present approx. 13% of the total territory of Armenia are covered by protected areas. These comprise 3 state reserves, (Khosrov, Shikahogh and Erebuni), 4 national parks (Sevan, Dilijan, Arpi Lake and Arevik), 232 natural monuments, and 27 state sanctuaries.

However, no Protected Areas are located within or in the vicinity of the Project Area of Influence. Also no other sensitive areas like Important Bird

and Biodiversity Areas (IBA) or Ramsar Sites are located near the Project Area of Influence.

5.1.3 Geology and Seismic Situation

5.1.3.1 General Geological Conditions of the Area

Yerevan is part of the quaternary geologic unit. According to MNP (2002), Armenia is a part of the Transcaucasus great arched fold and medium-Araxian intermountain lowering. These two geological structural units are included in the Caucasus-Anatolia-Iranian segment of the Mediterranean plicate zone. Given the time of establishment of geological structural units and accomplishment age of plicate formation the territory of Armenia is divided into the Somkhети-Ghapan complex, Bazum-Zangezur and trans-Araksian zones.

The trans-Araksian weak plicate zone is divided into the Yerevan-Ordubad and orogenic lowering sub-zones. The Project area of Influence is part of the Yerevan-Ordubad sub-zone which is located in the south of the Bazum-Zangezur zone and is characterized by meogeocyncline type. Land, carbonate, ophiolite, volcanic and sedimentary formation stratum, as well as volcanic origin and land formations of Quaternary period are found here. The sub-zone is composed of two structural units: the Yerevan-Ordubad concave fold and Urts-Vayots Dzor arched fold.

5.1.3.2 Tectonics and Seismicity

Armenia is located in a seismically active zone stretching from Turkey to the Arabian Sea. Here, the Arabian landmass slowly collides with the Eurasian plate. As large earthquakes with magnitudes over 5.5 occur in Armenia every 30 to 40 years reaching magnitudes up to 7.1 on the Richter scale, a high-level seismic hazard is indicated for the country. The Garni earthquake in 1679 was the most destructive one, with a magnitude oscillating between 5.5 and 7. Another destructive earthquake with a magnitude of 6.9 occurred in Spitak in 1988⁹. In 2011 an earthquake with a magnitude of 3.2 occurred 37 km north of Gyumri¹⁰.

Maximum seismic risk is given around the city of Yerevan, where the Project Area is located, and in a zone from Gyumri to Vanadzor and the northern part of Lake Sevan, where active faults exist. Seismic stability of 9 magnitudes by Richter scale and more is to be followed because the country is classified as the third seismic zone under

⁹<http://info.worldbank.org/etools/docs/library/114715/istanbul03/docs/istanbul03/09melku/myan3-n%5B1%5D.pdf>

¹⁰ <http://www.emsc-csem.org/Earthquake/earthquake.php?id=210376>

MSK 64 standards with an acceleration value of 0.4G m/s and a speed of 32 cm/s.¹¹

Earthquake risk has been considered in the design of the new power plant YCCPP-2.

5.1.3.3 Field Investigations at the Construction Site

In order to ensure the proper setting of YCCPP-2, a geotechnical investigation program has been performed¹². The program comprised execution of core drillings, engineering-geological reconnaissance surveys and collection and review of existing geological data. The scope of investigations was set to determine the natural, geo-mechanical and geo-hydraulic characteristics of the underground, as well as groundwater levels and the location of rock surfaces, if any.

Another geological study¹³ has been performed in 2017 by “Armhydroenergyproject” CJSC in the construction site area including topographic mapping, geophysical and engineering geological works, experimental borehole drilling, piezometer installation in some boreholes to measure the ground water level fluctuation, periodic measurement of water level and sample taking.

The following main outcomes resulted from the geological studies:

- The territory’s geological-lithological structure is mainly formed by clayey soils, in some places covered by fill up soils.
- In the study site the 2nd and the 3rd layers can serve as foundation bottom.
- In the study area underground waters have been detected in all the boreholes with 0.5-7.0 m depth and have seasonal fluctuation from 0.5 to 1.0 m. According to the laboratory data, the detected underground waters have strong sulphate aggressiveness against ordinary concrete.
- There are no hazardous physical-geological phenomena and processes (landslides, rock slides, rockfall, erosion, suffosion, etc.) in the study area.
- According to RA Construction Standards II-6.02-06 the guideline largely passes by the third (III) seismic zone (9 points and more). The class of the soils of the areas according to their seismic characteristics belongs to the II (second) and III (third) classes.
- The maximum depth of frost in soil is 60 cm.
- The study area is suitable for capital construction.

¹¹ RENCO SPA: Armenia 250 MW CCGT Yerevan Capital City. Draft Feasibility Study [CCGT 250 MW – Yerevan /Armenia]

¹² Geoterproject LTD (2016): Report on engineering-geological survey of Yerevan TPP new energy block area

¹³ Armpower CJSC (2017): Geological Report of Armhydroenergyproject CJSC

5.1.4 Soil

In the area where the Project will be situated, semi-desert alkali soils are common. The warm, mild and variable humid climate, the long period of active soil formation, presence of sufficient drainage system and seasonal change in ground streams direction promote deep and intensive weathering of primary minerals, formation of secondary mineral substances and rather thick clay soils. The geological structure of the area and the study site is represented by radical clays, generally covered by contemporary alluvial, diluvial-proluvial, and technogenic generations, formed of clayey and sandy soils.

The geological studies which were performed at the construction site found mainly clayey soils which are in some places covered by fill up soils.

The construction site has obviously been earth worked in the past. According to the information gathered during the site visits in July 2017 and February 2018 by Fichtner's environmental specialists, the site has never been covered by buildings and has never been used for industrial purposes. The site was used as temporary laydown area for construction of adjacent YCCPP-1. The area might have also been used for illegal disposal of different waste materials in the past, however during the site visits no asbestos-containing material or other hazardous waste was found, except for some empty oil drums at two different spots. Near to these drums the topsoil was found to be contaminated superficially by an oil leakage (see Figure 5-4). During the site visit in July 2017, Fichtner's environmental specialist took samples of the contaminated soil at each of the two spots. The samples were analyzed by a certified laboratory in Germany for contents of PCBs. All PCB concentrations were below the detection limit of 0.2 ppm (see Section 12.4 in the Annexes for test results). The site visit in February 2018 showed that the empty oil drums had been removed meanwhile to the property of YCCPP-1.



Figure 5-4: Oil leakages near to some empty oil drums at YCCPP-2 site (Source: Fichtner, July 2017)

Due to the superficial oil contamination at these two areas and the potential former illegal storage of waste at the construction site, as well as the existence of some fill soil in the area, in August 2017 a monitoring study was performed on behalf of RENCO regarding groundwater quality and possible historic soil contamination at the construction site (Consecoard

LLC, 2017). Sampling was conducted according to the methodology of the “Environmental Monitoring and Information Center” SNCO of the Ministry of Nature Protection and the samples were analyzed for metal contents at the laboratory of the named institution. The measured concentrations of Chromium, Manganese, Cobalt, Nickel, Copper, Zinc, Lead and Arsenic exceed the limit values of the national Sanitary Norms and Rules N 2.1.7.003-10. For details and further analysis results see Section 12.5 in the Annexes.

Additional soil sampling was undertaken in November 2017 by the Armenian company GeoterProject Ltd. for the analysis of concentration of heavy metals and possible organic pollutants in the soil. Field work had been primarily planned by the German company U/C-tec GmbH. In total 45 bore holes with a diameter of 110 mm were distributed over the area. They were drilled to 2 meters (20 x) or to 4 meters (25 x) depth. The sampling depth was 1.7 to 1.9 m, and 3.7 to 3.9 m respectively. The chemical analyses were performed by the laboratory of the Environmental Monitoring and Information Center in Yerevan. Analytical results were compared to Armenian, German and Dutch threshold values (as no common European standards exist) by U/C-tec GmbH.

Analysis results of the soil samples taken in November 2017 regarding content of metals confirm the findings of August 2017 with Chromium, Manganese, Cobalt, Nickel, Copper, Zinc, Lead and Arsenic exceeding the national Armenian MACs. However, it has to be stated that **Armenian national MACs are very strict compared to internationally used threshold values** for industrial areas (e.g. German and Dutch MACs). All analysis results of the soil samples are far below the existing respective German and Dutch standard thresholds (see examples for Chromium and Arsenic below). It has also to be clarified, that during construction and operation of the new YCCPP-2 no pollutants will be added to soil, if the mitigation measures are implemented. RENCO has no liability for soil remediation in their land purchase agreement.

These very strict MACs can be directly used for the construction of schools, playgrounds, etc. If other usage of the area is foreseen (e.g. industrial use) a calculation has to be done according to Armenian Decision N 1277-N¹⁴ in order to classify the soil as clean, permissible, moderately dangerous, dangerous or extremely dangerous (see Section 2.4). According to this calculation, **the soil is classified as “permissible”. This kind of soil may be used for construction of non-high vulnerability objects¹⁵** without further mitigation measures. This is the case for the YCCPP-2. Details about the Armenian legal framework for standardization of soil pollution (Consecoard LLC 2018a) can be found in Section 12.10 in the Annexes.

¹⁴ Decision N 1277-N “On establishment of technical regulations for general requirements for protection of lands from pollution, list of substances polluting the lands, and assessment of level of land pollution”

¹⁵ High vulnerability objects are: school buildings, residential construction areas, sport’s and children’s playgrounds, health and resort areas, water objects, water mains

Concentrations of Polycyclic Aromatic Hydrocarbons (PAH), BTEX (Benzene, Toluene, Ethylene, Xylene) and Total Petroleum Hydrocarbons (TPH) have also been analyzed. No Benzene and Ethylbenzene could be detected in any of the analyzed soil samples; concentrations of Toluene and Xylene are below the respective Armenian and German MACs. No PAH were detected in the soil samples. The concentrations of TPH were analyzed, but no national or international MAC exist.

The reports from GeoterProject Ltd. and U/C-tec GmbH including the detailed analyses results are presented in Section 12.11 in the Annexes.

In summary, soil has been found **to be not contaminated according to international threshold values** (German, Dutch). In addition, according to the Armenian legislation, even though several MACs of heavy metals are exceeded, **the land may be used for implementing structures such as industrial plants** without further mitigation/remediation measures for the existing soil.

5.1.5 Water Resources

5.1.5.1 Surface Water

The Republic of Armenia is covered with a dense net of rivers. Armenian rivers belong to the Caspian Sea basin. Basins of the tributaries of Kur River occupy an area of 700 km² (Debed, Pambak, Aghstev, Tavush Rivers, etc.), and basins of the tributaries of Arax River an area of 22,790 km² (Akhuryan, Kasakh, Metsamor, Hrazdan, Azat, Vedi, Arpa, Vorotan Rivers, etc.). Armenia's rivers have mixed feeding - melting, groundwater, and rain. Their flow changes considerably within a year. During summer-time and fall, when water demand is approaching its maximum, the annual water share amounts to 20-25 %, in winter-time to 10-12 % of the total flow, whereas in spring-time is 55-70 %.

The Republic of Armenia is not rich in lakes. Sevan is the biggest lake in the Caucasus and Armenia. Its surface amounts to 1,240 km². The lake is located at an altitude of 1,897 m a.s.l. The rest of the lakes in the country (Kari, Akna, and Sev, etc.) are small and mostly located in the highland zones. Lake Arpi and Lake Parz (in Dilijan National Park) are located at a medium altitude highland zone. Lake Ayghr is a lowland lake fed by underground waters.

The Hrazdan River is the primary waterway in Armenia and the country's second largest river. While the Hrazdan River receives effluent from various agricultural, commercial, industrial, and residential sources, it is most significantly impacted by the discharge of Yerevan's almost entirely untreated wastewater. The effects of this poorly treated wastewater are

evident through a variety of water quality indicators, most notably through drastic drops in dissolved oxygen levels downstream of the city¹⁶. Water quality of the Hrazdan River is categorized as bad (5th class of the surface water quality assessment system of RA¹⁷) in the area south of Yerevan¹⁸. Comparative data for assessing the water quality are given in Table 2-12 in Section 2.4.

Regarding the Project Area, the nearest water body, Artashati Jrants Canal, is located 700 m southeast of the construction site. Thus, no risk of flooding of the area is foreseen. No water from this canal will be used for YCCPP-2 and no water will be discharged to it. It is planned that YCCPP-2 will only use the water from the city water grid and use the existing discharge structure (pipeline and open channels) downstream of YCCPP-1 for the discharge of the treated waste water (see Figure 3-3 in Section 3 for location of raw water tie-in, treated waste water and sewage water tie-in points). The YCCPP-1 discharges the treated wastewater into a 1 km pipeline and later to an existing man-made network of open channels – Figure 5-5. Afterwards, the water is finally discharged into the Hrazdan River as its ultimate receiver. The ultimate receiving point is located ca. 7-9 km away from the site (aerial distance) (Figure 5-6 and Figure 5-7). The same discharge infrastructure will be used by the new YCCPP-2. The waste water from YCCPP-2 will fulfill the requirements from IFC/World Bank General EHS Guidelines defining less than 3°C increase of ambient water temperature (see Section 2.4). For further details of the study see Section 12.7 in the Annexes.



Figure 5-5: Channels part of the channel network discharging the treated waste water of YCCPP-1 finally to Hrazdan River (Source: courtesy of ADB, February 2018)

¹⁶ <http://ace.aua.am/monitoring-dissolved-oxygen-in-the-hrazdan-river/>

¹⁷ Source: RA Decision N75-N (2014) on the definition of the norms of ensuring water quality of management zone of each water basin based on peculiarities of the area

¹⁸ Ecobarik-Audit LLC (2016): Report of Evaluation of Environmental Impact of the new Steam and Gas Combined Cycle Power Plant in Yerevan



Figure 5-6: Hrazdan River in the area where the channels discharge the treated waste water of YCCPP-1 finally to the river (Source: courtesy of ADB, February 2018)



Figure 5-7: Final discharge for the treated waste water from YCCPP-1 (and for the future for YCCPP-2 as well)

Analysis of the water quality of Hrazdan River were undertaken in November 2017 by GeoterProject Ltd. Samples were taken from one of the main channels leading the treated waste water from YCCPP-1 to Hrazdan River, as well as upstream and downstream of this discharge point. Analyzes of water quality was performed by the laboratory of

Environmental Monitoring and Information Center in Yerevan. Analytical results were compared to the classes of the surface water quality assessment system of RA, as well to as European and German threshold values by U/C-tec GmbH and in this ESIA study.

The results of the analysis show that applicable European and German limit values are not exceeded (see Table 5-1). Bold results (Vanadium, Sodium, and Iron) justify the categorization of Hrazdan River as exceeding the national standards and as level 5 (“bad” water quality). The results show also that the **discharge of the treated waste water from the existing YCCPP-1 does not seem to affect the water quality of Hrazdan River negatively**, as the analyzed parameters upstream and downstream of the discharge point do not show any qualitative difference.

Table 5-1: Surface water quality analysis from November 2017 and comparative data

Parameter	Unit	Upstream channel	In the channel	Downstream channel	Armenian Water Quality Classes and Standards					European standard	German standard
					I	II *	III	IV	V	EU-WFD	OGewV
pH	-	7.45	7.76	7.47	6.5 – 9.0					<6.5 / >9	5.5 – 8.5
Minerals	mg/l	666	593	661							
BOD ₅	mgO ₂ /l	2.52	2.87	3.91	3	5	9	18	>18		<3
COD-Cr	mgO/l	42	26	30	10	25	40	80	>80		
Lithium	µg/l	26.6	25.28	27	1	36	50	<2500	>2500		
Sodium	mg/l	64.94	82.2	59.63	4.96	9.92	19.84	39.68	>39.68		
Magnesium	mg/l	27.5	21.96	27.46	2.8	50	100	200	>200		
Aluminium	µg/l	13.8	3.3	13.2	65	130	260	5000	>5000		
Potassium	mg/l	5.74	4.715	5.58	1.54	3.08	6.16	12.32	>12.32		
Calcium	mg/l	68.06	50.65	67.72	9.7	100	200	300	>300		
Titanium	µg/l	6.72	6.09	6.374	7	14	28	56	>56		
Vanadium	µg/l	14.96	17.7	13.205	1	2	4	8	>8		
Chrom	µg/l	4.34	3.73	4.477	1	10	100	250	>250		
Iron	µg/l	106.72	80.14	106.66	0.08	0.16	0.5	1	>1		
Manganese	µg/l	26.11	8.18	28.988	5	10	20	40	>40		
Cobalt	µg/l	0.34	0.55	0.304	0.14	0.28	0.56	1.12	>1.12		
Nickel	µg/l	3.31	4.04	3.085	1	11	50	100	>100	34	34
Copper	µg/l	1.83	1.53	1.679	3	23	50	100	>100		
Zinc	µg/l	2.5	0.6	2.253	3	100	200	500	>500		
Arsenic	µg/l	6.77	7.58	6.365	0.13	20	50	100	>100		
Selen	µg/l	2.1	1.1	2.069	0.47	20	40	80	>80		
Strontium	µg/l	387.97	254.36	391.98							
Molybdenum	µg/l	3.24	5.98	2.763	7	14	28	56	>56		
Cadmium	µg/l	0.021	0.03	0.019	0.02	1.02	2.02	4.02	>4.02	0.45-1.5	0.45
Tin	µg/l	0.0006	0.003	0.006	0.09	0.18	0.36	0.72	>0.72		
Stibium	µg/l	0.0912	0.12	0.11	0.19	0.38	0.76	1.52	>1.52		
Barium	µg/l	32.3	16.72	32.977	9	18	36	1000	>1000		
Lead	µg/l	0.21	0.092	0.692	0.3	10.3	25	50	>50	14	14
BETX	µg/l	<1	<1	<1	10	30	42	50	>50		50

Parameter	Unit	Upstream channel	In the channel	Downstream channel	Armenian Water Quality Classes and Standards					European standard	German standard
					I	II *	III	IV	V	EU-WFD	OGewV
TPH	µg/l	<1	<1	<1	0.05	0.1	0.3	0.5	>0.5		
PAH	µg/l	ND	ND	ND	--	--	--	--	--		0.27

* The Scale Value “II” is considered as the Armenian Surface Water Quality Standard; the other values are used as a reference for classifying the water into levels.

EU-WFD: EU Water Framework Directive

OGewV: Surface Water Regulation (Oberflächengewässerverordnung)

5.1.5.2 Groundwater

According to one of the geological studies¹⁹ the main water horizon at the construction site is connected with quaternary age sediments, which are spread on Miocene age hydrophobic clays. In quaternary water sediments the ground waters have widespread diffusion. These waters are non-pressure ground water flow, which is directed towards the incidence of the relief. The mentioned water horizon is fed by technical waters through precipitation, which penetrate into old CCPP area from Artashat channel underground drain and irrigation waters. The latter plays a great role connected with the intensity of irrigation associated with water level in the area. In the area of Yerevan CCPP during different years, ground water level fluctuate measuring data have shown that there is no pattern which proves that ground water level is related to irrigation, discharge of technical waters and drainage works.

Besides the described main horizon of the ground waters, also layer waters with weak pressure are met. Their level height from pit mouth is 0.3 m, which extends in Miocene age clays, in first layers and sub layers of sand. These layers have weak water tankage; in some places they supply to the water horizon and in some way affect its chemical composition. According to the archival materials the waters of the study area mainly have sulphate-sodium partly chlorine-sulphate-magnesium chemical composition. Ground waters existing in the area are considered to be strong saline, where the content of dissolved minerals according to archival materials fluctuates from 1,949 mg/l to 10,884.4 mg/l that is why they have a sulphate aggressive attitude to concrete marks.

According to another geological study²⁰, the groundwater level in the Project area is located at a depth of 0.5 to 7.0 m and shows a seasonal fluctuation of 0.5 to 1.0 m.

One monitoring study was performed in August 2017²¹ regarding groundwater quality and possible historic soil contamination at the construction site. Sampling was conducted according to the methodology of the “Environmental Monitoring and Information Center” SNCO of the Ministry of Nature Protection and the samples have been analyzed at the laboratory of the named institution. According to the RA Government Decree “On defining water quality norms for each water basin management area taking into consideration the peculiarities of the Locality,” (RA Government Decree N 75-N, dated on 27 January 2011), the surface water quality assessment system in Armenia distinguishes five classes or grades: "excellent" (1st grade), "good" (2nd grade), "mediocre" (3rd grade); "insufficient" (4th grade) and "bad" (5th grade). The government’s decision

¹⁹ Armpower CJSC (2017): Geological Report of Armhydroenergyproject CJSC

²⁰ Geoterproject LTD (2016): Report on engineering-geological survey of Yerevan TPP new energy block area

²¹ Consecord LLC (2017): Report on Monitoring Services

envisages maximum permissible concentrations (MPC) for all classes. In case of exceeding them, the flow to water resources is prohibited.

YCCPP-2 is located in Hrazdan River basin (water shade) management area. The water in the lower stream of the Hrazdan River is classified as "bad". The results of all groundwater sampling tests made in August 2017 were within the limits of the 5th grade of water quality; however, limit values for groundwater do not exist in Armenia. For details and analysis results see Section 12.5 in the Annexes.

Dutch Standards²² are internationally used reference values for environmental pollutants used mainly in environmental remediation, investigation and cleanup. Values are given as "target values" and "intervention values" for groundwater and soil. For shallow groundwater between 1 m and 10 m below ground, the concentrations of all analyzed heavy metals are below the intervention values except for Vanadium and Zinc, according to initial samples undertaken by Consecord (2017 - Annex 12.5).

Additional analyses of groundwater were undertaken in November 2017 by GeoterProject Ltd. to confirm or further extend the results from the analysis undertaken in August 2017. Field work was primarily planned by the German company U/C-tec GmbH. Three new groundwater wells were installed at the site with a depth of 10 meters. Groundwater table was measured between 1.9 to 2.7 m below surface. The chemical analyses were performed by the laboratory of Environmental Monitoring and Information Center in Yerevan. Analytical results were compared to German threshold values (Federal Soil Protection Act -BBodSchG and Groundwater Ordinance - GrwV) by U/C-tec GmbH and additionally to Dutch Standards in this ESIA report.

Analyses of the groundwater samples (November 2017) show that concentrations of several metals exceed the German and/or Dutch threshold values. This is the case for Vanadium (V), Arsenic (As), and Molybdenum (Mo) and slightly for Cadmium (Cd). Especially groundwater well No. 2 shows very high values (see Table 5-2). Concentrations of Polycyclic Aromatic Hydrocarbons (PAH), BTEX (Benzene, Toluene, Ethylene, Xylene) and Total Petroleum Hydrocarbons (TPH) have also been analyzed. No PAH were detected in the groundwater samples. Concentrations of BTEX and Benzol were below the respective threshold values. Concentrations of TPH exceed the German limit values at groundwater well No. 1 and especially at well No. 2.

Analyzed concentrations of some metals in the groundwater samples also exceed the limit value of the worst class 5 of the surface water quality assessment system in Armenia (RA Government Decree N 75-N, dated on 27 January 2011): concentrations of Sodium (Na) are 5 to 10-fold higher,

²² Soil Remediation Circular (2009). http://esdat.net/Environmental_Standards.aspx

Vanadium (V) 10 to 95-fold higher, Manganese (Mn) up to 10-fold higher, Cobalt (Co) up to 5-fold higher, Arsenic (As) 2-fold higher.

Thus, according to the new samples taken in November 2017, the **groundwater at the site exceeds international standards for some heavy metals and organic pollutants**. These high values of some heavy metals in the analyzed groundwater are most probably based on the industrial background of the wider area around the construction site. No abstraction, discharge or other use of contaminated groundwater is to occur.

The reports from GeoterProject Ltd. and U/C-tec GmbH including the detailed analyses results are presented in Section 12.11 in the Annexes.

Table 5-2: Groundwater quality comparative data (November 2017 data)

Substance	German Standards		Dutch Standard	Measured values [µg/l] - November 2017		
	BBodSchG [µg/l]	GrwV [µg/l]	Intervention value [µg/l]	Well 1	Well 2	Well 3
Arsenic (As)	10	10	60	22.94	215.5	16.57
Barium (Ba)			625	39.86	31.43	36.57
Cadmium (Cd)	5	0.5	6	0.25	0.59	0.16
Chromium (Cr)	50		30	4.41	12.37	9.98
Cobalt (Co)	50		100	1.1	5.4	2.33
Copper (Cu)	50		75	7	9.47	10.74
Nickel (Ni)	50		75	14.96	5.41	25.28
Lead (Pb)	25	10	75	0.08	0.18	0.09
Molybdenum (Mo)	50		300	72.97	219.4	58.45
Selenium (Se)	10		160	6.73	8.75	8.42
Tin (Sn)	40		50	0.04	0.1	0.05
Vanadium (V)			70	84.95	759.87	52.84
Zinc (Zn)	500		800	4.64	3.78	7.41
BETX	20			<1	0.56	<1
Benzol	1			<1	<1	<1
TPH	200			168	7,407	<1
PAH	0.2			n.d.	n.d.	n.d.

BBodSchG: Federal Soil Protection Act (Bundesbodenschutzgesetz)

GrwV: Groundwater Ordinance (Grundwasserverordnung)

The studies from August 2017 and November 2017 show some common results, but also some differences. In respect for international practices (prevention principle), the worst case scenario is considered in this ESIA, and mitigation measures are defined accordingly.

5.1.6 Climate and Air Quality

5.1.6.1 Climate

Because of Armenia's position in the deep interior of the northern part of the subtropical zone, enclosed by lofty ranges, its general climate is dry and continental. Nevertheless, regional climatic variation is considerable. The capital Yerevan is located at the lowest altitudes of the country (between 900 and 1200 m a.s.l.). Here, the prevailing climate is a mountainous continental climate. The location is classified as BSk by Köppen and Geiger. It is characterized by hot and arid summers (Figure 5-8) and rather cold winters; in a year there are on average a hundred days with minimum temperatures below freezing. The average temperature in Yerevan is 11.6°C. In summer (July and August) the average temperature exceeds 30°C. The coldest month is January at -4°C. Generally, there is little rainfall throughout the year; precipitation averages 319 mm. The driest months are June to October with an average below 25 mm of rain. The wettest months are February, April and May with an average of 40 mm of rain.

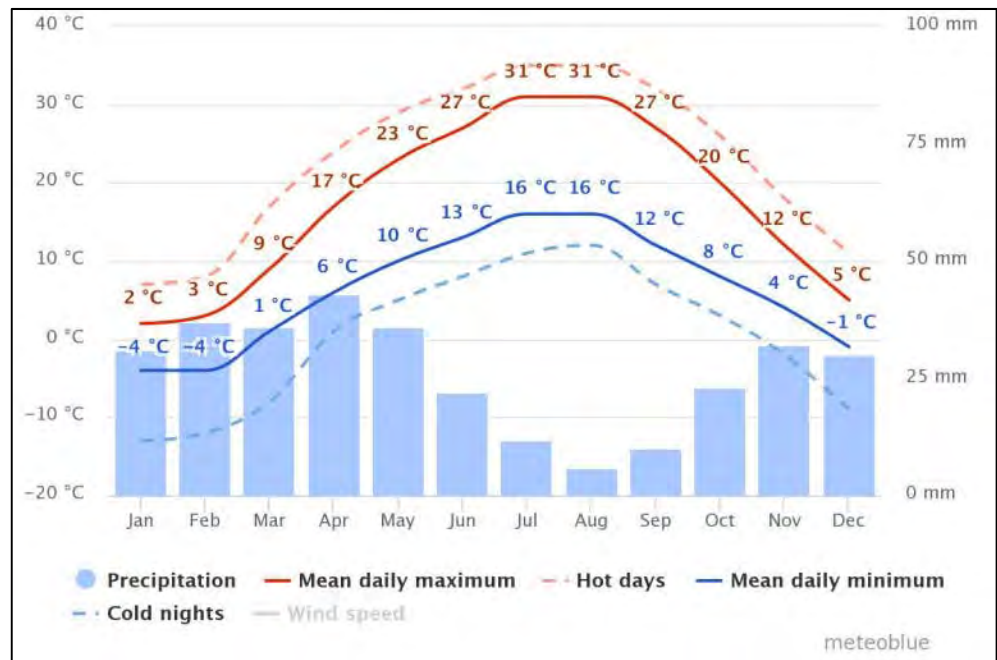


Figure 5-8: Average temperatures (min. and max.) and precipitation (mm) in Yerevan (30-year global history with hourly weather data).²³

On average, the most wind is seen in July. The strongest wind speed is observed in March and April (> 38 km/h). On average, the least wind is seen

²³ <https://www.weather-and-climate.com>

in September. The mean monthly wind speed over the year is 6.1 km/h (Figure 5-9).

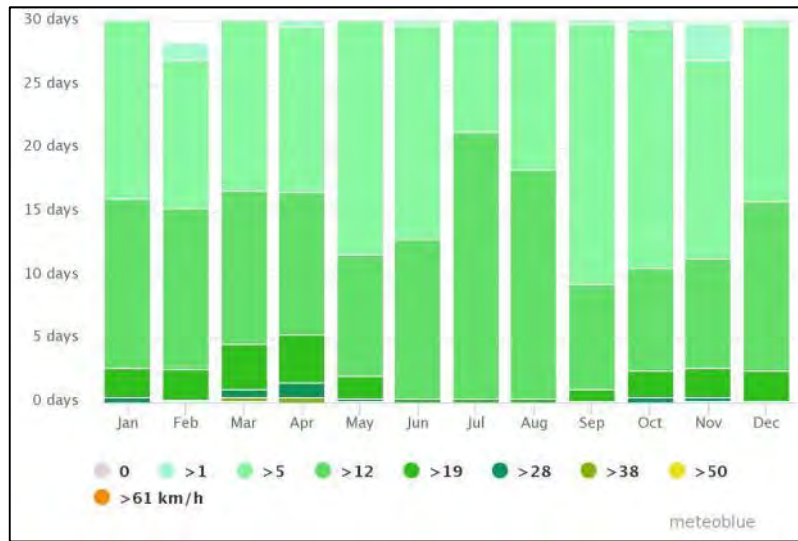


Figure 5-9: The diagram for Yerevan shows how many days within one month can be expected to reach certain wind speeds

Figure 5-10 presents the wind rose for the years 2014 to 2016. It shows that the prevailing winds blow from northeast (NE). The wind rose also indicates that the more frequent wind speeds are between 1.5 and 3 m/sec, which is equivalent, in the Beaufort scale, to the levels “light air” and “light breeze”. The wind data is relevant especially for the Air Dispersion Calculation (see Section 12.8 in the Annexes). Data was used from the meteorological station at Zvartnots Airport, which is the closest site to YCCPP-2.

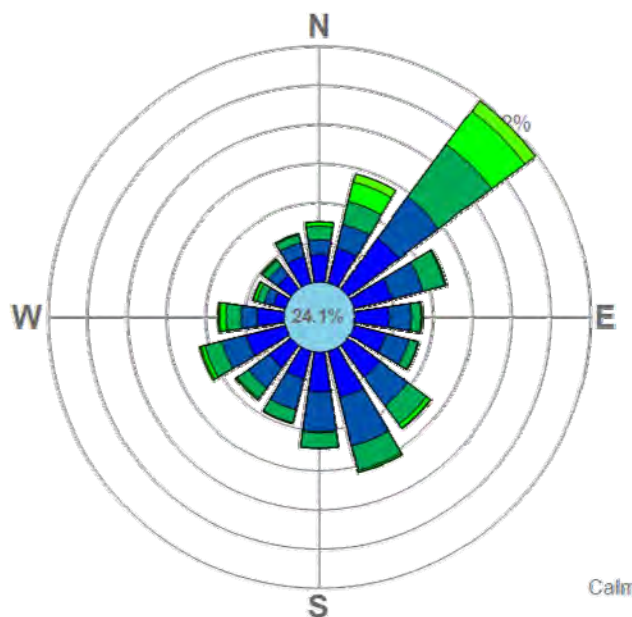


Figure 5-10: Wind rose for the years 2014-2016 (wind blowing from)

5.1.6.2 Air Quality

Air pollution has always been a sensitive issue in Armenia. According to a recent report of the WHO²⁴ these unfavorable conditions have hardly improved and Armenia is on the top ten list of deaths linked to air pollution in Europe, with 125 deaths per 100,000 inhabitants per annum. Although data from 2004 (when population depended mainly on solid fuel) was used, numbers are still very high. Particulate matter (PM₁₀) is the most important air pollutant in urban atmospheres of Armenia, which is created in a considerable degree from vehicle air emissions. Old diesel vehicles, an insufficiently developed public transport and problematic traffic management lead to high emissions from motor transport.

The City of Yerevan is surrounded by mountains on three sides which does not allow for natural dispersion of pollutants in the atmosphere, thereby resulting in high concentrations in the air. The main source of air pollutants are emissions arising from automobiles.

According to Ecobarik-Audit LLC (2016) the "Environmental Monitoring and Information Center" SNCO (Ecomonitoring) of the Ministry of Nature Protection of the RA monitors the atmospheric air pollution of Yerevan city with five stationary points of measurement. On the basis of their measurements the background level of city air pollution is calculated. The following data on the pollution of the air basin of Yerevan are according to 2014 reference of Ecomonitoring:

- Air basin observations were done by 24-hour active sampling. The contents of dust, SO₂, NO_x and near-ground O₃ were determined. In total 9,963 air samples were taken by active sampling. The average annual concentrations of the determined materials did not exceed the maximum permissible concentrations (MPC).
- Atmospheric air observations through automatic devices were made at five observation points in the city. The contents of CO, SO₂ and NO_x in the atmosphere were determined. In total 347,538 observations of air were made through automatic devices. According to the data of automatic observations the average annual concentrations of the materials determined in the atmosphere did not exceed the MPC.
- Air basin observations with passive samplers were made in 48 observation points of the city. 4,715 samples of air were taken, in which the average annual concentrations of SO₂ and NO_x did not exceed the maximum permissible concentrations (MPC).

To obtain up-to-date data about the ground level concentrations (GLC) of air pollutants in the Project Area of Influence, and help defining the airshed as degraded or non-degraded (according to the WB EHS Guidelines), FICHTNER undertook a baseline air quality assessment in July/August 2017 (Summer), October/November 2017 (Autumn), and December

²⁴ WHO (2016), World Health Statistics 2016

2017/January 2018 (Winter) in the Project Area of Influence. These campaigns included the measurement of SO₂, NO₂ and PM₁₀ in 5 locations around the project area, including the specific areas where the highest pollution levels resulting from the operation of the YCCPP - 2 are expected:

- For gases (SO₂ and NO₂), the Consultant performed a 7 days campaign in Summer, a 10 days campaign in Autumn, and a 30 days campaign in Winter with diffusion tubes, followed by a laboratory analysis.
- For particulates (PM₁₀), the Consultant performed 5 days campaigns in Summer and Autumn, and a 30 days campaign in Winter.

The results show that the airshed surrounding the future YCCPP - 2 can be classified as **non-degraded** regarding the pollutants PM₁₀, SO₂ and NO₂. Please consult further details on this study on Annex 12.8 to this ESIA.

New monitoring campaigns will be undertaken in Spring 2018 to capture the seasonal variations in the pollutant's GLC, and reinforce or adapt this conclusion.

5.1.7 Noise

To obtain data about the existing noise levels in the Project Area of Influence, FICHTNER undertook a noise monitoring campaign in an area around the YCCPP-2 site at five monitoring points, including work-days and weekends at day-time as well as night-time. Measurement point Noise 1 is placed approx. 1,700 m to the south-west of YCCPP-2; it is located near the northeast border of Ayntap community. Measurement point Noise 2 is situated approx. 1,750 m to the west from YCCPP-2. This point is located on the eastern border of Noragavit settlement in front of the highway. Measurement points Noise 3 and Noise 5 are located in Kharberd horticultural settlement. Both points are situated along the northern border of the settlement, south of YCCPP-2. Noise 5 is located at a distance of approx. 1,100 m, while the distance between Noise 3 and YCCPP-2 is 1,500 m. Measurement point Noise 4 is placed in an industrial area near the northern border of the YCCPP-2 (Figure 5-11). The results are shown in

Table 5-3. Please consult further details on this study on Annex 12.6 to this ESIA.



Legend

● Baseline monitoring - Noise

Figure 5-11: Baseline Monitoring Points - Noise

The campaign used the Sound Level Meter WS1361, a high precision instrument in line with the International Committee TYPE 2 ANSI S1.4 and the United States National Standard TYPE 2 IEC 651. According to The Sanitary Norms N2-III-11.3, the applicable noise limits in the residential areas are 45 dB(A) during the night time and 55 dB(A) during the day time (the same limits imposed by the IFC General EHS Guidelines). In the industrial areas the limits fluctuate from 50 dB(A) to 80 dB(A) depending on the category of works. The IFC General EHS Guidelines impose a limit of 70 dB(A) for industrial sites. The said limits are referred to the total environment noise (the power plant contribution + the current sound pressure (“ante operam” or baseline sound pressure)).

Table 5-3: Results of the baseline noise monitoring at the Project site

Point of measurement	Wind speed [m/s]	Time of measurement	Leq(A) [dB(A)]
Work-day			
R1	< 1.7	Day-time	49.8
	< 1.8	Night-time	47.1
R2	< 1.9	Day-time	72.6
	< 2.3	Night-time	62.4
R3	< 1.8	Day-time	48.1
	< 1.7	Night-time	40.0
R4	< 1.6	Day-time	53.6
	< 1.9	Night-time	57.3
R5	< 1.7	Day-time	36.2
	< 2.0	Night-time	39.4
Weekend			
R1	< 1.5	Day-time	43.3
	< 2.1	Night-time	49.0
R2	< 1.8	Day-time	72.8
	< 2.5	Night-time	59.2
R3	< 1.9	Day-time	43.9
	< 2.0	Night-time	33.9
R4	< 1.8	Day-time	56.4
	< 2.0	Night-time	57.2
R5	< 1.5	Day-time	35.6
	< 1.8	Night-time	34.2

Note: On sensitive receptor R4 the limit of 70 dB(A) is applicable during the day and during the night.

Baseline day-time noise evaluation

Based on the noise measurement results conducted during work-days and weekend days, it can be concluded that the noise equivalent levels in/near the residential areas were generally within the applicable limits except the point R2 (located in front of the highway), where the noise level exceeded the 55 dB(A) normative value. This can be explained by the movement of heavy vehicles and high traffic density along the highway.

Baseline night-time noise evaluation

Equivalent noise levels during work-days and weekend days at measurement points R3 and R5 are within the 45 dB(A) limit. Noise levels at point R1 during both work-days and weekend days were slightly exceeding the limit (2.1 dB(A) and 4 dB(A) accordingly). This is due to the existence of background night noise from the facilities located in the vicinities. As a result of night-time measurements, the equivalent noise level at point R2 (located in front of the highway) is above the 45 dB(A) limit. The reason is high traffic density along the highway even at night-time.

5.1.8 Landscape

In spite of its comparably small surface area, Armenia is topographically highly diverse. A broad range of landscapes is found. Yerevan is part of the “low mountain dry steppe” landscape zone.

The Project Area is located in a highly industrialized area in southern Yerevan. Here, the existing YCCPP-1, chemical plants, metal factories and other industrial infrastructure dominate the landscape that is characterized by existing stacks, gas pipelines and other visual burdens.

5.2 Socio-economic Conditions

5.2.1 Population within the Project Area of Influence

The Republic of Armenia has a population of approx. 3 million people with a territory of 29,743 km². Population density is 101 persons/km². Nominal GDP is \$10.56 billion (2015), per capita \$ 3,595. The Human Development Index is estimated for 2010 at 0.733 which ranks the country 85th, the lowest among the Transcaucasian republics. After the break-up of the USSR the country has experienced a problem of population decline due to elevated levels of emigration. The rates of emigration have decreased drastically in the recent years and a moderate influx of Armenians returning to Armenia is expected to continue.

Ethnic Armenians make up 98.1 % of the population. Yazidis make up 1.2 %, and Russians 0.4 %. Other minorities include Assyrians, Ukrainians, Greeks, Kurds, Georgians, and Belarusians. There are also smaller communities of Vlachs, Mordvins, Ossetians, Udis, and Tats. Minorities of Poles and Caucasus Germans also exist though they are heavily russified.²⁵ According to the Statistical Yearbook of Armenia 2016²⁶ Yerevan has a population of 1,075,000 inhabitants with a density of 4,815 persons/km².

There are no people living within the YCCPP-2 site/Project Area. The population in the Project Area of Influence can be differentiated into urban population of the districts of Shengavit (approx. 140,000 inhabitants) and Erebuni (approx. 117,000 inhabitants) and the village population of Ayntap (approx. 11,000 inhabitants) and Kharberd (approx. 17,000 inhabitants).

5.2.2 Sensitive Receptors

People living in the residential areas at a distance between 1,200 m and 1,500 m from YCCPP-2 site might be affected by noise and air emissions during construction, operation, and decommissioning of the new power

²⁵ Source: Asatryan, Garnik; Arakelova, Victoria (2002). The Ethnic Minorities of Armenia. Routledge

²⁶ National Statistical Service of RA 2016; <http://www.armstat.am>

plant. As YCCPP-2 will be located in an industrial area with the existing YCCPP-1, chemical plants, metal factories and other industrial infrastructure, the newly created noise and air emissions will accumulate with the already existing burden.

This might be the case for people living in the legal and illegal residential areas in the Project Area of Influence, as well as the training center of the fire brigade located to the southwest of the project site. All these receptors, including illegal residents, are located outside the land plot allocated for the project (see Figure 5-12 and Pictures below). Notwithstanding, since these residential areas are located within the Project Area of Influence, they are considered in this ESIA as receptors for potential impacts. It shall be noted that, according to a written communication from the Municipality of Yerevan, the YCCPP-2 Project will not have any influence on the future of the nearby illegal houses located northeast and south of the construction site (see Annex 12.1). These people are classified as vulnerable under ADB's Safeguard Requirements as they are poor and occupy illegal housing. Their vicinity to the Project Area makes them directly affected by construction and operation impacts, however no physical or economic displacement will occur due to the Project.



Figure 5-12: Location of illegal houses located northeast and south of new YCCPP-2 and training center of fire brigade



Figure 5-13: Illegal houses located northeast of YCCPP-1 and YCCPP-2 (Source: Fichtner, July 2017)

In a distance of about 1 km from the new YCCPP-2 no schools, kindergartens, hospitals, etc. are found. Nearest hospital is Erebuni Medical Center which is located approx. 3 km northeast of the new power plant.

5.2.3 Livelihood and Housing

Despite economic reforms and some recent growth, unemployment and poverty remain widespread in Armenia. Agriculture is the country's largest labor sector, followed by services and industry. The UNDP report (Spoor 2004) analyses that rural poverty used to be lower than urban poverty, and access to land has been important in the explanation of this phenomenon. However, rural poverty in 2003 has surpassed its urban counterpart, stagnating at a level similar to 1996. While access to land is still widespread in rural Armenia, amongst farm households, the poor and extreme poor are those who own very little land, or the landless. The poorest Armenians are found in rural areas with the least favorable conditions for agricultural activities. There is a stark contrast between the city of Yerevan and the remote rural areas in terms of socio-economic opportunities. The industrial area in the south of Yerevan provides some jobs also for people living in the surrounding villages.

5.2.4 Land Usage and Ownership

According to the Statistical Yearbook of Armenia (2016) RA has approx. 2 million ha of agricultural land, meaning about 70 % of the country's land area. Most of this, however, are pastures (about 1 million ha). Cultivable land comprises about 446,700 ha arable land, 34,400 ha perennial grass, 121,100 ha plough-land, and 392,200 ha others.

The Project Area is part of a highly industrialized region of Yerevan. Only the area west of the foreseen construction site (but outside of it) is used for pasture and/or agricultural purposes. The whole area of the construction site has already been acquired by ArmPower CJSC and local population does not live in nor use the land in any way. ArmPower/RENCO entered a land purchase agreement with the seller (Yerevan Thermal Power Plant CJSC) in March 2017. According to this agreement, the Seller guarantees that the land is free of any form of occupancy or any other possession by any third

party and there are no current and, to the best of its knowledge, threatened or pending actions, suits or other proceedings which may affect the Seller's rights to dispose of the Project Land, and the Purchaser's title to the Project Land. The designated purpose of the Land is "for energy, transport, communication, utility infrastructure objects", as stated in the title certificate 18042017-01-0184. A legal opinion has been emitted by an Armenian lawyers company, which stated that the preliminary agreement is legally binding and enforceable. The land was owned by the government and the seller since the 1960s. Some fields and farmlands are located to the west and south of the construction site but outside of the Project Area. These fields and farmlands will not be impacted by the Project. As already mentioned in Section 5.2.2 there are some people living illegally in houses outside of the construction site (northeast and south) .

5.2.5 Historical and Cultural Sites

As the history of human settlement in Armenia goes back to the Neolithic age and the area has since then been important as settlement, trade and agricultural area, numerous historical and cultural sites exist. However, there are no maps indicating exact locations (GPS coordinates) of the sites. Also, only a minor part of the existing monuments are visible and known to the public. Others are known only to a few local experts linked to the Department for the Protection of Monuments of RA.

No known historical or cultural sites are located within the Project Area of Influence. As there has been significant ground disturbance of the area in the past, the presence of undisturbed historical or cultural remains at the site is very unlikely. Nonetheless, the Ministry of Culture shall be informed by the EPC Contractor about the Project prior to construction, in order to allow the Ministry to perform a proof of occurrence/absence of any cultural or historical goods at the Project site, if deemed necessary. For the case of an unexpected encounter of Cultural and Historical Sites or Goods a Chance Find Procedure will be implemented for construction period (see Section 6.3.3). The Erebuni Museum of History and Architecture is located approx. 4 km from the foreseen construction site.

6. Environmental and Social Impact Assessment

In this chapter, possible environmental and social impacts from the construction, operation and decommissioning of YCCPP-2 are analyzed. Potential impacts of the Project in relation to environmental and social receptors are characterized and the extent of the impact (after implementation of mitigation measures) is assessed. The following evaluation scale is applied:

Significance of impact:

■■■	=	high negative
■■	=	medium negative
■	=	low negative
	=	nil
+	=	locally positive
++	=	regionally positive

6.1 Environmental Impacts during Construction Phase

6.1.1 Fauna, Flora and Biodiversity

Site preparation for the plant extension requires clearing of vegetation and ground excavation. Hence, the construction activities will result in a permanent loss of the sparse vegetation composed of grass, herbs and some bushes. As the biodiversity value of the construction site is assessed to be low, there are only low impacts on biodiversity expected during the construction phase.

Under normal dry weather conditions, a significant amount of dust will be released by excavating activities. Hence, vegetation and animal habitats in the vicinity of the site might be affected by wind-blown dust and its deposition. The contribution to the natural dust concentration in the air will only be of relevance at the beginning of the construction phase, during the main excavation activities. During this period, dust can be expected to settle on plant leaves, which could hinder plant's air exchange and assimilation.

The temporarily increased vehicular traffic coupled with high noise levels due to various construction activities may also have some negative impacts on animals. Especially birds and other acoustically orientated animals potentially living in the vicinity of the site and the roads used could be disturbed by noise. However, the site has been assessed to be of low ecological value. No significant impacts by dust and noise on the flora and fauna in the vicinity of the site and the used roads are to be expected.

The impact significance will be low if mitigation measures are implemented. Adequate mitigation measures are possible and are given in the ESMP.

Impact of/ on	Significance of Impact (after Mitigation)
Fauna and Flora	■

6.1.2 Protected Areas

As no Protected Areas or other sensitive areas like Ramsar Sites or Important Bird and Biodiversity Sites (IBA) are located within or near to the Project Area of Influence, there will be no impacts from the Project on any of these areas.

Impact of/ on	Significance of Impact (after Mitigation)
Protected Areas	○

6.1.3 Soil

6.1.3.1 Soil Use and Soil Erosion

Loss of vegetation and soil compaction increases the soils' vulnerability to erosion. Erosion can cause further unwanted interactions. Earthmoving activities such as vegetation clearing, grading and grubbing for site preparation, and heavy equipment hauling over unpaved ground, may loosen soils and cause fugitive dust and particulate matter to become airborne.

Armenia suffers significant soil erosion problems. But, compared to other regions in Armenia, the Project Area is not prone to soil erosion due to the following reasons:

- the terrain at construction site is nearly flat
- there are no hazardous physical-geological phenomena and processes (like landslides, rock slides, rock fall, erosion, suffosion, etc.) in the Project Area

Due to the restricted surface area of the planned construction activities and after implementation of the mitigation measures given in the ESMP, impacts on soil use and soil erosion are considered low. However, it is recommended that the EPC Contractor develops and implements an Erosion and Sediment Control Plan.

Impact of/ on	Significance of Impact (after Mitigation)
Soil Use and Soil Erosion	■

6.1.3.2 Soil Contamination

As mentioned in Section 5.1.4, analysis of a possible historic soil contamination at the construction site has been performed in August 2017 and an additional analysis to confirm the initial results and provide a more detailed picture of the site was done in November 2017. For details and analysis results see Sections 12.5 and 12.11 in the Annex. Concentration of heavy metals in the analyzed soil samples are far below international threshold standards. However, national Armenian MACs are exceeded by some heavy metals. These very strict MACs can be directly applied if the site is used for the construction of schools, playgrounds, etc. If other usage of the area is foreseen (e.g. industrial use) a calculation has to be done according to Armenian Decision N 1277-N in order to classify the soil as clean, permissible, moderately dangerous, dangerous or extremely dangerous (see Section 2.4). According to this calculation, the soil at the YCCPP-2 is classified as “permissible” (see more details in Annex 12.10). This kind of soil may be used for construction of non-high vulnerability objects²⁷ without further mitigation measures. This is the case for the YCCPP-2.

It has also to be clarified, that during construction and operation of the new YCCPP-2 no pollutants will be added to soil, if the mitigation measured are implemented. RENCO has no liability for soil remediation in their land purchase agreement.

Soil contamination during construction works can arise from improper waste disposal and accidental leakage from tanks of lubricants, solvents, paint, oil, diesel, chemicals, etc. Depending on the kind of the contaminant, soil can be polluted short- or long-term. Measures given in the ESMP to prevent pollution of soil by oil and chemical spills have to be implemented during construction phase.

Impact of/ on	Significance of Impact (after Mitigation)
Soil Contamination	■

6.1.4 Water Resources

6.1.4.1 Surface Water

The nearest water body to the construction site is Artashati Jrants Canal, located about 700 m to the south east. The Hrazdan River is located at least 5 km away from the construction site. Thus, surface water is not expected to

²⁷ High vulnerability objects are: school buildings, residential construction areas, sport's and children's playgrounds, health and resort areas, water objects, water mains

be influenced during the construction period, including possible phenomena of soil erosion.

Impact of/ on	Significance of Impact (after Mitigation)
Surface Water	○

6.1.4.2 Groundwater

No groundwater will be used in any way during construction period of the Project. Operation of workers' camps during the construction period will not be necessary, as local workforce from Yerevan will be employed who can return to their homes daily, and those from other cities/abroad will be lodged in RENCO's guesthouse or hotels. However, during construction period toilets and sanitary rooms will have to be provided for the workforce at the construction site, separately for men and women and according to IFC/ EBRD Guidance Note²⁸. Sewage water shall be led to the city sewage water system, or septic tanks will have to be used for collecting sewage water which then would have to be emptied by a specialized company from time to time. An alternative has not yet been chosen by the EPC Contractor. In terms of environmental impacts, both alternatives are acceptable as long as a proper final destination of the liquid effluents is provided.

Contamination of the soil can indirectly lead to a pollution of the groundwater. Groundwater contamination can e.g. arise from improper waste storage and accidental leakage from tanks of lubricants, solvents, paint, oil, diesel, chemicals, etc. Depending on the kind of the contaminant, the groundwater may be polluted short or long term. Measures given in the ESMP to prevent pollution of groundwater by oil and chemical spills have to be implemented during construction phase.

An effective mitigation strategy to prevent pollution of the groundwater at the construction sites is to enforce a Waste Management Plan (see Section 6.1.7). Storing of construction material and any kinds of waste outside defined places shall be prevented and potential pollutants shall be handled properly. The impact magnitude is expected to be low when applying the identified mitigation measures.

The results of all groundwater sampling tests made in August 2017 (Consecoard LLC) were within the limits of the 5th grade of water quality; however, limit values for groundwater do not exist in Armenia. For details and analysis results see Section 12.5 in the Annexes.

Additional analysis of groundwater was undertaken in November 2017 by GeoterProject at three sampling sites (upstream of the site, at the site, and downstream of the site) for content of TPH, PAH, BTEX, Metals, as well as

²⁸ see IFC/ EBRD Guidance Note on Workers' Accommodation (2009)

pH, dissolved oxygen, mineralization, BOD5, and COD5. Results of these analyses show that groundwater is contaminated by some heavy metals and organic pollutants (see Section 5.1.5.2 and Section 12.11 in the Annex for details and results). However, it is not foreseen that the groundwater will be influenced or used by the Project.

An evaluation is currently ongoing regarding the management of groundwater during construction and operation. The current proposal is to install sub-surface drainage to permanently deviate groundwater around the site. According to the latest engineering designs, the possibility is being studied of setting up a clay barrier around the site together with underground drainage trenches filled with gravel. These trenches would collect groundwater and naturally convey and disperse it away from the foundations. This solution is to be set before construction but be kept during operation. No abstraction, discharge or other use of contaminated groundwater is to occur.

Notwithstanding the above, the Client will conduct further hydrological assessment and implement appropriate environmental management of this solution, to be approved by IFC and ADB before construction. This will include consideration of impacts and mitigation measures for changes to the groundwater profile, both within the site and on neighboring properties.

In the unlikely event that groundwater rises to the surface or needs to be removed from the site and discharged in a different receptor (river or public network), treatment options need to be included as well in the future assessment study. Options to remove hydrocarbons could include separation and filtration methods, such as an oil-water separator and activated carbon filter. It is noted that an oil-water separator is planned for the site. Depending on where the water would be discharged, different standards would apply. An overview of applicable standards can be consulted in Section 2.4 of this report.

Impact of/ on	Significance of Impact (after Mitigation)
Groundwater deviation	(still unknown - see ESAP)
Groundwater contamination	■

6.1.5 Climate and Air Quality

Dust generation from transportation and construction activities as well as emissions from vehicles and construction machinery will be the main impacts on air quality during the construction phase of the proposed Project.

During construction activities dust particles can be swirled up resulting in a visible dust deposition close to the construction activities. Dust generation and distribution is dependent on weather conditions, wind speed,

precipitation rate, as well as type and extent of construction activities. Dust deposition under low precipitation rates and high temperatures will be much higher than under wet conditions.

The main sources of dust emissions during construction are site clearing, site excavation and other earthworks as well as movement of construction vehicles.

During construction, the proposed project will lead to an increase in overall traffic flows for a limited period, which will cause a rise in vehicular emissions. These emissions together with exhaust emissions from construction machinery are likely to result in marginal increases in the emissions of SO₂, NO_x, CO, CO₂, and unburned hydrocarbons (UHC).

Due to the limited duration of the construction period and implementation of mitigation measures (like covering soil piles with tarps, etc.), the impact on air quality during construction can be considered as low.

Impact of/ on	Significance of Impact (after Mitigation)
Climate and Air Quality	■

6.1.6 Landscape and Visual Aspects

The construction site is located in a highly industrialized area in southern Yerevan. Here, the existing YCCPP-1, chemical plants, metal factories and other industrial infrastructure dominate the landscape. During construction activities heavy construction machinery will be working at the site producing dust (e.g. due to excavation works) and thus representing a visual impact which can be mitigated by spraying water during this kind of activity. The construction of the new power plant will add further highly visible structures (e.g. stacks and buildings) to the Project Area of Influence. However, due to the already existing industrial infrastructure in the area, the construction of YCCPP-2 will not enhance the contrast between the industrial site and the surrounding areas significantly. It is recommended to develop and implement a landscape / planting plan for the YCCPP-2 site. As a recommendation that came up during the Public Consultation meeting it shall also be taken into account to include landscaping in the Shengavit and Erebuni Districts. After construction works all construction waste shall be cleared up and all machinery shall be removed. Any adjacent damaged areas (if any) shall be reinstated.

Impact of/ on	Significance of Impact (after Mitigation)
Landscape and Visual Aspects	■

6.1.7 Waste

The main waste types generated during construction works can be generally classified as follows:

- domestic wastes generated by the workers (e.g. paper, plastic, drink containers, food waste etc.)
- plant debris from clearance of the construction site
- excavated inert material
- spilled soil polluted e.g. by fuel, engine oil or lubricants
- construction waste (e.g. unused/ unusable construction material, wood from framework, maintenance waste, packaging material, empty containers etc.)
- small amounts of hazardous waste like fuel, oils, paint, lubricants, etc.

Waste Management Plan:

Possible impacts on soil and water can be prevented and mitigated by a professional handling and storage of hazardous substances and a proper handling of waste. The EPC Contractor (RENCO) shall develop a **Waste Management Plan** for the construction period that contains at least the following principles:

- respecting the waste management hierarchy of avoidance, preparing for reuse, recycling as much as possible, recovery, and proper disposal of remaining waste according to EU Directive 2008/98/EC (Waste Framework Directive)
- segregating all waste by category on site, based on their nature, and ultimate disposal sites
- good technical planning in order to minimize the generation of construction waste
- regular staff training to increase awareness of waste minimization issues and handling of different wastes.

A **Waste Management System** shall be implemented. In general, the generated construction waste shall be recycled as much as possible on site and the construction activities shall be controlled regularly. Storing of construction material, excavated soil and all kinds of waste outside defined places as well as throwing waste in open spaces shall be prevented.

The EPC Contractor will have to establish an official agreement with municipal authorities regarding the final disposal of the different wastes resulting from the works. This may include using the services of communal service providers for domestic waste disposal purposes during the construction period. If any scrap metal will accrue as waste, this can be sold to local recycling companies in Yerevan like e.g. Metexim LLC, or others.

Small amounts of hazardous waste like residual oil, fuel, paint or spill contaminated soil may accrue and shall be stored in adequate storage sites (lockable, roofed, ventilated, concreted and bunded floor) at the new

YCCPP-2 site. All hazardous wastes shall be securely packed in sealed drums or other suitable containers, clearly identified by labels, and marked according to national and internationally recognized requirements and standards, including the International Chemical Safety Cards (ICSC), Materials Safety Data Sheets (MSDS), or equivalent. If any asbestos containing material (ACM) will be found at the construction site, all ACM has to be securely double bagged in high-density polyethylene (HDPE) bags and sealed (e.g. using duct tape). All bags shall be labeled to show that they contain asbestos containing materials and shall be stored in a separate bunded and locked storage room with a warning sign installed. The final disposal of hazardous waste is subject to medium to long term national-level solutions to be decided upon and provided by the Government of RA, as no suitable disposal sites do exist in Yerevan or Armenia at the time being.

During the site visit in July 2017 empty oil drums, gas cylinders, scrap metal, old metal cabins, old toilets and wash basins and other material that has been disposed on the foreseen construction site of YCCPP-2 were found (see figure and pictures below). During the site visit in February 2018 it was found that the gas cylinders and the empty oil drums had been removed meanwhile to the property of YCCPP-1. All the material presently existing at the site is in possession of YCCPP-1 and will be removed by them. It is recommended that this material shall be segregated and stored or disposed of accordingly. There are also some concreted areas at the construction site which will have to be removed. Concrete waste can be disposed of at Yerevan dumping site or used as land filling material. The material located at the temporary laydown area (mainly scrap metal and wood) will be removed by YCCPP-1 to another location at their property.



Figure 6-1: Location of waste on the site found during the site visit of July 2017



Figure 6-2: Scrap metal



Figure 6-3: Wooden and metal material



Figure 6-4: Metal cabin on concreted area



Figure 6-5: Old toilets and wash basins



Figure 6-6: Gas cylinders / scrap metal



Figure 6-7: Old filter

(Source: Fichtner, July 2017)



Figure 6-8: Scrap metal at the temporary laydown area

(Source: Fichtner, February 2018)

If all mitigation measures given in the ESMP are implemented, including a Waste Management Plan and a Waste Management System, the impact from waste is rated as medium (because there is not a solution for hazardous waste disposal in Armenia presently).

Impact of/ on	Significance of Impact (after Mitigation)
Waste	■ ■

6.2 Environmental Impacts during Operation Phase

6.2.1 Fauna, Flora and Biodiversity

Compliance with the performance guarantees for NO_x, CO and UHC will be achieved at the plant and monitored by a CEMS. Added to this, as no sensitive fauna and flora species occur in the Project Area of Influence the impact on these components derived from air emissions will be low.

Impacts on aquatic organisms of the Hrazdan River, which is categorized as having a bad water quality, are foreseen to be low. The waste water streams will be treated and discharged according to applicable requirements (see Section 6.2.4 for further details).

Impact of/ on	Significance of Impact (after Mitigation)
Fauna and Flora	■

6.2.2 Protected Areas

As no Protected Areas or other sensitive areas like Ramsar Sites or Important Bird and Biodiversity Sites (IBA) are located near the Project Area of Influence, there will be no impacts from the operation of YCCPP-2 on any of these areas.

Impact of/ on	Significance of Impact (after Mitigation)
Protected Areas	○

6.2.3 Soil

Soil contamination can be possible due to spillages from oil/ fuel/ paint/ chemicals used during operation of the power plant. However, if the mitigation measures given in the ESMP (like correct storage and handling of

those items; use of spill-fighting materials, etc.) are implemented, the impact is rated low.

Impact of/ on	Significance of Impact (after Mitigation)
Soil Contamination	■

6.2.4 Water Resources

6.2.4.1 Water Supply

Water supply during operation of the YCCPP-2 will be branched from the existing water pipelines which are presently serving the YCCPP-1. All water will be taken from the Yerevan potable water grid and will be used for all civil utilities like cooking, drinking, etc. It will also be used as process water which is connected to the raw water storage tank and for all other uses (e.g. cooling tower make up, HRSG blow-down tank quench, firewater tank and network, utility water network, etc.). Cooling towers are designed as evaporative towers needing the highest share of the raw water (approx. 310 m³/h). The maximum power plant water flow rate (referred to normal operation) will be 450 m³/h (annual average). The necessary average monthly water quantity will be around 300,000 m³. Use of potable water is agreed and described in the Framework Agreement between ArmPower and the Government of Armenia and in the correspondence between ArmPower and Veolia Djur CJSC, the local drinking water supplier (see Section 12.2 in the Annex). The location of the tie-in point for raw water can be consulted in Figure 3-3 in Section 3.

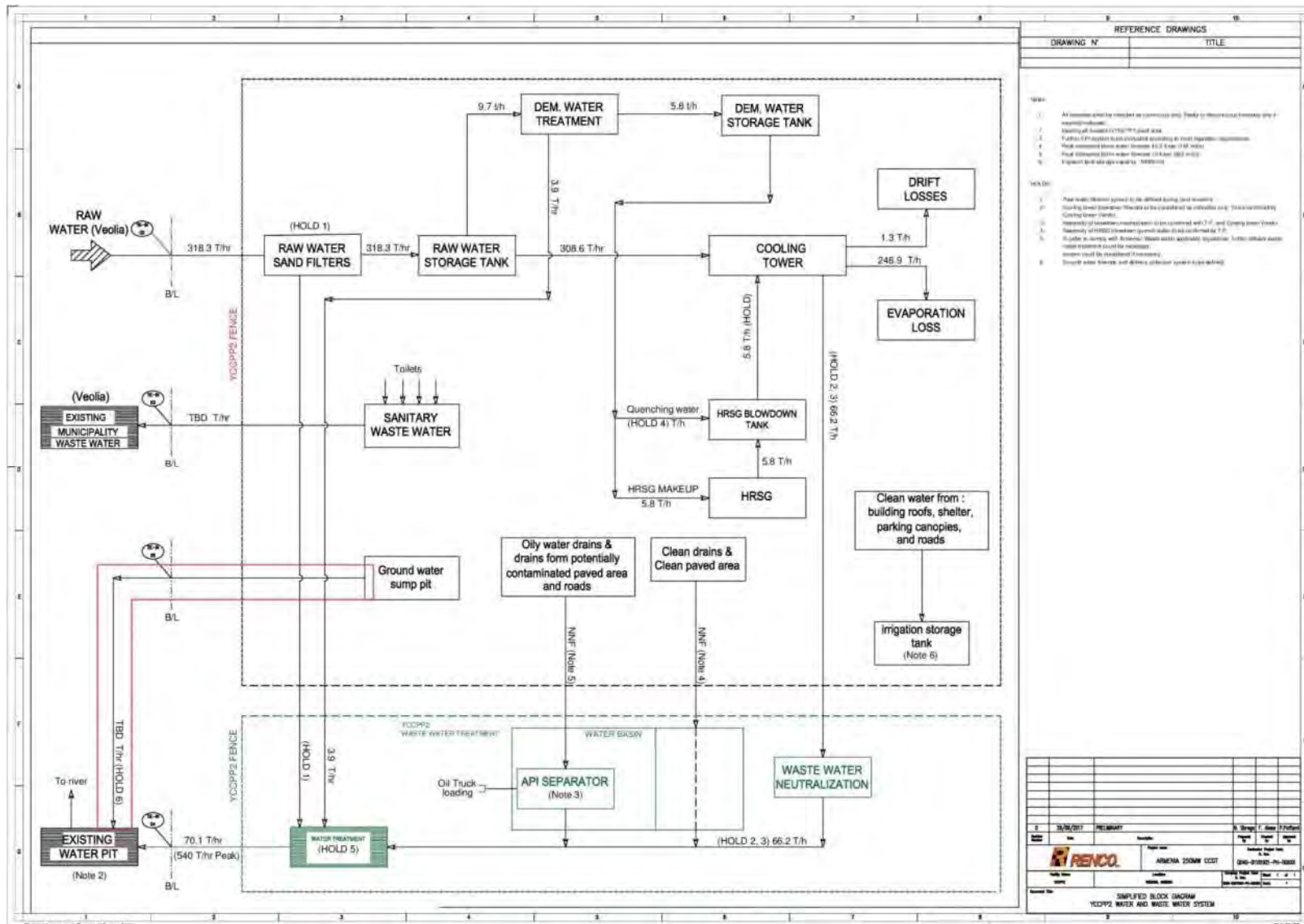


Figure 6-9: Preliminary Water Balance of YCCPP-2 (Source: RENCO)

6.2.4.2 Surface Water

All waste water coming from the power plant operation will be duly collected and routed to an onsite waste water treatment plant at YCCPP-2 (which is still in the detailed design phase). It will include an API and, if necessary, a CPI oil separator, as well as a biological treatment of the waste water. The treated water will be discharged to the existing discharge pipeline and open channels downstream of YCCPP-1. It will finally be discharged to the Hrazdan River, 7-9 km away from the site (see Figure 5-7). The treatment system will be suitably selected and implemented to meet the environmental limits and the good industry practice.

Since there are no Armenian standards for the quality of the liquid effluents, the limits applicable to the effluents of the YCCPP-2 will be defined by the Ministry of Nature Protection based on a nationally recognized calculation method. This ESIA recommends that such limits are at least as stringent as those provided in the Design Data of ArmPower for YCCPP-2 (2017), as these comply with the IFC Guidelines (see Section 2.4 of this report, where also the allowed concentrations on the effluent of YCCPP-1 are provided for comparison).

According to RENCO, rain water from internal roads and other paved areas will be collected and led to the onsite waste water treatment plant before discharging it to the existing system of YCCPP-1. Rain water from roofs of buildings and shelters will be collected in an underground tank (location and routing will be defined) for reusing the water without any treatments for irrigation inside the YCCPP-2 site.

According to the water balance scheme the HRSG blow down water will be led to the cooling towers. Drainage from these cooling towers will be neutralized at the chemical shop of the power plant, and will then enter the onsite waste water treatment plant to meet the relevant water quality standards.

The domestic sewage will be connected to the already existing city sewage collection system.

According to RENCO's water balance, approx. 70 m³/h of treated waste water will be discharged by YCCPP-2 into the existing discharge system downstream of YCCPP-1, which is large enough to accommodate this additional flow (for location of the tie-in point see Figure 3-3). Additionally, approx. 14 m³/h of sanitary sewage water will be led to the city sewage system operated by Veolia Djur CJSC, which is (according to RENCO) large enough to receive this additional flow.

A monthly monitoring program shall be established to be performed by ArmPower and results shall be reported to the "Environmental Monitoring and Information Center" SNCO at the Ministry of Nature Protection. The objective is to guarantee the adherence of all industrial wastewater, sanitary

water to the effluent standards that are still to be set by national authorities for YCCPP-2, the design data/performance guarantee values, or international limit values, whichever are **more stringent**.

In order to assess the influence of the YCCPP-2 treated waste water (together with YCCPP-1 waste water) on the water quality of the ultimate recipient Hrazdan River, chemical water quality parameters were analyzed from samples taken upstream and downstream of the discharge point to the River. Results of analyses show that the discharge of the treated waste water of YCCPP-1 has no negative effect on the water quality of Hrazdan River (see Section 5.1.5.1).

According to RENCO the temperature of the treated waste water will be in the range of 25°C to max. 34°C depending on the seasonally varying ambient temperature. However, thermal impacts of the water finally discharged to Hrazdan River as ultimate receiver via the existing discharge pipeline and channels are not expected to be significant. This is because the discharge point for the treated waste water is located far away from the plant, and before reaching the river it is transported in a 1 km pipeline and afterwards in open channels for over 7-9 km (aerial distance). The “Waste Water Temperature Study” from ArmPower (2018) evaluated the water effluent temperature profile from YCCPP-2 up to the Hrazdan River during winter and summer conditions. The results are shown below:

Season	Temp. of the Cooling Tower Discharge [°C]	Temp. of the water effluent discharging into the Hrazdan River [°C]	Seasonal temp. of the Hrazdan River [°C]	Difference [°C]
Winter	25.0	7.6	10.3	-2.7
Summer	34.0	17.8	20.5	-2.7

Based on a waste water temperature of 25°C (winter) and 34°C (summer) when leaving the YCCPP-2, the waste water temperature is calculated to be 7.6°C (winter) and 17.8°C (summer) when finally reaching the Hrazdan River. The water temperature of the Hrazdan River was observed in 2015 and 2016 to be between 10.3°C (winter average) and 20.5°C (summer average). Thus, the waste water from YCCPP-2 will fulfill the requirements from IFC/World Bank General EHS Guidelines defining less than 3°C increase of ambient water temperature (see Section 2.4). For further details of the study see Section 12.7 in the Annexes.

If all mitigation measures given in the ESMP are implemented the impact is rated to be low.

Impact of/ on	Significance of Impact (after Mitigation)
Water Courses	■

6.2.4.3 Groundwater

Contamination of the soil can indirectly lead to pollution of the groundwater. Contamination can be possible due to spillages from oil/ fuel/ paint/ chemicals used during operation of the power plant. However, if the mitigation measures given in the ESMP (like correct storage and handling of those items; use of spill-fighting materials, etc.) will be implemented, the impact from contamination is rated low.

An evaluation is currently ongoing regarding the management of groundwater during construction and operation. The current proposal is to install sub-surface drainage to permanently deviate groundwater around the site. According to the latest engineering designs, the possibility is being studied of setting up a clay barrier around the site together with underground drainage trenches filled with gravel. These trenches would collect groundwater and naturally convey and disperse it away from the foundations. This solution is to be set before construction but be kept during operation. No abstraction, discharge or other use of contaminated groundwater is to occur.

Notwithstanding the above, the Client will conduct further hydrological assessment and implement appropriate environmental management of this solution, to be approved by IFC and ADB before construction. This will include consideration of impacts and mitigation measures for changes to the groundwater profile, both within the site and on neighboring properties.

In the unlikely event that groundwater rises to the surface or needs to be removed from the site and discharged in a different receptor (river or public network), treatment options need to be included as well in the future assessment study. Options to remove hydrocarbons could include separation and filtration methods, such as an oil-water separator and activated carbon filter. It is noted that an oil-water separator is planned for the site. Depending on where the water would be discharged, different standards would apply. An overview of applicable standards can be consulted in Section 2.4 of this report.

Impact of/ on	Significance of Impact (after Mitigation)
Groundwater deviation	(still unknown - see ESAP)
Groundwater contamination	■

6.2.5 Climate and Air Quality

Stack emissions:

During the operation of the new power plant the impact on atmospheric air is due to emissions generated as a result of fuel combustion. IFC/World Bank Group EHS Guidelines for Thermal Power Plants (2008) describe emission levels for new thermal power plants. For combustion turbines using natural gas the NO_x emissions shall be less than 51 mg/Nm³ (referring to dry exhaust and 15% O₂). In order to comply with this limit value, a low-NO_x burner will be used in the new YCCPP-2.

There are no Armenian air emission limits for thermal power plants. The specifications for YCCPP-2 demand compliance with the following Performance Guarantee values (ArmPower, 2017): NO_x emissions equal or less than 50 mg/Nm³, CO emissions equal or less than 30 mg/Nm³ and UHC emissions equal or less than 10 mg/Nm³ (referring to dry exhaust and 15% O₂).

A Continuous Emissions Monitoring System (CEMS) will be installed at the stack of the new power plant. Adherence to the limit values shall be continuously checked by ArmPower and the results shall be monthly reported to “Environmental Monitoring and Information Center” SNCO at Ministry of Nature Protection and the financing agencies. When emissions are exceeded, this means that the conditions of the performance guarantee tests are not fulfilled anymore - there needs to be a verification of the combustion conditions and the air emissions reduction equipment. If the situation does not improve, or a problem is detected, the plant must be temporarily shut down for repairing.

An Air Dispersion Calculation (ADC) has been prepared to allow understanding what is the expected impact of the YCCPP-2 in the airshed of Yerevan (see Section 12.8 in the Annex). Indicative results for the cumulative effects have also been assessed. Altogether **3 scenarios** were simulated:

- Baseline scenario, or Scenario A;
- Project scenario, or Scenario B;
- Cumulative scenario, or Scenario C.

Each of the scenarios was simulated for a stack height of 35 meters (design), for a stack height of 43 meters (alternative), and for a stack height of 66 meters (alternative 2, or Good Engineering Practice (GEP) stack height).

The results of the ADC show that the standards for CO are expected to be fulfilled in all cases. The effect of YCCPP-2 on the ground level concentrations of NO₂ would, however, represent more than 25% of the national and international standards for this pollutant if a stack with 35 meters or with 43 meters would be built. However, if the stack height is raised to 66 meters (GEP stack height), the GLC of NO₂ will be kept below

25% of the standards. This will allow fulfilling IFC’s recommendation for a future sustainable development in the area. To keep up with best international practice, and fulfill the requirements of the financing agencies IFC and ADB, the **YCCPP-2 will be built with a 66 m stack height**. Details about the Armenian legal framework for standardization of air emissions (Consecoard LLC, 2018b) can be found in Section 12.12 in the Annexes.

Greenhouse gases:

The project’s greenhouse gases emissions are, according to RENCO, expected to be 785,000 tons CO_{2eq}/year (considering 8,350 OH at 12°C) and 371 g CO₂/kWh gross, respectively. This value is within the range of the typical CO_{2eq} emissions provided in the IFC/World Bank Group EHS Guidelines for Thermal Power Plants (CCGT with 51% efficiency: 396 g CO₂/kWh gross). According to IFC Performance Standard PS 3 an annual quantification of greenhouse gas emissions shall be done for plants emitting more than 25,000 t CO₂/year, which is the case for YCCPP-2. ADB’s Safeguard Requirements demand annual quantification of greenhouse gas emissions for Projects emitting at least 100,000 t CO_{2eq}/year for aggregate emissions (direct and indirect²⁹). This annual quantification of direct and indirect emissions shall be reported to the financing institutions and the national authorities.

In its “Intended Nationally Determined Contribution (INDC)” from 2015³⁰, Armenia describes its approach to establishing a level of GHG emissions of 5.4 tons CO_{2eq}/year (average) that it will not exceed during the period 2015-2050. The INDC notes Armenia’s 2010 GHG emissions of 2.14 tons per person³¹.

The emissions of the power plant correspond to a per capita value of 0.23 tons CO_{2eq}/year (according to the INDC, a population of 3.35 million is accounted for in Armenia). This corresponds to 11% of the 2010 emission levels and to 4% of the 2015-2050 annual averaged emission target. Given this, there is no reason to declare that the new YCCPP-2 negatively affects the pursue of recent national strategies and policies promoting the reduction of greenhouse gas emissions like the ‘Action Plan for Implementation of the National Program for Energy Saving and Renewable Energy (2010)’, ‘RA Renewable Energy Development Roadmap (2011)’, ‘Energy Security Concept of RA (2013)’ and others (MNP, 2015).

²⁹ Indirect emissions refer to the off-site generation by others of electricity, and heating and cooling energy used by the Project (IFC, 2012)

³⁰ <http://www4.unfccc.int/Submissions/INDC/Published%20Documents/Armenia/1/INDC-Armenia.pdf>

³¹ https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID_GHG%20Emissions%20Factsheet_Armenia.pdf

The YCCPP-2 will be fueled with natural gas, which has comparatively lower GHG emissions than other fossil fuels (oil, coal). In addition, it will be built with state-of-the art technology with elevated combustion efficiency (51%), which supports the minimization of GHG emissions. In order to keep the GHG emissions of the plant as low as technically possible, process control techniques and good maintenance of the combustion system shall be applied. The monitoring of GHG emissions (CO₂) shall be undertaken by means of the CEMS, which will allow keeping a tight control of the plant's performance in this field. The direct emissions of other GHG (CH₄ and N₂O), as well as the indirect emissions of GHG shall be calculated based on internationally recognized guidelines (for example, the guidelines from the IPCC³² or the US EPA³³).

Particulate Matter (PM) emissions from cooling towers:

The principal air pollutant emitted directly from wet cooling towers is small particulate matter (PM). Dissolved solids in the circulating water result in fine particulate emissions (PM₁₀ / PM_{2.5}) when water droplets are ejected from the tower evaporate before they reach the ground. Cooling tower particulate emissions are controlled through the use of drift eliminators, which are shaped materials that collect small water droplets as they exit the tower. Design Data of ArmPower (2017) mention that the evaporative towers of YCCPP-2 shall be designed to have a low drift phenomena (0.01 % drift loss, which will be approx. 1.3 m³/h according to the preliminary water balance provided by RENCO).

In order to reduce the emissions of particulate matter from the cooling towers during operation of the power plant, drift eliminators according to Good International Industry Practice (GIIP) shall be included in the design of cooling towers and raw water shall be filtered in order to reduce the content of Total Dissolved Solids (TDS). A baseline air quality monitoring was just undertaken by FICHTNER in August 2017 at the surroundings of the power plants' site which included the measurement of PM₁₀. Results show that PM₁₀ concentrations (measured at different daytime periods) are clearly below the maximum permissible concentrations and the daily average concentration limits as set by RA Decree No. 160-N "Norms of maximum permissible concentrations of atmospheric air pollutants in residential areas". The international air quality standards for PM₁₀ are also fulfilled.

Implementing all mitigation and monitoring measures as given in the ESMP, the impact of the Project on climate and air quality is rated at this stage as low.

³² <http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html>

³³ https://www.epa.gov/sites/production/files/2016-03/documents/stationaryemissions_3_2016.pdf

Impact of/ on	Significance of Impact (after Mitigation)
Climate and Air Quality	■

6.2.6 Landscape and Visual Aspects

The Project Area is located in a highly industrialized area in southern Yerevan. Here, the existing YCCPP-1, chemical plants, metal factories and other industrial infrastructure dominate the landscape. The planned new power plant will add further highly visible structures (e.g. stacks and buildings). However, due to the already existing industrial infrastructure in the area, the realization of the project will not enhance the contrast between the industrial site and the surrounding areas. Planting of trees in the framework of the recommended Landscape Management Plan would add a positive impact to the area.

Impact of/ on	Significance of Impact (after Mitigation)
Landscape and Visual Aspects	○

6.2.7 Waste

According to IFC/World Bank Group EHS Guidelines for Thermal Power Plants (2008), gas fired thermal power plants generate essentially no solid waste during operation because of the negligible ash content.

Domestic waste produced by the plant staff shall be collected in provided bins and picked up by a contracted waste collector for disposal at Yerevan dumping site.

Oil separated from water in the API separator of the waste water treatment plant will be collected by a licensed company for final disposal. Currently there are no suitable dumping sites for hazardous waste in Armenia. All hazardous waste generated by the Project (if any) shall therefore be stored in adequate storage sites (lockable, roofed, ventilated, concreted and with bunded floor) at the new YCCPP-2 site for future disposal (see also Section 6.1.7).

In the Chemical Workshop of the new YCCPP-2, acids and alkaline solutions will be used for neutralization of HRSG blow down and other drainage from steam/water system in order to meet the effluent standards (still to be set by national authorities for YCCPP-2) or international limit values, whichever are more stringent (see Section 6.2.4). These hazardous materials have to be adequately stored and used only by trained personnel using the adequate Personal Protective Equipment (PPE). Material has to be clearly labeled and marked according to national and internationally recognized requirements and standards, including the International

Chemical Safety Cards (ICSC), Materials Safety Data Sheets (MSDS), or equivalent. Waste material from these processes as well as e.g. used turbine oil, has to be stored accordingly as hazardous waste (see above). Related to the mid-term or long-term storage of hazardous waste on the site, the Waste Management Plan (WMP) for operation of the power plant shall also include a risk assessment considering among others (i) implications of long-term storage of waste types including consideration of any potential change in hazardous properties over time, (ii) risks associated with reactivity between waste types, and (iii) type of containers to be used for storage including consideration of container integrity and resilience over the projected timeframe of storage. Furthermore, the size of the storage area for hazardous waste shall be adapted to the projected volume of hazardous material and the anticipated storage duration. The frequency of checks for the integrity of the waste storage facilities shall be as well defined in the WMP.

Impact of/ on	Significance of Impact (after Mitigation)
Waste	■

6.3 Social Impacts during Construction Phase

6.3.1 Local Workforce

During the construction period local workforce (mainly unskilled workers) from the nearby villages and Yerevan shall be employed for the construction works. According to RENCO in peak construction times about 450 workers will be needed. This will contribute to much needed monetary income in the region. Special attention shall be laid on the recruitment of women, wherever possible. However, the income generation opportunity is not of long term duration, as it will be limited to the construction period. The EPC Contractor shall discuss potential barriers for employment with local labor / training organizations so that measures to overcome these barriers can be developed and put in place.

RESCO SPA as the EPC Contractor has a systematic approach which fully complies with the international standards ISO 14001 and OHSAS 18001. RENCO has a Human Resources Policy in place that will be applied to the Project as it has been done by RENCO for many other projects in the past (including a non-discriminatory hiring and wage policy according to IFC PS 2; clearly stating that the company will not discriminate in hiring and salaries based on gender, age, religion, ethnicity or place of origin, etc.) The Human Resources Policy shall in addition include international labor standards as defined in ILO (2014), in order to fulfill the requirements of IFC PS 2.

Impact of/ on	Significance of Impact (after Mitigation)
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Impact of/ on	Significance of Impact (after Mitigation)
Local Workforce	+

6.3.2 Land Usage and Ownership

There are no people living at the site nor the land is used by the local population. The area has already been acquired, fenced, and foreseen for construction of YCCPP-2. ArmPower/RENCO entered a land purchase agreement with the seller (Yerevan Thermal Power Plant CJSC) in March 2017. According to this agreement, the Seller guarantees that the land is free of any form of occupancy or any other possession by any third party and there are no current and, to the best of its knowledge, threatened or pending actions, suits or other proceedings which may affect the Seller's rights to dispose of the Project Land, and the Purchaser's title to the Project Land. The designated purpose of the Land is "for energy, transport, communication, utility infrastructure objects", as stated in the title certificate 18042017-01-0184. A legal opinion has been emitted by an Armenian lawyers company, which stated that the preliminary agreement is legally binding and enforceable. Also, there are no houses or private assets located inside the construction site, so that no physical relocation or acquisition of further land will be necessary for this Project. Some fields and farmlands are located to the west and south of the construction site but outside of the Project Area. These will not be impacted by the Project. There are some people living illegally in houses northeast and south of the construction site, which will be affected by noise and air impacts, however no physical or economic displacement will occur due to the Project.

There is already an agreement in place with YCCPP-1 for usage of the access road to the construction site and for usage of the temporary laydown area, which are both in the possession of YCCPP-1.

Impact of/ on	Significance of Impact (after Mitigation)
Land usage and ownership	○

6.3.3 Historical and Cultural Sites

Within the construction site and the Project Area of Influence no cultural or historic sites are known. For the case of an unexpected encounter of Cultural and Historical Sites or Goods a **Chance Find Procedure** has to be implemented. In case of any chance finds, the construction has to be stopped immediately and the Agency of Protection of Historical and Cultural Monuments/ Ministry of Culture has to be informed to agree on further steps (as according to Armenian Law). The Chance Find Procedure will include:

- Stop the construction activities immediately in the area of the find.
- Notify the responsible local authorities and the Ministry of Culture.
- Evaluation of the findings to be performed by the archaeologists of the Agency of Protection of Historical and Cultural Monuments/ Ministry of Culture.
- Decision on how to handle the find to be taken by the responsible authorities and implementation of the decision concerning the management of the finding.
- Construction work could resume only after written permission is given from the responsible local authorities and the Ministry of Culture concerning safeguard of the heritage.

The Ministry of Culture shall be informed by the EPC Contractor about the Project prior to construction, in order to allow the Ministry to perform a proof of occurrence/absence of any cultural or historical goods at the Project site, including a preconstruction field survey, if deemed necessary by the Ministry.

Impact of/ on	Significance of Impact (after Mitigation)
Historical and Cultural Sites	■ (if any)

6.3.4 Occupational and Community Health and Safety

6.3.4.1 Occupational Health and Safety

RENCO SPA will be the EPC Contractor for this Project. RENCO has a Health, Safety and Environment Policy (2015) in place, in order to meet the requirements, regulations and communities affairs for the health of all persons working under the control of RENCO, environment protection and plants safety. An integrated system for safety, environment and quality has been implemented in compliance to international guidelines and standards (RENCO is OHSAS 18001 and ISO 14001 certified).

For construction of YCCPP-2 a site-specific Health, Safety and Environment Management Plan (HSEMP) will be developed and a Health, Safety and Environment Management System (HSEMS) implemented during construction, considering national and international requirements like Occupational Health and Safety Guidelines presented in the IFC/WB General EHS Guidelines and the IFC/WB EHS Guidelines for Thermal Power Plants. An H&S manager of RENCO shall be on duty all the time during construction period. These HSEMP and HSEMS shall also be valid for any third parties or subcontractors in the supply chain.

The HSEMS shall include among others medical health care, proper sanitation installations and use of Personal Protective Equipment (PPE) such as wearing of helmets and ear plugs when working under high noise levels, wearing of safety shoes, protection clothes, etc. The HSEMS shall explicitly

include measures aiming at health and safety of the public (e.g. Life and Fire Safety, Traffic Safety, etc.). Construction workers shall be trained in proper handling and storage of hazardous construction materials etc. Handling and storing materials involve diverse operations such as driving a truck; hoisting tons of steel with a crane; carrying bags or materials manually and stacking materials such as drums, iron parts, barrels, etc. Therefore, specially designated, logistically applicable lay-down areas will be set up inside the boundaries of the foreseen construction site. To manage human exposure to electric and magnetic fields IFC PS and IFC/ WB EHS Guidelines for Electric Power Transmission and Distribution require respecting the limits established by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) - see Section 2.4.

Areas (if any) at the construction site and the adjacent new substation (which is proposed to be connected by underground cable to the new power plant), where high electric or magnetic fields occur, shall be signed. The exposure of workers has to be below the values given above. Workers have to be equipped with special Personal Protective Equipment (PPE) for working in these areas.

Skilled working personnel (partly from abroad) will be accommodated in RENCO’s guesthouse or at hotels in Yerevan. Distance to the construction site is approx. 7 km. Local (mainly unskilled) workforce shall be employed from Yerevan and the adjacent villages. No workers’ camps will have to be established as local workers will return to their home daily, and workers from abroad/other cities will be lodged in RENCO’s guesthouse or hotels. Transfer to and from the construction site will be carried out by personnel private means or public transport, and in addition by means managed by the EPC Contractor. A Traffic Management Plan shall be developed and implemented by the EPC Contractor including, among others, the transport of workers, planning of truck movements, short-term closure of roads (if necessary: details about road use (by whom and for what purpose) and alternative routes), description of communication measures, etc.

Impact of/ on	Significance of Impact (after Mitigation)
Occupational Health and Safety	■

6.3.4.2 Community Health and Safety

Transporting construction equipment on trucks might be dangerous to residents, when trucks drive through residential areas or small villages. Thus, adequate security measures to prevent accidents and injury have to be foreseen as part of the Traffic Management Plan (e.g. keeping speed limits, inform population along public roads in advance in case of transporting heavy equipment, etc.)

The construction site itself will be fenced and the entrance gates will be guarded by security staff in order to prevent any unauthorized access to the site, thus also minimizing possible impacts on community health and safety. Development and implementation of a Security Force Management Plan guided by principles of proportionality, good international practice³⁴ and Armenian national law and include training and monitoring of security personnel regarding the use of force and conduct towards the community.

The new transmission line (overhead line or underground cable) connecting new YCCPP-2 with the high voltage substation just under construction, will be constructed mainly inside the properties of YCCPP-2 or the new substation, just crossing one road. The proposed option is construction of an underground cable.

Emergency Preparedness and Response Plan

RENCO as EPC Contractor shall develop an **Emergency Preparedness and Response Plan** based on robust Quantitative Risk Assessment (QRA) / Hazard Identification Study (HAZID) for the construction period that contains at least the following principles (according to IFC PS 1):

- Identification of areas where accidents and emergency situations may occur
- Definition of assembly points in case of an emergency
- Consideration of earthquake and flood risks
- Identification of communities and individuals that may be impacted
- Establishment of response procedures
- Provision of equipment and resources
- Designation of responsibilities
- Communication with workers and the public
- Training of workers

RENCO shall also assist and collaborate with the potentially affected communities and local government agencies in their preparation to respond effectively to emergency situations. RENCO shall provide appropriate information to potentially affected communities and relevant government agencies. The emergency preparedness and response activities shall be periodically reviewed and revised, if necessary.

The impact on human health for the public during construction can be assessed to be low, if the mitigation measures of the ESMP are implemented.

Impact of/ on	Significance of Impact (after Mitigation)
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³⁴ e.g. UN Code of Conduct for Law Enforcement Officials; UN Basis Principles on the Use of Force and Firearms by Law Enforcement Officials; IFC (2017): Good Practice Handbook on Use of Security Forces - Assessing and Managing Risks and Impacts.

Impact of/ on	Significance of Impact (after Mitigation)
Community Health and Safety	■

6.3.4.3 Noise

As stipulated in the General EHS Guidelines of IFC/ World Bank Group, ‘no employee should be exposed to a noise level greater than 85 dB (A) for a duration of more than 8 hours per day without hearing protection’. Construction workers will wear ear protection devices as part of their Personal Protective Equipment (PPE), if they are exposed to noise levels higher than 80 dB (A), according to Armenian legislation (see also Section 2.4).

Noise impacts to the public will be generated by operation of heavy equipment at the construction site and by an increased frequency of vehicular traffic in the area. However, these impacts are short term, intermittent and temporary in nature.

Residential areas in the located several kilometers away from the site, which are located near to major roads, will be exposed to higher noise levels due to a greater volume of heavy truck traffic passing by on the main roads. Thus, truck movements shall only be allowed during daylight, but not between 7 pm and 6 am.

The overall impact of noise on the environment that is generated during construction of the plant is temporary only and mainly confined to daylight hours, as working hours will only be during the day. It is anticipated that - with the measures outlined in ESMP - it will be possible to reduce noise impacts during construction to an acceptable minimum according to the most stringent limits (see Section 2.4).

Impact of/ on	Significance of Impact (after Mitigation)
Noise	■

6.4 Social Impacts during Operation Phase

6.4.1 Electricity Supply

Power demand in Armenia is constantly rising due to rapidly growing economy and a rising population. The Armenian Government is becoming more focused on financial support for projects that have nation-wide significance, are capable of ensuring an adequate level of energy security and independence, and can secure social and economic development

(Government of Armenia, 2005). The new YCCPP - 2 is listed as one of the projects that shall support achieving these objectives.

The operation of YCCPP-2 with a guaranteed gross power output of 254 MW will increase the total output of electric energy, providing a more reliable power supply countrywide.

Impact of/ on	Significance of Impact (after Mitigation)
Electricity Supply	++

6.4.2 Occupational and Community Health and Safety

6.4.2.1 Occupational Health and Safety

The new power plant YCCPP-2 will be operated by ArmPower CJSC, which is a subsidiary company of RENCO SPA and Siemens. ArmPower is a fit-to-purpose new company. It is assumed that the shareholders' certification will apply to ArmPower, too.

RESCO SPA has a Health, Safety and Environment Policy (2015) in place, in order to meet the requirements, regulations and communities affairs for the health of all persons working under the control of RENCO, environment protection and plants safety. An integrated system for safety, environment and quality has been implemented in compliance to international guidelines and standards (like OHSAS 18001 and ISO 14001 standards).

The implementation of the HSE management system assures a systematic control of safety and environment performances through a constant internal monitoring in order to improve the performances itself.

To meet these targets, among others the following actions have been established:

- Provide a safe working environment to safeguard health of personnel and environment
- Prevent risk situation and hazard to the people, to the material and to the environment
- Prevent and protect in the field of safety and environment (incidents, damages pollution, etc.), under overall aspects managing all the activities in conformity with applicable laws and local regulations
- Provide adequate equipment and qualified personnel to match the requirements of the task
- Provide training, information and dialogue to our personnel
- Preparation of environmental and safety reporting in order to monitor the performance of each project site
- RENCO's responsibilities cover all people working under the RENCO control: consultants, suppliers, subcontractors, etc.

Among others, RENCO SPA has also a Social and Cultural Heritage Policy (2016), as well as an Anti-Corruption Policy (2016) and a Code of Ethics in place.

The above mentioned policies and HSE management systems shall also be established at ArmPower CJSC as subsidiary company of RENCO SPA and Siemens considering national and international requirements like Occupational Health and Safety Guidelines presented in the IFC/WB General EHS Guidelines and the IFC/WB EHS Guidelines for Thermal Power Plants (including among others exposure to heat, confined spaces, fire and explosion hazards, and chemical hazards). The HSEMS shall explicitly include measures aiming at health and safety of the public (including Life and Fire Safety).

RESCO's Human Resources Policy shall include international labor standards as defined in ILO (2014), in order to fulfill the requirements of IFC PS 2.

Impact of/ on	Significance of Impact (after Mitigation)
Occupational Health and Safety	■

6.4.2.2 Community Health and Safety

The Performance Guarantees (ArmPower, 2017) demand the guaranteed gaseous emissions described in Section 2.4. These limits comply with the IFC/World Bank Group EHS Guidelines for Thermal Power Plants (2008). There are no national air emission limits for thermal power plants.

The Final Air Dispersion Calculation (see Section 12.8 in the Annex) proposes a rise in the stack height to 66 meters in order to assure compliance with national and international air quality standards. RENCO will implement this proposal.

Emission of particulate matter (PM₁₀ / PM_{2.5}) from cooling towers will be reduced by including drift eliminators according to Good International Industry Practice (GIIP) in the design of cooling towers and filtering of raw water in order to reduce the content of Total Dissolved Solids (TDS).

The area of the new power plant will be fenced and the entrance gates will be guarded by security staff in order to prevent any unauthorized access to YCCPP-2 site. Development and implementation of a Security Force Management Plan guided by principles of proportionality, good international practice³⁵ and Armenian national law is recommended. This

³⁵ e.g. UN Code of Conduct for Law Enforcement Officials; UN Basis Principles on the Use of Force and Firearms by Law Enforcement Officials; IFC (2017): Good Practice Handbook on Use of Security Forces - Assessing and Managing Risks and Impacts.

shall include training and monitoring of security personnel regarding the use of force and conduct towards the community.

Emergency Preparedness and Response Plan

ArmPower as Operator of YCCPP-2 shall develop an **Emergency Preparedness and Response Plan** for the operation phase, based on the emergency preparedness and response activities already implemented during construction phase of the project. The plan shall be based on robust Quantitative Risk Assessment (QRA) / Hazard Identification Study (HAZID) taking into account general and site-specific risks and contain at least the following principles (according to IFC PS 1):

- Identification of areas where accidents and emergency situations may occur
- Consideration of earthquake and flood risks
- Identification of communities and individuals that may be impacted
- Establishment of response procedures
- Provision of equipment and resources
- Designation of responsibilities
- Communication with workers and the public
- Training of workers

ArmPower shall also assist and collaborate with the potentially affected communities and local government agencies in their preparation to respond effectively to emergency situations. ArmPower shall provide appropriate information to potentially affected communities and relevant government agencies. The emergency preparedness and response activities shall be periodically reviewed and revised, if necessary.

If the mitigation measures given in the ESMP will be implemented the impact on public health and safety will be low.

Impact of/ on	Significance of Impact (after Mitigation)
Community Health and Safety	■

6.4.2.3 Noise

Noise levels will have to be measured regularly during the operation phase of the new power plant and their compliance with the Performance Guarantees (see Section 2.4) will have to be monitored.

YCCPP-2 has been designed with particular attention to limit the noise emissions. The most relevant noise sources will be located inside soundproofed cabins/ buildings to minimize noise propagation.

A Noise Propagation Study is available in Annex 12.6 and includes a Noise Calculation for the new power plant (YCCPP-2) site. The Noise Calculation

has been done by using the propagation model SoundPlan. The model determines sound propagation based on the provisions of ISO 9613. This model is widely used in EU noise mapping projects. Application of this model allows determining whether the noise levels emitted by the new plant will represent a nuisance to the surrounding areas, i.e., if the resulting ambient noise will be above the national and international standards. For more details and methodology refer to Annex 12.6. The simulation results can be consulted in Tables 6-1 and 6-2 below. The corresponding noise map (at 2 meters high) is shown in Figure 6-10 below.

The results provide a comparison to the national and the international noise limit values. The international limit values (IFC EHS General Guidelines) have the particularity that, whenever the background levels are presently above the applicable limits, a maximum increase of 3 dB(A) due to a project is accepted. This is evaluated in the tables below.

Table 6-1: Predicted noise pressure at the sensitive receptors and “post – operam” noise limits compliance check

ID Receptor	Reference period	Applicable limit	“Ante operam” sound pressure LAeq [dB(A)]	“Ante operam” noise limits compliance check	Sound level contribution LAeq [dB(A)]	Predicted noise (“post operam”) pressure value LAeq [dB(A)]	Predicted (“post operam”) noise limits compliance check
Work-day							
R1	Day time	55	49,8	Compliant	32,5	49,88	Compliant
	Night time	45	47,1	Not compliant: In this case, a max. increase of 3 dB (A) is allowed for „post operam“	32,5	47,25	Compliant: the maximum increase is of +0,15 dB (A)
R2	Day time	55	72,6	Not compliant: In this case, a max. increase of 3 dB (A) is allowed for „post operam“	38,0	72,60	Compliant: the maximum increase is of +0,00 dB (A)
	Night time	45	62,4	Not compliant: In this case, a max. increase of 3 dB (A) is allowed for „post operam“	38,0	62,42	Compliant: the maximum increase is of +0,02 dB (A)
R3	Day time	55	48,1	Compliant	34,9	48,30	Compliant
	Night time	45	40,0	Compliant	34,9	41,17	Compliant
R4	Day time	70	53,6	Compliant	42,7	53,94	Compliant
	Night time	70	57,3	Compliant	42,7	57,45	Compliant
R5	Day time	55	36,2	Compliant	31,8	37,55	Compliant
	Night time	45	39,4	Compliant	31,8	40,10	Compliant
Weekend							
R1	Day time	55	43,4	Compliant	32,5	43,74	Compliant
	Night time	45	49,0	Not compliant: In this case, a max. increase of 3 dB (A) is allowed for „post operam“	32,5	49,10	Compliant : the maximum increase is of +0,10 dB (A)
R2	Day time	55	72,8	Not compliant: In this case, a max. increase of 3 dB (A) is allowed for „post operam“	38,0	72,80	Compliant : the maximum increase is of +0,00 dB (A)
	Night time	45	59,2	Not compliant: In this case, a max. increase of 3 dB (A) is allowed for „post operam“	38,0	59,23	Compliant : the maximum increase is of +0,03 dB (A)
R3	Day time	55	43,9	Compliant	34,9	44,41	Compliant

ID Receptor	Reference period	Applicable limit	“Ante operam” sound pressure LAeq [dB(A)]	“Ante operam” noise limits compliance check	Sound level contribution LAeq [dB(A)]	Predicted noise (“post operam”) pressure value LAeq [dB(A)]	Predicted (“post operam”) noise limits compliance check
	Night time	45	33,9	Compliant	34,9	37,44	Compliant
R4	Day time	70	56,4	Compliant	42,7	56,58	Compliant
	Night time	70	57,2	Compliant	42,7	57,35	Compliant
R5	Day time	55	35,6	Compliant	31,8	37,11	Compliant
	Night time	45	34,2	Compliant	31,8	36,17	Compliant

As measurement point ‘Noise 4’ is located in an industrial area, limit values for industrial areas have been used in Table 6-1 for this point. However, as this measurement point is located near to the illegal housings northeast of YCCPP-1, Table 6-2 below shows in addition the relevant noise pressure at this point under consideration of limit values (international = national) for residential areas.

Table 6-2: Predicted noise pressure at the sensitive receptors and “post – operam” noise limits compliance check - measurement point ‘Noise 4’

ID Receptor	Reference period	Applicable limit - <u>residential areas</u>	“Ante operam” sound pressure LAeq [dB(A)]	“Ante operam” noise limits compliance check	Sound level contribution LAeq [dB(A)]	Predicted noise (“post operam”) pressure value LAeq [dB(A)]	Predicted (“post operam”) noise limits compliance check
Work-day							
R4	Day time	55	53,6	Compliant	42,7	53,94	Compliant
	Night time	45	57,3	Not compliant: In this case, a max. increase of 3 dB (A) is allowed for „post operam“	42,7	57,45	Compliant : the maximum increase is of + 0.15 dB (A)
Weekend							
R4	Day time	55	56,4	Not compliant: In this case, a max. increase of 3 dB (A) is allowed for „post operam“	42,7	56,58	Compliant : the maximum increase is of + 0.18 dB (A)
	Night time	45	57,2	Not compliant: In this case, a max. increase of 3 dB (A) is allowed for „post operam“	42,7	57,35	Compliant : the maximum increase is of + 0.15 dB (A)

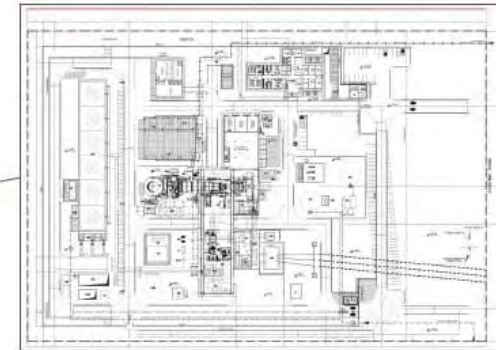
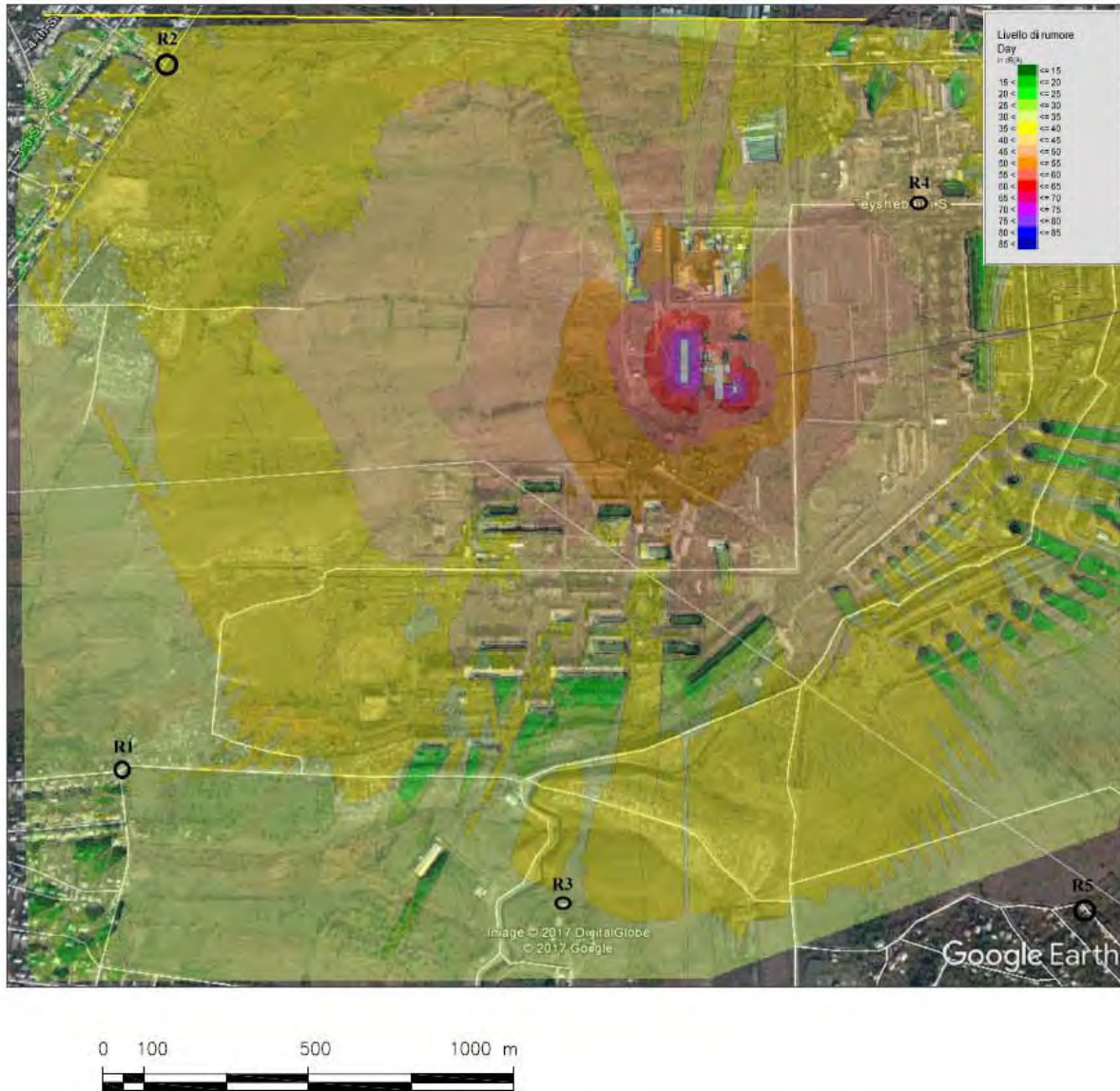
The calculation outcomes of the model for YCCPP-2 have shown that the operation of **the new plant will not produce any significant increase of the noise pressure at the sensitive receptors**. In particular:

- where the current noise pressure is under the applicable limits, the YCCPP-2 operation will not produce any exceedance of the said limit either during the daytime or during the night time;
- where the current noise pressure is already over the applicable limits, the YCCPP-2 will produce a negligible contribution, i.e., a contribution below 3 dB(A). The IFC standards are therefore respected as well as these locations.

As last consideration, it has to be underlined that, although at the YCCPP-2 fence no sensible receivers are present, the sound level contribution of the plant will be significantly below the applicable international industrial areas noise limit (70 dB(A)) and national industrial buildings noise limit (80 dB(A)).

Under implementation of the mitigation measures given in the ESMP the impact of noise generated during operation of YCCPP-2 is at the moment rated to be low.

Impact of/ on	Significance of Impact (after Mitigation)
Noise	■



Plant layout

Item	Source	Lp(A) (@1m) [dB(A)]
HRSG	Lateral Walls	71
	Roof	71
Air Intake GT	Intake	77
HRSG Diffuser	All surfaces	70
Main Machine Building (GT, SF)	All surfaces	60
Stack	External surfaces	75
Close cycle heat exchanger	Mouth	80
	All surfaces	75
Cooling Towers	All surfaces	80
Main Transformer	All surfaces	80
Units Transformer	All surfaces	75
Fuel Gas Booster Compressors Building	All surfaces	80
Auxiliary Boiler	All surfaces	60

Most relevant Noise emission Items considered in the Plant project

Annex A	
Noise emissions - 2 m height noise map	

Figure 6-10: Noise map at 2 meters height resulting from the simulation with Sound Plan

6.4.3

6.4.3 Job Opportunities

During operation phase the workforce is estimated by RENCO to be approx. 120 people comprised of administration, and operation and maintenance staff on roster working shifts. Most jobs during operation of YCCPP-2 will be for specialized workers (electrical engineers, automation and control engineers, mechanical engineers, etc.) which will require specific power plant training and will not be readily found in Armenia, with exception of personnel presently operating at similar plants (e.g. YCCPP-1). These personnel would also require some retraining to adapt to the new facilities. There are also graduated people (with electrical and mechanical training) from Yerevan who could potentially work at the new plant. However, extensive training on the job as well as theory training is recommended. .

A few simpler jobs (e.g. food supply, housekeeping, etc.) however, will also be available for people which shall be employed from the adjacent residential areas (if possible) in order to create some additional income. Special attention shall be laid on the recruitment of women.

Impact of/ on	Significance of Impact (after Mitigation)
Job opportunities	+

6.5 Additional Impacts from new Connection Facilities

Interconnections to gas, water and electrical grid are planned. The new CCPP shall be connected with the facilities of the existing grid infrastructure provided below (see Figure 3-3):

- Electricity: A new 220 kV substation is just under construction for YCCPP-1; the connection from the new power plant to the new substation is proposed to be by underground cable (still subject of design, if overhead transmission line or underground cable will be used); the distance between the new power plant and the new 220 kV substation is approx. 400 m
- New connection to the natural gas supply pipeline system from Gazprom Armenia, approx. 1,500 m (under responsibility of Gazprom Armenia)
- New connection to the city water system managed by Veolia (make-up water), approx. 1,000 m
- New connections to the water sewerage of the city, approx. 450 m
- New connection to the industrial waste water discharge system downstream of YCCPP-1, less than 100 m

6.5.1 Additional Impacts during Construction Phase

Impacts and mitigation measures mentioned in the sections above concerning the construction phase of the Project also apply to the construction of the necessary additional connection facilities. **Additional aspects** to be considered are presented in the following, based on the information available at the time of writing this report.

Impacts on **flora and fauna** from construction of the new connection facilities will be low after implementation of mitigation measures. If any trees will have to be felled for construction of water and gas pipelines or for the transmission line/ underground power cable, replanting of trees (native site-adapted tree species) shall be performed, based on a replanting plan to be developed.

Possible **soil erosion** due to the excavation for underground pipelines shall be additionally considered in the Erosion and Sediment Control Plan that is already recommended.

No additional **land** will have to be acquired for the construction of the planned connections, as the land is already in possession of the operator or the Government. No physical relocation will be necessary for the above mentioned construction activities.

The Chance Find Procedure regarding **historical and cultural goods** will also apply to the construction activities considered here in this section.

HSE Management Plan and HSE Management System to be set up by the EPC Contractor have to consider also the construction of the mentioned connection facilities. Specially trained workers equipped with the necessary personal protective equipment will be required for connecting the additional gas pipeline to the existing gas infrastructure. The same applies for connection of the new transmission line/ underground cable to the substation.

The **Traffic** Management Plan to be developed by the EPC Contractor has also to consider the construction works of these connections. Construction sites will have to be clearly signed and a short-time closure of roads for construction works may be necessary.

Special attention has to be paid to already **existing infrastructure** like e.g. gas, water and power connections of the already existing YCCPP-1 and existing communal supply lines or sewerage systems, in order not to damage any existing infrastructure during construction works. If for connections works the gas or water supply has to be interrupted, all affected parties (e.g. industries, private persons) will have to be informed in advance about the date, extent and duration of the foreseen interruption.

6.5.2 Additional Impacts during Operation Phase

Impacts and mitigation measures mentioned in the sections above concerning the operation phase of the Project also apply to the operation of the necessary additional connection facilities. These have also to be considered in the Emergency Preparedness and Response Plan to be developed and implemented by the operator of YCCPP-2.

Regarding health and safety of the public the new transmission line (overhead line or underground cable) connecting new YCCPP-2 with the high voltage substation just under construction, will run nearly completely inside the properties of YCCPP-2, crossing one road to reach the tie-in point at the border of the substation. Good Engineering Practice will be implemented in order to avoid any danger to the public, according to the alternative chosen (it is foreseen to construct an underground cable). If an overhead line will be constructed it will be assured that e.g. in the case of falling down of cut wires circuit breakers will immediately stop the power flow.

The new gas pipeline that will lead from the metering point inside the property of YCCPP-2 to the tie-in point proposed by Gazprom Armenia and will be under the responsibility of Gazprom. It is recommended, however, to construct an overhead pipeline (as the already existing ones) and to construct concrete poles where the pipeline runs on the ground to avoid possible accidents with cars from the road.

6.6 Additional Impacts during Decommissioning Phase

Design life of YCCPP-2 is 20 years. Even though the operator ArmPower will probably apply for an extension of the operating permit, the decommissioning phase is also considered shortly in this ESIA.

If the power plant will be dismantled after closedown, environmental and social impacts regarding air emissions, noise, traffic, local workforce, etc. will be mainly the same as during the construction phase. The dismantling works will have to adhere to the latest editions of national and international laws and guidelines, or even to new ones that will be relevant at this time. Mitigation measures regarding the impacts during decommissioning will also be mainly the same as during construction phase. A Decommissioning Plan shall be prepared by the operator at least 5 years before closure of the plant, and a Detailed Decommissioning Plan shall be developed at least 18 months in advance of the closure of the plant.

It shall be highlighted that a large amount of waste will have to be managed, if the plant will be dismantled. This will also include different types of hazardous waste. A detailed Waste Management Plan for Decommissioning will have to be developed by ArmPower following the same principles as given in Section 6.1.7 respecting the waste management hierarchy of avoidance, preparing for reuse, recycling as much as possible (e.g. scrap metal, batteries), recovery, and proper disposal of remaining waste

according to EU Directive 2008/98/EC (Waste Framework Directive). Scrap metal and used batteries can be sold to local recycling companies at Yerevan like e.g. Metexim LLC, or others.

In the next 20 years a solution for the final disposal of hazardous waste will probably be decided upon and provided by the Government of RA. Hazardous waste shall be stored first in adequate storage sites (lockable, roofed, ventilated, concreted and bunded floor) at the YCCPP-2 site. All hazardous wastes shall be securely packed in sealed drums or other suitable containers, clearly identified by labels, and marked according to national and internationally recognized requirements and standards, including the International Chemical Safety Cards (ICSC), Materials Safety Data Sheets (MSDS), or equivalent. Hazardous waste shall then be disposed of, if adequate disposal sites exist at the time.

6.7 Summary of Impacts

A summary of the assessment of the environmental and social impacts, **after implementation of the mitigation measures** presented in the ESMP, is given in the following tables.

Table 6-3: Summary of impacts during construction phase (incl. associated facilities)

Impact of/on	Significance of Impact on/by
Fauna, Flora and Biodiversity	■
Protected Areas	○
Soil Use and Soil Erosion	■
Soil Contamination	■
Surface Water	○
Groundwater deviation	(still unknown - see ESAP)
Groundwater contamination	■
Climate and Air Quality	■
Landscape and Visual Aspects	■
Waste	■■
Local Workforce	+
Land Use and Ownership	○
Historical and Cultural Sites	■ (if any)
Occupational Health and Safety	■
Community Health and Safety	■
Noise	■

Table 6-4: Summary of impacts during operation phase (incl. associated facilities)

Impact of/on	Significance of Impact on/by
Fauna, Flora and Biodiversity	■
Protected Areas	○

Impact of/on	Significance of Impact on/by
Soil Contamination	■
Water Courses	■
Groundwater deviation	(still unknown - see ESAP)
Groundwater contamination	■
Climate and Air Quality	■
Landscape and Visual Aspects	■
Waste	■
Electricity Supply	++
Occupational Health and Safety	■
Community Health and Safety	■
Noise	■
Job opportunities	+

Table 6-5: Summary of impacts during decommissioning phase (incl. associated facilities)

Impact of/on	Significance of Impact on/by
Fauna, Flora and Biodiversity	■
Protected Areas	○
Soil Use and Soil Erosion	■
Soil Contamination	■
Surface Water	○
Groundwater contamination	■
Climate and Air Quality	■
Landscape and Visual Aspects	○
Waste	■■■
Local Workforce	+
Land Use and Ownership	○
Historical and Cultural Sites	○
Occupational Health and Safety	■
Community Health and Safety	■
Noise	■

Significance of Impact:

■■■	=	high
■■	=	medium
■	=	low
○	=	nil
+	=	locally positive
++	=	regionally positive

In conclusion, from the results of the impact assessment it can be seen that the environmental and social impacts will be of low or medium extent, if all proposed mitigation measures of the ESMP are implemented. The highest expected impacts relate to solid waste, as presently there is not a solution for management of hazardous waste in Armenia. Positive impacts are related to creating of job opportunities especially during construction. The additional

power generation will increase the total output of electric energy, providing a more reliable power supply countrywide.

7. Information Disclosure, Consultation, and Participation

7.1 Background

During the preparation of the National ESIA (Ecobarik-Audit LLC 2016), consulting and information disclosure activities with some stakeholder groups have been undertaken. The invitations for these sessions can be consulted in the Final SEP (Stakeholder Engagement Plan) presented as an Annex (Section 12.9) to this ESIA Report.

This chapter describes shortly the stakeholder meetings held by FICHTNER during the site visit in July 2017 and provides an overview about the requirements for disclosure of the ESIA study to the public and performing of a Public Consultation meeting at 10th February 2018, where stakeholders and Project Affected People (PAP) had the chance to give their feedback and concerns regarding the ESIA study and the implementation of the Project. The Final SEP provides further details about this procedure.

During the site visit in July 2017, FICHTNER's environmental and social specialists performed stakeholder meetings with mayors of the adjacent villages Kharberd and Ayntap, with the Heads of Departments of Erebuni and Shengavit Administrative Districts, with the Environmental Monitoring and Information Center, with the Environmental Department of the Municipality of Yerevan, and with the Aarhus Center ³⁶ (for a record of the meetings see Section 12.3).

The mayors of the villages Kharberd and Ayntap had no concerns regarding the implementation of the Project. No medical/ health issues of local population concerning the operation of existing YCCPP-1 were reported. As both villages suffer under a high unemployment rate (> 70%) the mayors hope that the Project will create jobs for the local population. These statements have also been supported during the discussions with the Heads of Departments of Erebuni and Shengavit Administrative Districts.

The Final Draft version of the ESIA, including the ESMP and Non-Technical Executive Summary (NTES) were disclosed to the public in English and Armenian versions. Interested people were provided access to the documents, which were not only posted on ArmPower's website, but were also delivered in printed copies to the local administration offices; advertisements in local media about their availability were made. Also the Aarhus Center received printed copies and ensured their sharing to the representatives of civil society organizations.

ADB's and IFC's policies require that once draft final ESIA report is disclosed, sufficient time is allowed for stakeholders to get acquainted with

³⁶ Aarhus Center Yerevan is a NGO that promotes public participation in environmental/ social decision making processes and in managing activities of upcoming projects.

the document prior to participating in a consultation meeting or otherwise communicating their feedback. According to national Armenian requirements the disclosure period is only 7 days, but disclosure of the documents for at least two weeks is recommended and was undertaken.

After disclosure of the documents, a public consultation meeting on the ESIA was held on 10th February 2018. It concentrated on interpreting the ESIA report to the stakeholders and seeking their feedback and concerns, which were then used as an input for the preparation of the Final ESIA report.

Various NGOs and the Aarhus Center Yerevan were invited to the public consultation meeting. The Aarhus Center helped to identify relevant NGOs and ensured sharing of information/ studies.

According to ADB's Safeguard Policy Statement (2009) and ADB's Public Communication Policy (2011), a draft environmental impact assessment (EIA) report for an environment category A project shall be disclosed for at least 120 days on ADB's website before Board consideration. ADB disclosed the Draft ESIA study in August 2017 on its website. IFC's Sustainability Framework (IFC 2012) requires a disclosure of 60 days for a category A project. An Environmental & Social Review Summary as well as the Draft ESIA study were disclosed on IFC's webpage in 27 December 2017.

For further details see the Final Stakeholder Engagement Plan in Section 12.9.

7.2 Results from the 2018 Public Consultation meeting

A public consultation meeting was held at 10th February 2018 at the Milano Hall in Double Tree Hotel in Yerevan city center. The meeting was advertised in the newspapers, invitation letters have been sent to relevant governmental institutions and stakeholders, and the invitation was published on RENCO's website. Local governments made the invitation available on their websites, at their offices and in other public places. For participating in the consultations, free transportation was made available from four pick-up points located in the residential areas nearest to the foreseen construction site.

At the public consultation meeting the Non-Technical Summary of the ESIA study was made available to the participants in printed copies in English and Armenian languages. A printed leaflet in both languages presented the main possible environmental and social impacts and the respective mitigation measures, as well as information about the grievance mechanism, including the contact details of RENCO's grievance coordinator. Furthermore, public grievance forms, comment forms to the ESIA study and feedback forms in English and Armenian were given to the participants.

After an introduction to the Project given by the Industrial Plants Division Director of RENCO, Fichtner's environmental and social specialist held a non-technical introduction (with slides) presenting the main contents and results of the ESIA. It was held in English and translated consecutively in Armenian language. All questions raised in Armenian were translated into English language; the answers to these questions were also translated consecutively into Armenian. The slides to the presentation were shown in Armenian.

This introduction presented a project description, stated who did the investigation, and gave information about the method of investigation and the method of assessment. Analysis of different alternatives was shortly demonstrated. Main possible environmental and social impacts of the Project were communicated and some examples were shown in detail, measures for mitigation and their monitoring were introduced, and recommendations were presented. The ESMP and Grievance Redress Mechanism were also introduced. After the introduction the discussion started. Answers to the questions were given by Fichtner's specialist and the representatives of RENCO.

The main concerns raised by the participants were about possible air pollution, water sources for operation, waste water treatment, waste management including hazardous substances, potential historical or cultural goods at the construction site, landscaping as additional possible mitigation measure, and more generally on the risk of higher electricity prices due to the involvement of private sector in energy production and regarding the necessity of building this power plant.

The questions raised and the corresponding answers of the meeting are given in the Minutes of Meeting in Section 12.13 in the Annexes, as well as the list of participants.

Recommendations from the Public Consultation Meeting

- Monitoring data which will be regularly collected during operation in order to verify the adherence of the new power plant's air and liquid emissions to the relevant limits shall be made available online. This will be taken into account by RENCO.
- Cooperation with the "Dalma-Sona" Cultural and Educational, Social and Ecological Foundation shall be foreseen in case of any chance find of historical or cultural goods during construction, which in any case will be reported to the Ministry of Culture.
- The landscape management plan shall foresee to include also landscaping in the Shengavit and Erebuni Districts apart from the area directly adjacent to the new power plant.
- It was suggested and welcomed by RENCO to cooperate with the Consumers Support Center as much as possible in relation to the grievance redress mechanism.

The returned feedback forms criticized that no representatives of authorities were present at the meeting, in order to answer e.g. questions about the necessity of the construction of YCCPP-2. However, as is shown in Section 12.13 in the Annexes they have been invited and verbally confirmed their participation. The mayors of the adjacent villages Kharberd and Ayntap and the Heads of Departments of Erebuni and Shengavit Administrative Districts were directly consulted by Fichtner in July 2017 about their possible concerns regarding the Project.

As no participants of the people living illegally in the vicinity of the existing YCCPP-1 (as nearest sensitive receptors) have been present at the consultation meeting, it was agreed with RENCO that the above mentioned documents that were presented at the meeting will also be distributed to them directly.

Conclusion

The Public Consultation meeting was successfully conducted with a good participation. Apart from interested private persons, mainly representatives of NGOs as well as from other public entities participated actively in the discussion.

7.3 Consultation of nearby temporary residents

Nearby the project site there are people living in temporary houses. These people are classified as vulnerable under ADB's Safeguard Requirements as they are poor and occupy illegal housing. Their vicinity to the Project Area makes them directly affected by construction and operation impacts, however no physical or economic displacement will occur due to the Project.

To avoid that the people living in temporary houses nearby the site would be left unaware of the consultation process, RENCO organized a personal meeting on the 12th of February (Figure 7-1 below).



Figure 7-1: Meeting with residents of the nearby temporary houses (source: RENCO, February 2018)

The residents had been absent from the Public Consultation Session that happened two days before because, according to their own declarations, they are mostly concerned about their housing problems (not project related). The people expressed their hope that the construction works will provide them with business opportunities (little markets, stores, canteens and fast food) and jobs. They also expect that their public transportation problems will be solved with the flow of YCCPP-2 construction workers. RENCO's responsible's telephone and email contacts have been transmitted to the residents.

8. Grievance Redress Mechanism

8.1 General Public Grievance Mechanism

In the course of the construction and operation, Project Affected People (PAP) may feel treated unjustly. This might happen for various reasons such as: the contractor does not adhere to sound construction principles, misunderstandings have arisen, or disagreement with procedures of consultation or notification. If this happens people shall be encouraged to lodge their complaints in a timely and effective manner without directly addressing the court, i.e., through a grievance mechanism.

All PAP will be notified about the Grievance Redress Mechanism (GRM) of the YCCPP -2 Project during the Public Consultation meetings, as well as through the disclosed project information leaflets. Contact data of the **RENCO's Grievance Coordinator (GC)**, part of the **Grievance Redress Committee (GRC)**, will be disclosed.

During consultation the PAP shall be notified orally or in a written form about their rights and the procedure of filing complaints. Local NGOs, e.g. the local Aarhus Centre, can inform communities about the possibility to raise complaints and how and where to address them. The grievance mechanism has to be locally implemented at the level of village institutions and local self-government, as well as bundled on national level at RENCO/ArmPower.

Grievances can be addressed at the local community level ('marzpet'), where the grievance will be recorded and forwarded to RENCO's GC. Grievances that are addressed to the EPC Contractor during the execution of civil works shall also be forwarded to RENCO's GC. Even if the constructor decides to settle the grievance on the spot, the documentation of the grievance settlement procedure needs to be prepared by RENCO's GC.

All project related complaints can in addition be directly addressed to RENCO's GC via phone, e-mail or grievance form (the SEP presents an example of the public grievances form). A project grievance hotline shall be made available by RENCO for direct complaints (at national level), and all received grievances shall be recorded in the Stakeholder Log.

The RENCO GC then decides whether to settle directly or to arrange a meeting with the Grievance Committee. The decision has to be taken within 15 days. In case of major grievances that cannot be directly settled, permanent and non-permanent members of the Grievance Committee will be called for a meeting. In case of failure of the grievance redress system, the PAP can submit their case to the appropriate court of law.

The EPC Contractor RENCO is obliged to carry out the work in accordance with the contractual requirements that include:

- Nominate a person of staff responsible for the reception and handling of grievances;
- Preparation of regular monitoring reports including details of any complaints that arose and how they were handled;
- If vulnerable affected people are identified, then the contractor will appoint professional advocates (social workers/legal experts) to assist those people during the entire process, and to act as independent advocates for them should any grievances arise;
- Arbitration of grievances with ArmPower and PAP.

ArmPower will carry out works that include:

- Nominate a person of staff responsible for grievance procedure coordination, hereby referred to as Grievance Coordinator (including first contact, periodical site visiting of mitigation measure to be implemented by contractor);
- A telephone line, e-mail address and contact name on project boards;
- Arbitration of grievances with contractor and PAP.
- Liaison with court.

The PAP have the option to choose a different representative, or directly liaison with ArmPower' staff responsible for grievance redress. Vulnerable households will have the support of their individual social worker and legal support, if applicable.

PAP need to be informed that in case of conflict with the community leader they can address NGO staff to follow up their complaint.

The aggrieved person (PAP) is encouraged to proceed in the following way:

- a) Contact contractor's designated grievance staff in the following way: in person via the designated telephone number, via email, via regular mail. Alternatively, the PAP can contact their community leader, who would convey their grievance to the contractor's designated grievance staff.
- b) Lodge a complaint and provide information on the case. Each complaint will be registered and a tracking number will be assigned to it. Responses to all complaints should be provided within 15 days (or 25 days in cases where complaint resolution requires special efforts).
- c) Agree with the contractor on a mitigation measure.
- d) Agree with the contractor on time limit for grievance settlement. Grievances have to be settled within two weeks, or otherwise specified in scheduled agreement.
- e) Sign if the mitigation measure has been implemented as agreed
- f) Seek redress from ArmPower if not satisfied with the above mentioned procedure through the designated telephone numbers, in person, or via email or regular mail. ArmPower should register all grievances and provide response within 15 days.

- g) Involve appropriate NGOs
- h) Seek redress from court if all else fails.

Although the grievance mechanism is designed to avoid lengthy court procedures, it does not limit the citizen’s right to submit the case straight to the court of law.

Figure 8-1 provides a flowchart of the Grievance Redress Mechanism as described above.

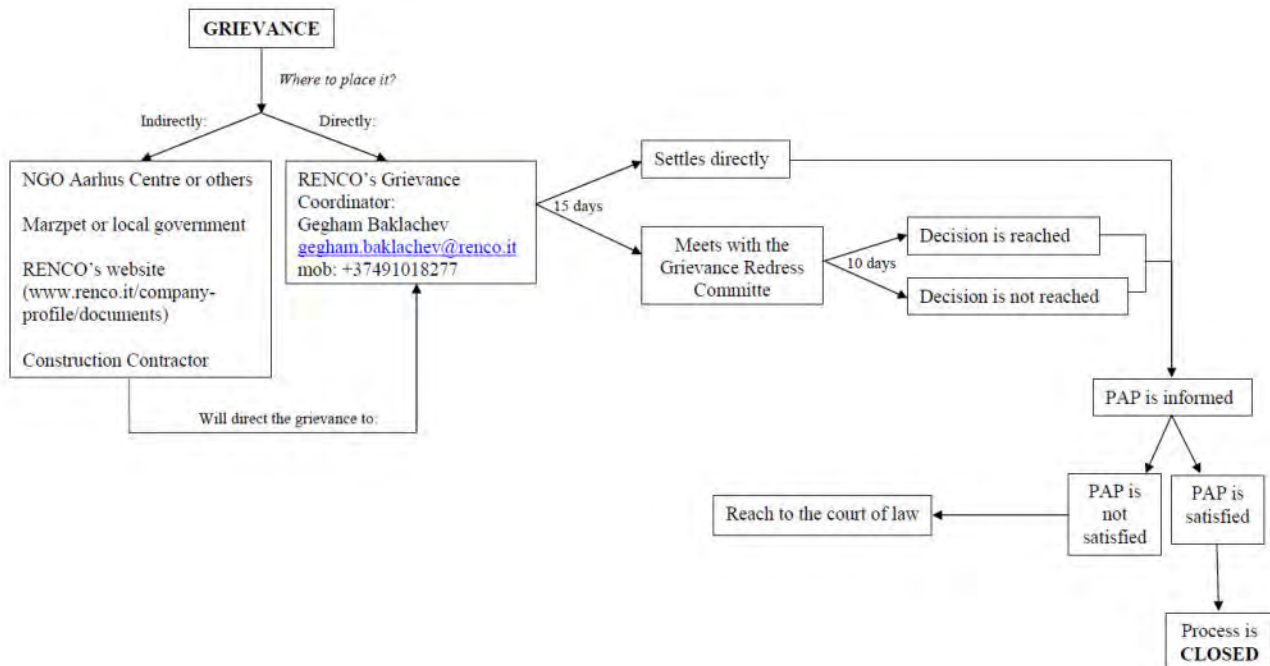


Figure 8-1: Flowchart of Grievance Redress Mechanism

ADB and IFC are not directly a part of the Grievance procedure but shall receive reports about which complaints were received and how they have been followed up/ mitigated.

Special consideration has to be taken for vulnerable people as complaint mechanisms may be unusual and contact with legal procedures let alone courts of law may appear uninviting. This would prevent the most disadvantaged persons from addressing their grievance. A personal contact with PAP is therefore recommended.

Vulnerable PAP (all households below the poverty line) will be entitled to a legal aid/ social worker to support them with complaints procedures.

An example of the public grievances form that is available in the developer’s webpage is provided in the Stakeholder Engagement Plan (SEP) (Section 12.9 in the Annex).

8.2 Workers Grievance Mechanism

The EPC Contractor RENCO and the future operator of YCCPP-2 ArmPower are requested to implement an independent grievance management system to enable the workers (and their organizations, where they exist) to raise reasonable workplace concerns. This includes complaints related to non-compliance with Health & Safety matters, discrimination cases and non-consideration of equal opportunities.

The workers grievance mechanism shall follow the same principles as the one created for the general public: complaints must be answered in a timely and effective manner without fear of retribution; the access to the grievance mechanism shall not replace or impede the subsequent access to other redress mechanisms; the promoter will inform workers of the grievance mechanism at the time of hire and make it accessible to them.

The grievance management system shall consider the possibility to contact directly a member of the Site Management Staff. The contacted staff members must take a note of the reported complaint or non-compliance and must report it to the Site Manager.

The Site Manager is requested to solve the complaint or non-compliance within 3 working days. In case the problem cannot be solved an action procedure specifying the needed activities together with a predicted deadline for resolution of the problem must be prepared and submitted to the general manager.

The EPC Contractor RENCO and ArmPower as operator are requested to provide as well the possibility for the workers to notify a complaint or non-compliance in a confidential way.

According to RENCO SPA a grievance mechanism for workers will be established for this Project, as it has been done in other international projects before. The system will allow staff and contractors to provide feedback on any element of the work via email or by hand delivery to a box placed on site. Grievances will be logged into a spreadsheet where they will be then delegated to the appropriate person for close out. Grievances will be confidential and staff and contractors will be in no way penalized for providing their feedback.

9. Environmental and Social Management Plans (ESMPs)

The negative environmental and social impacts of the Project that are described in Chapter 6 can be avoided, minimized or mitigated by performing suitable measures.

This chapter deals with the concrete mitigation measures (Section 9.1) and the monitoring measures (Section 9.2) to be taken during the construction, operation and decommissioning phases of YCCPP-2. It summarizes the anticipated environmental and social impacts and provides details on the measures; responsibilities to mitigate these impacts; the costs of mitigation; and the ways in which implementation and effectiveness of the measures will be monitored and supervised.

The compliance of the Project with IFC Performance Standards (PS) after implementation of the mitigation and monitoring measures given in the ESMPs is analyzed in Section 9.7.

An Environmental and Social Action Plan (ESAP) is presented in Section 9.8 in order to highlight the most urgent steps for implementation of the mitigation measures given in the ESMP, according to the relevant IFC Performance Standards and/or international guidelines and standards.

9.1 Mitigation Measures

9.1.1 Mitigation Measures for the Construction Phase

Table 9-1: Summary of Mitigation Measures during Construction Activities concerning Fauna and Flora

Mitigation measures to be applied during construction phase		
Issue for Mitigation: Impacts on Fauna and Flora		
Mitigation measures (considering IFC PS 6 and General EHS Guidelines)	Responsible Party	Budget for implementing (USD)
Prohibition of herbicides for site clearance (use mechanical process only)	EPC Contractor	Included in construction costs
Mitigation measures to be implemented to reduce risks of soil and water contamination also mitigate the impact on flora and fauna (see Table 9-3 and Table 9-4)		
Mitigation measures to be implemented to noise reduction like using low sound power mechanical equipment also mitigate the impact on noise sensitive fauna (if any)		
Dust generated by construction works (e.g. excavation works) shall be suppressed by spraying water		

Table 9-2: Summary of Mitigation Measures during Construction Activities concerning Erosion Control

Mitigation measures to be applied during construction phase		
Issue for Mitigation: Erosion		
Mitigation measures (considering IFC PS 3 and General EHS Guidelines)	Responsible Party	Budget for implementing (USD)
Develop and implement an Erosion and Sediment Control Plan	EPC Contractor	Included in construction costs
Minimization of the area of construction site and material storage		
Minimize removing topsoil at construction site and store in line with international good practice, so that it can be re-used after construction		
Protect excess spoils, if any, from runoff		

Table 9-3: Summary of Mitigation Measures during Construction Activities concerning Soil Pollution

Mitigation measures to be applied during construction phase		
Issue for Mitigation: Soil pollution		
Mitigation measures (considering IFC PS 3, General EHS Guidelines and EHS-Guidelines: Waste Management, Hazardous Material Management)	Responsible Party	Budget for implementing (USD)
Regular maintenance of all vehicles and machines at regular service stations, if possible	EPC Contractor	Included in construction costs
Maintenance and re-fueling of the construction equipment only on sealed and enclosed areas		
In case of any spillage: Localization of the spilled material and immediate cleaning of the contaminated area in order to prevent the pollutant from entering soil		
Store all liquid materials (e.g. fuel, engine oil, paint, chemicals, lubricants, etc.) in locked tanks and on sealed, bunded and roofed areas. Installation of secondary containment for storing liquid materials is recommended.		
Store construction material (bags of cement etc.) in containers in order to avoid rinsing out		
Train transporters and workers in spill prevention and control especially in handling of oil and fuel		
Provide spill-control materials to drivers and workers, in order to clean up spills, if necessary		
Equip all construction vehicles with spill-control kits		
Report and respond to spills promptly and train workers in how to report		
Remove contaminated soil if spills occur and handle as hazardous waste		

Table 9-4: Summary of Mitigation Measures during Construction Activities concerning Water Pollution

Mitigation measures to be applied during construction phase		
Issue for Mitigation: Water pollution		
Mitigation measures (considering IFC PS 3, General EHS Guidelines and EHS-Guidelines: Water and Sanitation, Wastewater and Ambient Water Quality, Waste Management, Hazardous Material Management)	Responsible Party	Budget for implementing (USD)
Mitigation measures given in Table 9-3 (Soil Pollution) also apply to avoid groundwater pollution	EPC Contractor	Included in construction costs
Construction site has to be equipped with toilets and sanitary rooms according to IFC/ EBRD Guidance Note ³⁷ - separately for men and women; lead sewage water to city sewage water system or use septic tanks for collecting sewage water, which have to be emptied by a specialized company from time to time.		
Train workers in appropriate sanitation practices		
Provide waste bins at the construction site in order to collect workers' waste (implement Waste Management Plan)		
Conduct further hydrological assessment and implement appropriate environmental management of the foreseen groundwater deviation at site including: impacts and mitigation measures for changes to the groundwater profile, both within the site and on neighboring properties; study of water treatment options in the unlikely event that groundwater rises to the surface or needs to be removed from the site and discharged in a different receptor (river or public network); assessment to be approved by IFC and ADB before construction.		

Table 9-5: Summary of Mitigation Measures during Construction Activities concerning Climate and Air Quality

Mitigation measures to be applied during construction phase		
Issue for Mitigation: Impacts on Air Quality and Climate Change		
Mitigation measures (considering IFC PS 3, General EHS Guidelines and EHS-Guideline: Air Emissions and Ambient Air Quality)	Responsible Party	Budget for implementing (USD)
Reduction of speed to 20 km/h within the construction site and optimization of the movement of vehicles	EPC Contractor	Included in construction costs
Optimize transportation management to avoid needless truck trips (as part of a Traffic Management Plan)		
Maintain vehicles and construction machinery properly maintained, as recommended by suppliers		
Cover truck beds with tarps during material transport		

³⁷ see IFC/ EBRD Guidance Note on Workers' Accommodation (2009)

Mitigation measures to be applied during construction phase		
Issue for Mitigation: Impacts on Air Quality and Climate Change		
Mitigation measures (considering IFC PS 3, General EHS Guidelines and EHS-Guideline: Air Emissions and Ambient Air Quality)	Responsible Party	Budget for implementing (USD)
Use dust-suppressing water spray during civil works, where necessary		
Store and handle material appropriately to limit dust (e.g. protect cement with tarpaulins)	EPC Contractor	Included in construction costs
Avoid unnecessary idling of construction machines and vehicles		

Table 9-6: Summary of Mitigation Measures during Construction Activities concerning Landscape and Visual Aspects

Mitigation measures to be applied during construction phase		
Issue for Mitigation: Impacts on Landscape and Visual Aspects		
Mitigation measures (considering General EHS)	Responsible Party	Budget for implementing (USD)
Use dust-suppressing water spray during civil works, where necessary	EPC Contractor	Included in construction costs
Clear up the construction waste and remove all machinery after construction works		
Reinstate any adjacent damaged areas		
Development and implementation of a landscape / planting plan is recommended		

Table 9-7: Summary of Mitigation Measures during Construction Activities concerning Waste Management

Mitigation measures to be applied during construction phase		
Issue for Mitigation: Impacts from Waste generation and disposal		
Mitigation measures (considering IFC PS 3, General EHS Guidelines and EHS-Guidelines: Water and Sanitation, Wastewater and Ambient Water Quality, Waste Management, Hazardous Material Management)	Responsible Party	Budget for implementing (USD)
Collect and segregate all type of wastes. EPC Contractor will agree with municipal authorities about using services of communal service providers for waste disposal purposes.	EPC Contractor Local authorities	Included in construction costs
Development of a Waste Management Plan (as part of the site specific HSE Management Plan) containing the following principles: (I) respecting the waste management hierarchy of avoidance, preparing for reuse, recycling as much as possible, recovery, and proper disposal of remaining waste according to EU guideline 2008/98/EC; (II) segregating all waste by category on site, based on their nature, and ultimate disposal sites; (III) good technical planning in order to minimize the generation of construction waste; (IV) regular staff training to increase awareness of waste minimization issues and handling of different wastes.	EPC Contractor	Included in construction costs
Implementation of a Waste Management System		
Store all hazardous waste (e.g. oil, fuel, paint, spill contaminated soil) in adequate storage sites (lockable, roofed, ventilated, concreted and bunded floor) for future disposal		
Pack all hazardous wastes securely in sealed drums or other suitable containers, clearly identify them by labels, and provide Materials Safety Data Sheets (MSDS)		
Soil polluted with any substances (oil, asbestos, other hazardous waste) that is excavated during construction, will have to be stored on site on a concreted and bunded area, protected against rain and wind for future disposal as hazardous waste (once an adequate disposal site is available)		
Train workers in handling and disposal of recyclable, sanitary, solid, liquid and hazardous waste		
Presently existing waste material at the construction site (e.g. scrap metal, old cabins, old toilets and wash basins, etc.) has to be segregated and stored or disposed of accordingly. Concrete waste can be disposed of at Yerevan dumping site or be used as land filling material		
Scrap metal shall be sold to local recycling companies		
If any asbestos containing material (ACM) will be found at the construction site, all ACM has to be securely double bagged in high-density polyethylene (HDPE) bags and sealed (e.g. using duct tape).		

Table 9-8: Summary of Mitigation Measures during Construction Activities concerning Historical and Cultural Sites and Goods

Mitigation measures to be applied during construction phase		
Issue for Mitigation: Impacts on Historical and Cultural Sites and Goods		
Mitigation measures (considering IFC PS 8 and General EHS-Guideline)	Responsible Party	Budget for implementing (USD)
Inform the Ministry of Culture about the Project prior to construction, in order to allow the Ministry to perform a proof of occurrence/absence of any cultural or historical goods at the Project site.	EPC Contractor	Included in construction costs
Implementation of a Chance Find Procedure (see Section 6.3.3) and training of the construction workers		
Report chance finds immediately to RA Ministry of Culture, Dep. Protection of Monuments and Historical Sites		

Table 9-9: Summary of Mitigation Measures during Construction Activities concerning Occupational Health & Safety

Mitigation measures to be applied during construction phase		
Issue for Mitigation: Impacts on Workers' Health and Safety		
Mitigation measures (considering IFC PS 1, PS 2, General EHS-Guideline and EHS-Guidelines: Occupational Health and Safety)	Responsible Party	Budget for implementing (USD)
EPC Contractor shall develop and implement a site-specific Health, Safety and Environment Management Plan (HSEMP) for the construction phase	EPC Contractor	Included in construction costs
EPC Contractor shall develop and implement a Health, Safety and Environment Management System (HSEMS) for construction phase. An H&S manager of EPC Contractor shall be on duty all the time during construction period.		
These HSEMP and HSEMS shall also be valid for any third parties or subcontractors in the supply chain		
Make sure that all workers have a health insurance or provide it to workers who don't have		
Awareness raising regarding sexually transmitted diseases (STD) should be provided to workforce		
Consider possible occurrence of venomous snakes during working (train the workers on venomous species identification and bite handling, provide related first aid equipment).		
According to national legislation for workers noise levels shall be kept below 80 dB (A), wherever possible. Hand out ear protection devices to all workers, when necessary (according to WB/IFC General EHS Guideline, workers are obliged to wear ear protectors where 85 dB (A) are exceeded for a duration of more than 8 hours).		
Provide workers with appropriate protective equipment (PPE) according to RENCO's Occupational Health & Safety Standards		
Train workers accordingly regarding work at heights, electrical and vehicular safety, handling of hazardous materials, PPE, hazard avoidance and reduction measures, use of first aid and rescue techniques, emergency response, etc.		

Mitigation measures to be applied during construction phase		
Issue for Mitigation: Impacts on Workers' Health and Safety		
Mitigation measures (considering IFC PS 1, PS 2, General EHS-Guideline and EHS-Guidelines: Occupational Health and Safety)	Responsible Party	Budget for implementing (USD)
Forbid alcohol and other drugs at the construction site	EPC Contractor	Included in construction costs
Assure transfer of injured workers to hospitals in the case of serious accidents		
Identify area emergency responders, hospitals, and clinics		
Limit occupational exposure to electric or magnetic fields (EMF) by use of shielding materials, signing of relevant areas and training of workers		
Licensing and training of drivers; improvement of driving skills		
Training and licensing industrial vehicle operators in the safe operation of specialized vehicles, including safe loading/ unloading, and load limits		
Maintain vehicles regularly and use manufacturer approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure		
Record work-hours as well as all accidents and incidents		
Skilled working personnel (partly from abroad) will be accommodated in RENCO's guesthouse or at hotels in Yerevan. Local (mainly unskilled) workforce shall be employed from Yerevan and the adjacent villages. No workers' camps will have to be established as local workers will return to their home daily		
Transfer of workers to and from the construction site shall be managed by the EPC Contractor (e.g. bus transfer) by means of a Traffic Management Plan		
Implement and communicate an accessible grievance mechanism for workers to address any complaints		

Table 9-10: Summary of Mitigation Measures during Construction Activities concerning Community Health & Safety

Mitigation measures to be applied during construction phase		
Issue for Mitigation: Impacts on Public Health and Safety		
Mitigation measures (considering IFC PS 1, PS 4, General EHS-Guideline and EHS-Guidelines: Community Health and Safety)	Responsible Party	Budget for implementing (USD)
Optimization of transportation management to avoid needless truck drives (as part of Traffic Management Plan)	EPC Contractor	Included in construction costs
Allow truck movements only during daylight, but not between 7 pm and 6 am (as part of Traffic Management Plan)		
Reduce vehicle speeds (stick to recommended speeds; 20 km/h for heavy trucks) in populated areas to avoid noise and accidents (as part of Traffic Management Plan)		
Development and implementation of a Traffic Management Plan (including regulations for truck movements, transport of workers, short-term closure of roads (if necessary), etc.)		
Use of machines with low sound power and fitting of construction machines with silencers or mufflers		
Regular maintenance and service of building machinery and other vehicles during construction works		
Shut down or throttling down of noisy machinery to a minimum		
For residents the noise levels may not exceed 50 dB (A) during daytime and 45 dB (A) during night.		
Notify population in advance about start date and duration of the overall construction works and of specific operations with high noise level (see also SEP in Annex 12.9)		
The construction site itself will be fenced and the entrance gates will be guarded by security staff in order to prevent any unauthorized access to the site, thus also minimizing possible impacts on community health.		
Security arrangements to be guided by principles of proportionality, good international practice ³⁸ and national law. A Security Force Management Plan shall be prepared for the construction stage.		
Security personnel shall be trained and monitored regarding the use of force and conduct towards the community		
Provide adequate security measures to prevent accidents and injury (e.g. keeping speed limits on public roads)		
Inform population of small villages along public roads in advance, in case of transporting heavy equipment		
Establish worker code of conduct to help prevent friction or conflict with communities		

³⁸ e.g. UN Code of Conduct for Law Enforcement Officials; UN Basis Principles on the Use of Force and Firearms by Law Enforcement Officials; IFC (2017): Good Practice Handbook on Use of Security Forces - Assessing and Managing Risks and Impacts.

Mitigation measures to be applied during construction phase		
Issue for Mitigation: Impacts on Public Health and Safety		
Mitigation measures (considering IFC PS 1, PS 4, General EHS-Guideline and EHS-Guidelines: Community Health and Safety)	Responsible Party	Budget for implementing (USD)
Provide cultural awareness training to be given for non-local workers (expand to local workers if grievances are raised or observations made of inappropriate behavior)	EPC Contractor	Included in construction costs
Develop and implement an Emergency Preparedness and Response Plan (see Section 6.3.4)		
Provide appropriate information about the Emergency Preparedness and Response Plan to potentially affected communities and individuals		

Table 9-11: Summary of Mitigation Measures during Construction Activities concerning Social Aspects

Mitigation measures to be applied during construction phase		
Issue for Mitigation: Social Aspects		
Mitigation measures (considering IFC PS 2, General EHS-Guideline and EHS-Guideline: Occupational Health and Safety)	Responsible Party	Budget for implementing (USD)
EPC's Human Resources Policy shall include international labor standards as defined in ILO (2014), in order to fulfill IFC PS 2	EPC Contractor	Included in construction costs
Develop and implement a non-discriminatory hiring and wage policy according to international labor standards as defined in ILO 2014 (clearly stating that the company will not discriminate in hiring and salaries based on gender, age, religion, ethnicity or place of origin), if not already in place		
Prosecute offenses related to payment of wages by sub-contractors strictly		
Prioritize employment of local people for construction works (offer job opportunities in nearby villages and Yerevan)		
Improve recruitment of women for construction works		
Discuss potential barriers for local employment with labor / training organizations so that measures to overcome these barriers (if any) can be developed and put in place		
Zero tolerance for sexual harassment at the work place		
Implement and communicate an accessible grievance mechanism for PAP to address any complaints		

9.1.2 Mitigation Measures for the Operation Phase

Table 9-12: Summary of Mitigation Measures during Operation concerning Protection of Flora and Fauna.

Mitigation measures to be applied during operation		
Issue for Mitigation: Flora and Fauna		
Mitigation measures (considering IFC PS 6, General EHS Guidelines and EHC Guideline: Thermal Power Plants)	Responsible Party	Budget for implementing (USD)
Oily waste water from Power plant operation will be duly collected and routed to a treatment plant including API and, if needed, CPI separators before being discharged to the existing system downstream of YCCPP-1.	ArmPower	Included in operational costs
HRSB blow down and other drainage from steam/water system will be neutralized at the chemical shop to meet relevant water quality standards and will then be discharged to the Hrazdan River using existing YCCPP-1 discharge system		
Compliance with international stack emission standards ensures that critical levels will not be exceeded and will thus not represent any danger for flora and fauna		
Compliance with national and international noise emission standards ensures that critical levels will not be exceeded and will thus not represent any danger for fauna		
Strict prohibition of herbicide use for maintaining YCCPP-2 site (use mechanical methods only)		

Table 9-13: Summary of Mitigation Measures during Operation concerning Soil and Water Pollution

Mitigation measures to be applied during operation		
Issue for Mitigation: Soil and Water Pollution		
Mitigation measures (considering IFC PS 3, General EHS Guidelines and EHS-Guidelines: Water and Sanitation, Wastewater and Ambient Water Quality, Waste Management, Hazardous Material Management, Thermal Power Plants)	Responsible Party	Budget for implementing (USD)
Oily waste water from Power plant operation will be duly collected and routed to a treatment plant including API and, if needed, CPI separators before being discharged to recipient existing system. Treatment system will be suitably selected and implemented to meet the environmental limits and the good industry practice.	ArmPower	Included in operational costs

Mitigation measures to be applied during operation		
Issue for Mitigation: Soil and Water Pollution		
Mitigation measures (considering IFC PS 3, General EHS Guidelines and EHS-Guidelines: Water and Sanitation, Wastewater and Ambient Water Quality, Waste Management, Hazardous Material Management, Thermal Power Plants)	Responsible Party	Budget for implementing (USD)
Rain water from internal roads and other paved areas will be collected and led to the waste water treatment plant before discharging it to the existing system of YCCPP-1. Rain water from roofs of buildings and shelters will be collected in an underground tank for reusing the water without any treatments for irrigation inside the plant site.	ArmPower	Included in operational costs
HRSB blow down and other drainage from steam/water system will be neutralized at chemical shop to meet relevant water quality standards (see Section 6.2.4.2) and will then be discharged to Hrazdan River using the existing YCCPP-1 discharge system		
The utility's domestic sewerage will be connected to the city's sewerage system		
Train staff in appropriate sanitation practices		
Provide spill-control materials at YCCPP-2, in order to clean up spills, if necessary		
Enforcement of a Waste Management Plan		
Elaboration of an emergency plan in case of accidental leakage		
Remove contaminated soil if spills occur and handle as hazardous waste		
Prohibition of herbicides for maintenance of YCCPP-2		
Proper handling and storage of hazardous material (lockable, roofed, ventilated, concreted and bunded floor)		
Train staff in proper management of recyclable, sanitary, solid, liquid, and hazardous wastes		
Regular maintenance of all vehicles and machines at regular service stations, if possible		
Maintenance and re-fueling of the equipment only on sealed and enclosed areas		
Conduct further hydrological assessment and implement appropriate environmental management of the foreseen groundwater deviation at site including: impacts and mitigation measures for changes to the groundwater profile, both within the site and on neighboring properties; study of water treatment options in the unlikely event that groundwater rises to the surface or needs to be removed from the site and discharged in a different receptor (river or public network); assessment to be approved by IFC and ADB before construction.	EPC Contractor and ArmPower	Included in construction and operational costs

Table 9-14: Summary of Mitigation Measures during Operation concerning Climate and Air Quality

Mitigation measures to be applied during operation		
Issue for Mitigation: Impacts on Air Quality and Climate Change		
Mitigation measures (considering IFC PS 3, General EHS Guidelines and EHS-Guidelines: Air Emissions and Ambient Air Quality, Thermal Power Plants)	Responsible Party	Budget for implementing (USD)
Maintain vehicles and engines properly, as recommended by suppliers	ArmPower	Included in operational costs
Avoid unnecessary idling of vehicles		
Compliance with performance guarantees of the operator for emission values (see Section 6.2.5)		
Rise the stack height to 66 meters (GEP stack height)		
Greenhouse gases emissions shall be quantified at least annually and results reported to the national authorities and the financing institutions.		
In order to keep the GHG emissions of the plant as low as technically possible, process control techniques and good maintenance of the combustion system shall be applied.		

Table 9-15: Summary of Mitigation Measures during Operation concerning Landscape and Visual Aspects

Mitigation measures to be applied during operation		
Issue for Mitigation: Landscape and Visual Aspects		
Mitigation measures (considering General EHS)	Responsible Party	Budget for implementing (USD)
Visual impact due to buildings and stack of YCCPP-2 is unavoidable	ArmPower	Included in operational costs
Planting of indigenous trees and bushes along YCCPP-2 boundaries is recommended, in order to reduce the visual burden at least to some extent (develop and implement landscape / planting plan)		

Table 9-16: Summary of Mitigation Measures during Operation concerning Waste Management

Mitigation measures to be applied during operation		
Issue for Mitigation: Impacts from Waste		
Mitigation measures (considering IFC PS 3, General EHS Guidelines and EHS-Guidelines: Water and Sanitation, Wastewater and Ambient Water Quality, Waste Management, Hazardous Material Management, Thermal Power Plants)	Responsible Party	Budget for implementing (USD)
Collect all types of wastes including domestic and sanitary wastes during CAPP operation. Make arrangements for proper waste handling, treatment and disposal with municipal authorities about using services of communal service providers for waste disposal purposes.	ArmPower	Included in operational costs
Oil separated from water in the API separator of the waste water treatment plant will be collected by a licensed company for final disposal		
Store all hazardous waste in adequate storage sites (lockable, roofed, ventilated, concreted and bunded floor) at YCCPP-2 site for future disposal		
Clearly label all hazardous waste and provide Materials Safety Data Sheets (MSDS)		
Train staff in handling and disposal of recyclable, sanitary, solid, liquid and hazardous waste		
Adequate storage and clear labeling and marking according to national / internationally recognized requirements and standards, including the International Chemical Safety Cards (ICSC), Materials Safety Data Sheets (MSDS), or equivalent, of all hazardous substances in chemical workshop (e.g. acids and alkaline solutions)		
Waste Management Plan for operation shall also include a risk assessment associated with the mid-term to long-term storage of hazardous waste, as well as an appropriate sizing and monitoring requirements of the storage facilities (see Section 6.2.7)		

Table 9-17: Summary of Mitigation Measures during Operation concerning Occupational Health & Safety

Mitigation measures to be applied during operation		
Issue for Mitigation: Impacts on Workers' Health and Safety		
Mitigation measures (considering IFC PS 1, PS 2, General EHS-Guideline and EHS-Guidelines: Occupational Health and Safety, Thermal Power Plants)	Responsible Party	Budget for implementing (USD)
ArmPower will have a Health, Safety and Environment Management System (HSEMS) in place, according to their HSE Policy, considering IFC/WorldBank EHS guidelines for Thermal Power Plants	ArmPower	Included in operational costs
Make sure that all staff has a health insurance		
Consider possible occurrence of poisonous snakes (train the workers on venomous species identification and bite handling, provide related first aid equipment).		
According to national legislation for workers noise levels shall be kept below 80 dB (A). Hand out ear protection devices to all workers, when necessary (according to WB/IFC General EHS Guideline, workers are obliged to wear ear protectors where 85 dB (A) are exceeded for duration of more than 8 hours).		
Staff will be provided with appropriate protective equipment (PPE) according to RENCO's Occupational Health & Safety Standards and IFC/WorldBank EHS guidelines for Thermal Power Plants		
Train staff accordingly regarding work at heights, electrical and vehicular safety, handling of hazardous materials, use of PPE, hazard avoidance and reduction measures, use of first aid and rescue techniques, emergency response, firefighting, etc.		
Forbid alcohol and other drugs at YCCPP-2 site		
Assure transfer of injured staff to hospitals in the case of serious accidents		
Limit occupational exposure to electric or magnetic fields (EMF) by use of shielding materials, signing of relevant areas and training of staff (see Section 6.3.4.1)		
Maintain vehicles and machinery regularly and use manufacturer approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure		
ArmPower's/RENCO's Human Resources Policy shall include international labor standards as defined in ILO (2014), in order to fulfill IFC PS 2		
Record work-hours as well as all accidents and incidents		
Implement and communicate an accessible grievance mechanism for staff to address any complaints		

Table 9-18: Summary of Mitigation Measures during Operation concerning Community Health & Safety

Mitigation measures to be applied during operation		
Issue for Mitigation: Impacts on Public Health and Safety		
Mitigation measures (considering IFC PS 1, PS 4, General EHS-Guideline and EHS-Guidelines: Community Health and Safety, Thermal Power Plants)	Responsible Party	Budget for implementing (USD)
For residents the noise levels may not exceed 50 dB (A) during daytime and 45 dB (A) during night.	ArmPower	Included in operational costs
Compliance with performance guarantees for emission limits and compliance with design specifications to keep noise emissions low		
YCCPP-2 site will be fenced and the entrance gates will be guarded by security staff in order to prevent any unauthorized access.		
The development and implementation of a Security Force Management Plan guided by principles of proportionality, good international practice ³⁹ and national law is recommended		
Security personnel shall be trained and monitored regarding the use of force and conduct towards the community		
Develop and implement an Emergency Preparedness and Response Plan (see Section 6.4.2)		
Provide appropriate information about Emergency Preparedness and Response Plan to potentially affected communities and individuals		
Undertake regular public communication of the company's environmental and social performance (for example, via the website)		

³⁹ e.g. UN Code of Conduct for Law Enforcement Officials; UN Basis Principles on the Use of Force and Firearms by Law Enforcement Officials; IFC (2017): Good Practice Handbook on Use of Security Forces - Assessing and Managing Risks and Impacts.

9.1.3 Mitigation Measures for the Decommissioning Phase

Environmental and social impacts during the decommissioning phase will be mainly the same as during the construction phase. Thus, mitigation measures for the construction phase will be also valid for the dismantling works, which will have to adhere to the latest editions of national and international laws and guidelines, or even to new ones that will be relevant at the time.

A Decommissioning Plan shall be prepared by the operator at least 5 years before closure of the plant, and a Detailed Decommissioning Plan shall be developed at least 18 months in advance of the closure of the plant.

The main impacts during decommissioning phase will be due to waste from dismantling, including different types of hazardous waste. A detailed Waste Management Plan will have to be developed by ArmPower following the same principles as given in Section 6.1.7 respecting the waste management hierarchy of avoidance, preparing for reuse, recycling as much as possible (e.g. scrap metal; batteries), recovery, and proper disposal of remaining waste according to EU Directive 2008/98/EC (Waste Framework Directive). Scrap metal and used batteries can be sold to local recycling companies at Yerevan like e.g. Metexim LLC, or others.

In the next 20 years a solution for the final disposal of hazardous waste will probably be decided upon and provided by the Government of RA. Hazardous waste resulting from the decommissioning activities shall be stored first in adequate storage sites (lockable, roofed, ventilated, concreted and banded floor) at the YCCPP-2 site. All hazardous wastes shall be securely packed in sealed drums or other suitable containers, clearly identified by labels, and marked according to national and internationally recognized requirements and standards, including the International Chemical Safety Cards (ICSC), Materials Safety Data Sheets (MSDS), or equivalent. Hazardous waste shall then be disposed of, if adequate disposal sites exist at the time.

9.2 Monitoring Measures

The local HSE officer of ArmPower will monitor the implementation of mitigation measures by the EPC Contractor (RENCO SPA), based on regular inspections. An external internationally experienced auditor will prepare environmental and social performance reports for ADB/ IFC, based on quarterly site inspections and the monthly reports of ArmPower’s HSE officer during construction and one additional site inspection during commissioning. ArmPower will be responsible for monitoring of environmental and social performance during operation and decommissioning of the CCPP. The external auditor will also perform one audit per year during operation.

9.2.1 Monitoring during the Construction Phase

Table 9-19: Summary of monitoring measures during Construction Phase

Activity/ Impact	What <i>parameter is to be monitored?</i>	Where <i>is the parameter to be monitored?</i>	How <i>is the parameter to be monitored/ type of monitoring equipment?</i>		When <i>is the parameter to be monitored-frequency of measurement or continuous?</i>	Responsibility for monitoring
			Method	Indicator		
Impacts on flora and fauna	Prohibition of herbicides for site clearance	Construction Site	Visual inspection	No herbicides used	At the beginning of construction period during site clearance	ArmPower
	Mitigation measures to be implemented to reduce risks of soil and water contamination do also mitigate the impact on flora and fauna			Measures for reduction of soil and water contamination implemented (see below)	Regularly during construction	ArmPower External auditor
	Mitigation measures to be implemented to noise reduction like using low sound power mechanical equipment do also mitigate the impact on noise sensitive fauna (if any)			Measures for noise reduction implemented (see below)		

Activity/ Impact	What parameter is to be monitored?	Where is the parameter to be monitored?	How is the parameter to be monitored/ type of monitoring equipment?		When is the parameter to be monitored-frequency of measurement or continuous?	Responsibility for monitoring
			Method	Indicator		
Impacts on flora and fauna	Suppress dust generated by construction works by spraying water	Construction Site	Visual inspection	Dust effectively suppressed	Regularly during construction	ArmPower External auditor
Soil Erosion	Develop and implement an Erosion and Sediment Control Plan	Construction Site Office of EPC Contractor	Visual inspection	Erosion and Sediment Control Plan implemented	In advance of construction	ArmPower External auditor
	Minimization of areas for construction and material storage	Construction Site	Visual inspection	Areas as small as possible	Regularly during construction	ArmPower External auditor
	Minimize removing topsoil at construction site and store in line with international good practice, so that it can be re-used after construction			Topsoil stored accordingly		
	Protect excess spoils, if any, from runoff			Excess spoils protected		
Soil (and water) pollution from vehicles and construction equipment	Regular maintenance of vehicles/ machines at regular service stations, if possible	Construction Site	Inspection of maintenance records	Vehicles and machines adequately maintained	Regularly during construction	ArmPower External auditor
	Maintenance and re-fueling of construction equipment on sealed and enclosed areas		Visual inspection of maintenance/ re-fueling areas	No unsuitable areas used for maintenance and re- fueling		

Activity/ Impact	What <i>parameter is to be monitored?</i>	Where <i>is the parameter to be monitored?</i>	How <i>is the parameter to be monitored/ type of monitoring equipment?</i>		When <i>is the parameter to be monitored-frequency of measurement or continuous?</i>	Responsibility for monitoring
			Method	Indicator		
Soil (and water) pollution from inadequate storage	Store all liquid materials (e.g. fuel, engine oil, paint, chemicals, lubricants) in locked tanks and on sealed, bunded and roofed areas. Installation of secondary containment for storing liquid materials is recommended.	Construction Site Storage areas	Inspection of storage areas	All liquid materials stored accordingly	Regularly during construction	ArmPower External auditor
	Store construction material (bags of cement etc.) in containers in order to avoid rinsing out			Construction material stored accordingly		
Soil (and water) pollution from spills	In case of any spillage: Localization of the spilled material and immediate cleaning of the contaminated area in order to prevent the pollutant from entering soil	Construction Site	Inspection of spill reports	Area accordingly cleaned	Regularly during construction	ArmPower External auditor
	Train transporters and workers in spill prevention and control especially in handling of oil and fuel		Inspection of training records	All workers and transporters trained accordingly		
	Provide spill-control materials to drivers and workers, in order to clean up spills, if necessary		Inspection of equipment	Spill-control equipment provided		
	Equip all construction vehicles with spill-control kits		Visual inspection	All vehicles equipped accordingly		

Activity/ Impact	What parameter is to be monitored?	Where is the parameter to be monitored?	How is the parameter to be monitored/ type of monitoring equipment?		When is the parameter to be monitored-frequency of measurement or continuous?	Responsibility for monitoring
			Method	Indicator		
Soil (and water) pollution from spills	Report and respond to spills promptly and train workers in how to report		Inspection of spill reports, and training records	Number of spill reports All workers trained accordingly	Regularly during construction	ArmPower External auditor
	Remove contaminated soil if spills occur and handle as hazardous waste	Construction Site Storage areas	Inspection of spill reports and storage areas	All contaminated materials adequately stored		
Water pollution from sanitation	Construction site equipped with toilets and sanitary rooms according to IFC/ EBRD Guidance Note - separately for men and women	Construction Site	Visual inspection	Number and quality according to IFC/ EBRD Guidance Note ⁴⁰	Regularly during construction	ArmPower External auditor
	Lead sewage water to the city's sewage water system or use septic tanks for collecting sewage water, which have to be emptied by a specialized company from time to time.		Visual inspection Inspection of contract with specialized company (if necessary)	Sewage water led to the city's sewage system or septic tanks in place. Appropriate emptying of tanks (if necessary)		
	Train workers in appropriate sanitation practices		Inspection of training records	All workers trained accordingly		
Water pollution from waste	Provide waste bins at the construction site in order to collect workers' waste (implement Waste Management Plan)	Construction Site	Visual inspection	Waste bin in place and used by workers	Regularly during construction	ArmPower External auditor

⁴⁰ see IFC/ EBRD Guidance Note on Workers' Accommodation (2009)

Activity/ Impact	What parameter is to be monitored?	Where is the parameter to be monitored?	How is the parameter to be monitored/ type of monitoring equipment?		When is the parameter to be monitored-frequency of measurement or continuous?	Responsibility for monitoring
			Method	Indicator		
Deviation of groundwater	The Client will conduct further hydrological assessment and implement appropriate environmental management of the foreseen groundwater deviation at site, to be approved by IFC and ADB in compliance with the bank's safeguards requirements.	Near construction sites	Review of hydrological assessment report Interviews with third parties Inspection of complaints	Mitigation measures of hydrological assessment report implemented; Third parties informed and water supply secured; no complaints	In advance of construction	ArmPower External auditor
Limitation of exhaust gas pollution	Reduction of speed and limited movement of vehicles	Construction Site	Inspection of complaints	No complaints from residents	Regularly during construction	ArmPower External auditor
	Optimize transportation management to avoid needless truck trips (as part of a Traffic Management Plan)		Inspection of transportation management	No needless truck trips Traffic Management Plan implemented		
	Maintain vehicles and construction machinery properly, as recommended by suppliers		Inspection of maintenance records	Equipment regularly maintained		
	Avoid unnecessary idling of construction machines and vehicles		Visual inspection	No unnecessary idling		
Limitation of dust	Cover truck beds with tarps during material transport	Construction Site	Visual inspection	Truck beds covered	Regularly during construction	ArmPower

Activity/ Impact	What parameter is to be monitored?	Where is the parameter to be monitored?	How is the parameter to be monitored/ type of monitoring equipment?		When is the parameter to be monitored-frequency of measurement or continuous?	Responsibility for monitoring
			Method	Indicator		
	Use dust-suppressing water spray during civil works, where necessary		Inspection of complaints	No complaints from residents		External auditor
Limitation of dust	Store and handle material appropriately to limit dust (e.g. protect cement with tarpaulins)	Construction Site	Visual inspection	Appropriate storage	Regularly during construction	ArmPower External auditor
Landscape and Visual Aspects	Use dust-suppressing water spray during civil works, where necessary	Construction Site	Inspection of complaints	No complaints from residents	Regularly during construction	ArmPower External auditor
	Clear up the construction waste and remove all machinery after construction works		Visual inspection	All waste and machinery removed		
	Reinstate any adjacent damaged areas		Inspection of complaints	No complaints from residents		
	Development and implementation of a landscape / planting plan is recommended		Visual inspection	Landscape / planting plan implemented		
Waste management	Develop Waste Management Plan for construction period	Construction Site	Control of Waste Management Plan	Waste Management Plan developed	In advance of construction	ArmPower External auditor
	Implementation of Waste Management System	Office of EPC Contractor	Control of Waste Management System	Waste Management System implemented		

Activity/ Impact	What parameter is to be monitored?	Where is the parameter to be monitored?	How is the parameter to be monitored/ type of monitoring equipment?		When is the parameter to be monitored-frequency of measurement or continuous?	Responsibility for monitoring
			Method	Indicator		
	EPC Contractor will agree with municipal authorities about using services of communal service providers for waste disposal purposes.		Control of written agreement	Written agreement provided		
Waste management	Collect and segregate all type of wastes	Construction Site Storage areas	Visual inspection	All wastes collected and segregated	Regularly during construction	ArmPower External auditor
	Store all hazardous waste in adequate storage sites (lockable, roofed, ventilated, concreted and bunded floor)			All hazardous wastes adequately stored		
	Pack all hazardous wastes securely in sealed drums or other suitable containers, clearly identify them by labels, and provide Materials Safety Data Sheets (MSDS)			All hazardous wastes adequately packed and labeled and MSDS provided		
	Existing waste material at the construction site has to be segregated and stored or disposed of accordingly	Construction Site	Visual inspection	All existing waste material segregated and stored or disposed of	In advance of construction	ArmPower
	Concrete waste can be disposed of at Yerevan dumping site or be used as land filling material			Concrete waste handled accordingly		
	Scrap metal shall be sold to local recycling companies			Scrap metal recycled		

Activity/ Impact	What parameter is to be monitored?	Where is the parameter to be monitored?	How is the parameter to be monitored/ type of monitoring equipment?		When is the parameter to be monitored-frequency of measurement or continuous?	Responsibility for monitoring
			Method	Indicator		
Training in waste handling	Train workers in handling and disposal of recyclable, sanitary, solid, liquid and hazardous waste	Construction Site	Inspection of training records	All workers trained accordingly	Regularly during construction	ArmPower External auditor
Impacts on Historical and Cultural Sites and Goods	Inform the Ministry of Culture about the Project prior to construction, in order to allow the Ministry to perform a proof of occurrence/absence of any cultural or historical goods at the Project site.	Construction Site	Follow-up of the Ministry's answer	Ministry informed about Project	In advance of construction	ArmPower
	Implementation of Chance Find Procedure and training of the construction workers	Construction Site	Inspection of chance find reports and training records	Chance Find Procedure implemented and all workers trained	Regularly during construction	ArmPower External auditor
Impacts on Historical and Cultural Sites and Goods	Report chance finds immediately to RA Ministry of Culture, Dep. Protection of Monuments and Historical Sites	Construction Site Office of EPC Contractor	Inspection of chance find reports	All chance finds reported to Ministry of Culture	Regularly during construction	ArmPower External auditor
HSE Policy and HSE Management	EPC Contractor develops and implements site-specific Health, Safety and Environment Management Plan (HSEMP) for the construction phase	Office of EPC Contractor	Inspection of relevant documents	HSE Management Plan developed	In advance of construction works	ArmPower External auditor

Activity/ Impact	What parameter is to be monitored?	Where is the parameter to be monitored?	How is the parameter to be monitored/ type of monitoring equipment?		When is the parameter to be monitored-frequency of measurement or continuous?	Responsibility for monitoring
			Method	Indicator		
HSE Policy and HSE Management	EPC Contractor develops and implements Health, Safety and Environment Management System (HSEMS) for construction phase. An H&S manager of EPC Contractor shall be on duty all the time during construction period.	Office of EPC Contractor Construction Site	Inspection of relevant documents	HSE Management System implemented	Regularly during construction	ArmPower External auditor
	HSEMP and HSEMS shall also be valid for any third parties or subcontractors in the supply chain			H&S Manager employed Subcontracts contain adequate HSEMP		
Occupational Health and Safety	Make sure that all workers have a health insurance or provide to workers who don't have	Construction Site	Inspection of workers' health documents	All workers have health insurance	Regularly during construction	ArmPower External auditor
	Awareness raising regarding sexually transmitted diseases (STD) should be provided to workforce		Inspection of training records	All workers trained accordingly		
	Consider possible occurrence of poisonous snakes during working		Inspection of incident and accident reports	No accidents related to poisonous snakes		
	For workers noise levels shall be kept below 80 dB (A), wherever possible. Hand out ear protection devices to all workers, when necessary.		Measurement with noise meter	Noise level below 80 dB (A); if noise levels are higher: workers fitted with PPE and warning signs installed		

Activity/ Impact	What <i>parameter is to be monitored?</i>	Where <i>is the parameter to be monitored?</i>	How <i>is the parameter to be monitored/ type of monitoring equipment?</i>		When <i>is the parameter to be monitored-frequency of measurement or continuous?</i>	Responsibility for monitoring
			Method	Indicator		
Occupational Health and Safety	Provide workers with appropriate protective equipment (PPE) according to RENCO's Occupational Health & Safety Standards	Construction Site	Visual Inspection	All workers provided with and using PPE	Regularly during construction	ArmPower External auditor
	Train workers accordingly regarding work at heights, electrical and vehicular safety, handling of hazardous materials, PPE, hazard avoidance and reduction measures, use of first aid and rescue techniques, emergency response, etc.		Inspection of training records	All workers trained accordingly		
	Identify area emergency responders, hospitals, and clinics, and provide advance notice of Project activities		Interviews	Area emergency responders informed about Project activities		
	Forbid alcohol and other drugs at construction site		Inspection of incident records	No workers found under influence of alcohol or other drugs		
	Assure transfer of injured workers to hospitals in the case of serious accidents		Inspection of accident records	Workers transferred to hospital in case of serious accidents		
	Limit occupational exposure to electric or magnetic fields (EMF) by use of shielding materials, signing of relevant areas and training of workers		Interviews Inspection of training records	Shielding materials in place All workers trained accordingly		

Activity/ Impact	What parameter is to be monitored?	Where is the parameter to be monitored?	How is the parameter to be monitored/ type of monitoring equipment?		When is the parameter to be monitored-frequency of measurement or continuous?	Responsibility for monitoring
			Method	Indicator		
Occupational Health and Safety	Licensing and training of drivers; improvement of driving skills	Construction Site	Inspection of licensing records	All drivers licensed and trained	Regularly during construction	ArmPower External auditor
	Training and licensing industrial vehicle operators in the safe operation of specialized vehicles, including safe loading/ unloading, and load limits		Inspection of training records	All vehicle operators trained and licensed		
	Maintain vehicles regularly and use manufacturer approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure		Inspection of maintenance records	Vehicles regularly maintained and approved parts used		
	Record work-hours as well as all accidents and incidents		Inspection of records	Recording implemented		
	Skilled working personnel (partly from abroad) will be accommodated in RENCO's guesthouse or at hotels in Yerevan. Local (mainly unskilled) workforce shall be employed from Yerevan and the adjacent villages. No workers' camps will have to be established as local workers will return to their home daily		Interviews	Accommodation for skilled personnel in adequate condition No workers' camps established		

Activity/ Impact	What parameter is to be monitored?	Where is the parameter to be monitored?	How is the parameter to be monitored/ type of monitoring equipment?		When is the parameter to be monitored-frequency of measurement or continuous?	Responsibility for monitoring
			Method	Indicator		
Occupational Health and Safety	Transfer of workers to and from the construction site shall be managed by the EPC Contractor (e.g. bus transfer)	Construction Site	Interviews	Transfer for workers established	Regularly during construction	ArmPower External auditor
	Implement and communicate an accessible grievance mechanism for workers to address any complaints	Construction Site Office of EPC Contractor	Inspection of grievance log book Interviews	All grievances adequately treated		
Noise impacts on public and on workers	Use of machines with low sound power and fitting of construction machines with silencers or mufflers	Construction Site	Visual inspection and inspection of complaints	Low sound equipment used; no complaints from residents	Regularly during construction	ArmPower External auditor
	Regular maintenance and service of building machinery and vehicles during construction works		Inspection of maintenance records	Equipment regularly maintained		
	Shut down or throttling down of noisy machinery		Inspection of complaints	No complaints from residents		
Noise impacts on public	Optimize transportation management to avoid needless truck drives (as part of a Traffic Management Plan)	Construction Site	Inspection of complaints	No complaints from residents	Regularly during construction	ArmPower External auditor
	Allow truck movements only during daylight, but not between 7 pm and 6 am (TMP)					

Activity/ Impact	What <i>parameter is to be monitored?</i>	Where <i>is the parameter to be monitored?</i>	How <i>is the parameter to be monitored/ type of monitoring equipment?</i>		When <i>is the parameter to be monitored-frequency of measurement or continuous?</i>	Responsibility for monitoring
			Method	Indicator		
Noise impacts on public	Reduce vehicle speeds (stick to recommended speeds; 20 km/h for heavy trucks) in populated areas (TMP)	Villages around construction site	Inspection of complaints	No complaints from residents	Regularly during construction	ArmPower External auditor
	For residents the noise levels may not exceed 50 dB (A) during daytime and 45 dB (A) during night, or a maximum increase of 3 dB(A)	Residential areas near construction site (up to 5 points)	Instrumental measurement	Noise level below 50 dB (A) during daytime and 45 dB (A) during night. or Maximum increase of 3 dB(A) at the receptors	5 hours of day-time measurements, twice per month during construction period (assumed no construction works at night)	RENCO/ ArmPower External auditor
	Notify population in advance about start date and duration of the overall construction works and of specific operations with high noise level	Residential areas near construction site	Inspection of complaints	No complaints from public	Regularly during construction	ArmPower External auditor
Community Health and Safety	Development and implementation of a Traffic Management Plan (including regulations for truck movements, transport of workers, short-term closure of roads (if necessary), details about road use (by whom and for what purpose) and alternative routes.)	Office of EPC Contractor	Inspection of Traffic Management Plan Inspection of complaints	Traffic Management Plan implemented No complaints from public	In advance of construction and regularly during construction	ArmPower External auditor

Activity/ Impact	What <i>parameter is to be monitored?</i>	Where <i>is the parameter to be monitored?</i>	How <i>is the parameter to be monitored/ type of monitoring equipment?</i>		When <i>is the parameter to be monitored-frequency of measurement or continuous?</i>	Responsibility for monitoring
			Method	Indicator		
Community Health and Safety	The construction site itself will be fenced and the entrance gates will be guarded by security staff in order to prevent any unauthorized access to the site, thus also minimizing possible impacts on community health.	Construction Site	Inspection of incidents/ accidents records	No incidents/ accidents regarding public health and safety	Regularly during construction	ArmPower External auditor
	Security arrangements to be guided by principles of proportionality, good international practice ⁴¹ and national law		Inspection of security concept and contracts	Arrangements according to good international practice; No complaints from public		
	Security personnel shall be trained and monitored regarding the use of force and conduct towards the community	Construction Site Office of EPC Contractor	Inspection of training records Review of recorded security incidents and adaptation of security management , if required	All security staff trained accordingly; No complaints from public; Adaptation of security management, if required		

⁴¹ e.g. UN Code of Conduct for Law Enforcement Officials; UN Basis Principles on the Use of Force and Firearms by Law Enforcement Officials; IFC (2017): Good Practice Handbook on Use of Security Forces - Assessing and Managing Risks and Impacts.

Activity/ Impact	What <i>parameter is to be monitored?</i>	Where <i>is the parameter to be monitored?</i>	How <i>is the parameter to be monitored/ type of monitoring equipment?</i>		When <i>is the parameter to be monitored-frequency of measurement or continuous?</i>	Responsibility for monitoring
			Method	Indicator		
Community Health and Safety	Provide adequate security measures to prevent accidents and injury (e.g. keeping speed limits)	Construction Site	Inspection of complaints and accident records	No complaints from residents; no accidents	Regularly during construction	ArmPower External auditor
	Inform population of small villages along public roads in advance, in case of transporting heavy equipment	Office of EPC Contractor				
	Establish worker code of conduct to help prevent friction or conflict with communities	Construction Site Office of EPC Contractor	Inspection of complaints	Worker code of conduct established		
	Provide cultural awareness training to be given for non-local workers (expand to local workers if grievances are raised or observations made of inappropriate behavior)	Construction Site Office of EPC Contractor	Inspection of training records Inspection of complaints	All non-local workers trained accordingly No grievances		
	Develop and implement an Emergency Preparedness and Response Plan		Inspection of documents	Emergency Preparedness and Response Plan implemented		
	Provide appropriate information about Emergency Preparedness and Response Plan to potentially affected communities and individuals	Residents living near construction sites	Interviews with residents	Residents informed accordingly		

Activity/ Impact	What <i>parameter is to be monitored?</i>	Where <i>is the parameter to be monitored?</i>	How <i>is the parameter to be monitored/ type of monitoring equipment?</i>		When <i>is the parameter to be monitored-frequency of measurement or continuous?</i>	Responsibility for monitoring
			Method	Indicator		
Employment	EPC's Human Resources Policy shall include international labor standards as defined in ILO (2014)	Office of EPC Contractor	Inspection of Human Resources Policy	According to international labor standards, fulfilling IFC PS 2	Regularly during construction	ArmPower External auditor
	Develop and implement a non-discriminatory hiring and wage policy according to international labor standards as defined in ILO 2014 (clearly stating that the company will not discriminate in hiring and salaries based on gender, age, religion, ethnicity or place of origin), if not already in place	Construction Site	Inspection of employment contracts (also of subcontractors)	Employment contracts according to international labor standards No complaints		
	Prosecute offenses related to payment of wages by sub-contractors strictly	Office of EPC Contractor	Inspection of complaints Interviews with employees	Employment contracts according to international labor standards No complaints		
	Prioritize employment of local people for construction works (offer job opportunities in nearby villages and Yerevan)			High percentage of local people employed		

Activity/ Impact	What parameter is to be monitored?	Where is the parameter to be monitored?	How		When is the parameter to be monitored-frequency of measurement or continuous?	Responsibility for monitoring
			Method	Indicator		
Employment	Discuss potential barriers for local employment with labor / training organizations so that measures to overcome these barriers (if any) can be developed and put in place	Construction Site Office of EPC Contractor	Inspection of results and measures	High percentage of local people employed	In advance of construction and regularly during construction	ArmPower External auditor
Employment / Gender aspects	Improve recruitment of women for construction works	Construction Site Office of EPC Contractor	Inspection of employment contracts	25% of employees are female; thorough justification, if this rate cannot be kept	Regularly during construction	ArmPower External auditor
Gender aspects	Zero tolerance for sexual harassment at the work place	Construction Site	Inspection of complaints	No complaints from residents and from workers	Regularly during construction	ArmPower External auditor
Grievance Redress Mechanism	Implement and communicate an accessible grievance mechanism for PAP to address any complaints	Construction Site Office of EPC Contractor	Inspection of grievance log book Interviews with PAP	All grievances adequately treated	Regularly during construction	ArmPower External auditor
One audit per quarter by an external internationally experienced auditor	Compliance with ESMP; monitoring data	Construction Site Office of EPC Contractor	Inspection of the site, HSE reports from ArmPower, monitoring data (air emissions, noise emissions, waste water, etc.)	All mitigation measures of ESMP implemented and adaptive measures applied, where necessary; Monitoring data below the defined limit values or regulative measures implemented	One audit per quarter during the construction phase	External auditor Costs per audit: 10,000 USD

9.2.2 Monitoring during the Commissioning Phase

Additionally to the monitoring measures provided for the operation phase, during the commissioning phase of the Project especially ambient air quality and noise emissions shall be monitored:

- Ambient air quality regarding NO₂ shall be monitored at two locations: one predicted maximum ground level concentration location and one background site during two years (starting with the commissioning phase) using continuous methods (at hourly intervals). Ground level concentration of NO₂ shall not exceed national and international standards. Results shall be reported to the national authorities (Environmental Monitoring and Information Center SNCO) and the financing agencies.
- For residents the noise levels may not exceed 50 dB (A) during daytime and 45 dB (A) during night, or a maximum increase of 3 dB(A) is to be applied. Instrumental measurements shall be done at legal and illegal residential areas near the YCCPP-2 site (up to 5 points) and results reported to the national authorities. 5 hours of day-time and night-time measurements shall be performed twice per month during the commissioning period.

9.2.3 Monitoring during the Operation Phase

Table 9-20: Summary of monitoring measures during Operation Phase

Activity/ Impact	What <i>parameter is to be monitored?</i>	Where <i>is the parameter to be monitored?</i>	How <i>is the parameter to be monitored/ type of monitoring equipment?</i>		When <i>is the parameter to be monitored-frequency of measurement or continuous?</i>	Responsibility for monitoring
			Method	Indicator		
Impacts on flora and fauna	Oily waste water from Power plant operation will be duly collected and routed to a treatment plant including API and eventually CPI separators before being discharged to the existing system of YCCPP-1.	YCCPP-2 site	Visual inspection	Water treatment plant installed and working properly	Monthly monitoring	ArmPower (results to be reported to Environmental Monitoring and Information Center SNCO, the financing institutions and the external and internal auditors)
	Inspection of monitoring reports					
	HRSB blow down and other drainage from steam/water system will be neutralized at chemical shop to meet relevant water quality standards and will then be discharged to Hrazdan River using existing YCCPP-1 discharge system		Inspection of waste water monitoring reports	Drainage water does not exceed applicable limits		
	Compliance with international stack emission standards ensures that critical levels will not be exceeded and will thus not represent any danger for flora and fauna		Inspection of air emission monitoring reports	Air emission does not exceed applicable limits		

Activity/ Impact	What parameter is to be monitored?	Where is the parameter to be monitored?	How is the parameter to be monitored/ type of monitoring equipment?		When is the parameter to be monitored-frequency of measurement or continuous?	Responsibility for monitoring
			Method	Indicator		
Impacts on flora and fauna	Compliance with national and international noise emission standards ensures that critical levels will not be exceeded and will thus not be dangerous for sensitive fauna (if any)	YCCPP-2 site	Inspection of design data and noise measurements	Noise emissions do not exceed applicable limits (see below: noise impacts)	Regularly during operation	ArmPower
	Strict prohibition of herbicide use for maintaining YCCPP-2 site		Visual inspection	No herbicides used for maintaining	Regularly during operation	ArmPower
Soil and Water pollution	Oily waste water from Power plant operation will be duly collected and routed to a treatment plant including API and eventually CPI separators before being discharged to the YCCPP-1 existing system. The treatment system will be suitably selected and implemented to meet the environmental limits and the good industry practice.	YCCPP-2 site	Visual inspection Inspection of monitoring reports	Treatment plant (oil separator) installed and working properly Drainage water does not exceed respective limits for water quality (national or IFC, whichever is more stringent)	Monthly monitoring	ArmPower (results to be reported to Environmental Monitoring and Information Center SNCO, the financing institutions and the external and internal auditors)

Activity/ Impact	What <i>parameter is to be monitored?</i>	Where <i>is the parameter to be monitored?</i>	How <i>is the parameter to be monitored/ type of monitoring equipment?</i>		When <i>is the parameter to be monitored-frequency of measurement or continuous?</i>	Responsibility for monitoring
			Method	Indicator		
Soil and Water pollution	Rain water from internal roads and other paved areas will be collected and led to the waste water treatment plant before discharging it to the existing system of YCCPP-1. Rain water from roofs of buildings and shelters will be collected in an underground tank for reusing the water without any treatments for irrigation inside the plant site.	YCCPP-2 site	Visual inspection Inspection of monitoring reports	Treatment plant (oil separator) installed and working properly Drainage water does not exceed respective limits for water quality (national or IFC, whichever is more stringent)	Monthly monitoring	ArmPower (results to be reported to Environmental Monitoring and Information Center SNCO, the financing institutions and the external and internal auditors)
	HRSB blow down and other drainage from steam/water system will be neutralized at chemical shop to meet relevant water quality standards and will then be discharged to Hrazdan River using the existing discharge system of YCCPP-1.		Visual inspection Inspection of waste water monitoring reports	Drainage water does not exceed respective limits for water quality (national or IFC, whichever is more stringent)		

Activity/ Impact	What parameter is to be monitored?	Where is the parameter to be monitored?	How is the parameter to be monitored/ type of monitoring equipment?		When is the parameter to be monitored-frequency of measurement or continuous?	Responsibility for monitoring
			Method	Indicator		
	All waste water		Analyses by a certified independent laboratory	All waste water complies with the applicable limits for water quality (national or IFC, whichever is more stringent)	Monthly monitoring	ArmPower (by hiring an independent certified laboratory). Results to be reported to Environmental Monitoring and Information Center SNCO, the financing institutions and the external and internal auditors)
	Utility sewerage will be connected to city's sewerage system		Inspection of monitoring reports	Sewage water led to city's sewerage system; not exceeding applicable limits for water quality (national or IFC, whichever is more stringent)		ArmPower
	Train staff in appropriate sanitation practices		Inspection of training records	All staff trained accordingly	Regularly during operation	ArmPower
Soil and Water pollution	Provide spill-control materials at YCCPP-2, in order to clean up spills	YCCPP-2 site	Inspection of equipment	Spill-control equipment provided	Regularly during operation	ArmPower
	Enforcement of a Waste Management Plan		Site inspection	All waste collected, segregated and stored/ disposed of appropriately		

Activity/ Impact	What <i>parameter is to be monitored?</i>	Where <i>is the parameter to be monitored?</i>	How <i>is the parameter to be monitored/ type of monitoring equipment?</i>		When <i>is the parameter to be monitored-frequency of measurement or continuous?</i>	Responsibility for monitoring
			Method	Indicator		
	Elaboration of an emergency plan in case of accidental leakage		Inspection of emergency plan and of accident reports	Emergency Plan implemented and accidental leakages treated appropriately (if any)		
	Remove contaminated soil if spills occur and handle as hazardous waste	YCCPP-2 site Storage areas	Visual inspection	Contaminated soil handled as hazardous waste		
	Prohibition of herbicides for maintenance of YCCPP-2	YCCPP-2 site		No herbicides used for maintaining		
	Proper handling and storage of hazardous material (lockable, roofed, ventilated, concreted and banded floor)	YCCPP-2 site Storage areas		Hazardous material properly handled and stored		
	Train staff in proper management of recyclable, sanitary, solid, liquid, and hazardous wastes	YCCPP-2 site	Inspection of training records	All staff trained accordingly		
	Regular maintenance of all vehicles and machines at regular service stations, if possible		Inspection of maintenance records	Vehicles and machines adequately maintained		
Soil and Water pollution	Maintenance and re-fueling of the equipment only on sealed and enclosed areas	YCCPP-2 site	Visual inspection of maintenance and re-fueling areas	No unsuitable areas used for maintenance and re-fueling	Regularly during operation	ArmPower

Activity/ Impact	What parameter is to be monitored?	Where is the parameter to be monitored?	How is the parameter to be monitored/ type of monitoring equipment?		When is the parameter to be monitored-frequency of measurement or continuous?	Responsibility for monitoring
			Method	Indicator		
Deviation of groundwater	The Client will conduct further hydrological assessment and implement appropriate environmental management of the foreseen groundwater deviation at site, to be approved by IFC and ADB in compliance with the bank's safeguards requirements.	Near the YCCPP-2 site	Interviews with third parties Inspection of complaints	Third parties informed and water supply secured; no complaints	Regularly during operation	ArmPower
Limitation of exhaust gas pollution	Maintain vehicles and engines properly, as recommended by suppliers	YCCPP-2 site	Inspection of maintenance records	Equipment properly maintained	Regularly during operation	ArmPower
	Avoid unnecessary idling of vehicles		Visual inspection	No unnecessary idling		
Air emissions and air quality	Monitoring of NO ₂ , CO and UHC at the stack Compliance with performance guarantees of the operator for emission values	Stack of YCCPP-2	Inspection of monitoring reports of CEMS data	Air emissions do not exceed ArmPower's Performance Guarantees (NO _x : < 50; CO < 30; UHC < 10 mg/Nm ³)	Continuously	ArmPower (results to be reported to Environmental Monitoring and Information Center SNCO, the financing institutions and the external and internal auditors)

Activity/ Impact	What parameter is to be monitored?	Where is the parameter to be monitored?	How is the parameter to be monitored/ type of monitoring equipment?		When is the parameter to be monitored-frequency of measurement or continuous?	Responsibility for monitoring
			Method	Indicator		
Air emissions and air quality	Monitoring of NO ₂ , CO and UHC at the stack	Stack of YCCPP- 2	Analyses by a certified independent laboratory	Air emissions do not exceed ArmPower's Performance Guarantees (NO _x : < 50; CO < 30; UHC < 10 mg/Nm ³)	Quarterly	ArmPower (by hiring an independent certified laboratory). Results to be reported to Environmental Monitoring and Information Center SNCO, the financing institutions and the external and internal auditors)
Air emissions and air quality	Greenhouse gases emissions shall be monitored and/or quantified at least annually and results reported to national authorities and financial institutions (direct CO ₂ emissions shall be monitored with the CEMS; direct emissions of CH ₄ and N ₂ O and indirect emissions of all GHG shall be calculated based on internationally recognized methods)	YCCPP-2 site	Inspection of monitoring reports of CEMS data, and of quantification reports	GHG emissions do not exceed IFC/ WB typical value of 396 g CO ₂ /kWh gross	At least annually during operation	ArmPower (results to be reported to Environmental Monitoring and Information Center SNCO, the financing institutions and the external and internal auditors)

Activity/ Impact	What parameter is to be monitored?	Where is the parameter to be monitored?	How is the parameter to be monitored/ type of monitoring equipment?		When is the parameter to be monitored-frequency of measurement or continuous?	Responsibility for monitoring
			Method	Indicator		
	Monitoring of ambient air quality - NO ₂	At two locations: one predicted maximum ground level concentration location and one background site	Continuous electronic monitors	Ground level concentrations of NO ₂ do not exceed national and international standards	Continuous measurements (at hourly intervals) during 2 years, starting during the commissioning phase	
Landscape and Visual Aspects	Planting of indigenous trees and bushes along YCCPP-2 boundaries is recommended, in order to reduce the visual burden at least to some extent (develop and implement landscape / planting plan)	YCCPP-2 site	Visual inspection Inspection of landscape / planting plan	Native site adapted tree species planted according to landscape / planting plan	Regularly during operation	ArmPower
Waste Management	Collect all type of wastes during CCPP operation. Make arrangements for proper waste handling, treatment and disposal with municipal authorities about using services of communal service providers for waste disposal purposes	YCCPP-2 site	Visual inspection Inspection of agreement with waste collector	All waste collected, segregated and stored/ disposed of appropriately Domestic waste picked up regularly by waste collector	Regularly during operation	ArmPower
Waste Management	Oil separated from water in the API separator of the waste water treatment plant will be collected by a licensed company for final disposal	YCCPP-2 site Waste water treatment plant	Visual inspection Inspection of contract with licensed company	All oil accordingly collected	Regularly during operation	ArmPower

Activity/ Impact	What <i>parameter is to be monitored?</i>	Where <i>is the parameter to be monitored?</i>	How <i>is the parameter to be monitored/ type of monitoring equipment?</i>		When <i>is the parameter to be monitored-frequency of measurement or continuous?</i>	Responsibility for monitoring
			Method	Indicator		
	Store all hazardous waste in adequate storage sites (lockable, roofed, ventilated, concreted and bunded floor) at YCCPP-2 site for future disposal	YCCPP-2 site Storage areas	Visual inspection Inspection of hazardous material/waste register	Hazardous waste and materials stored appropriately and clearly labelled; Materials Safety Data Sheets (MSDS) provided		
	Clearly label all hazardous waste and provide Materials Safety Data Sheets (MSDS)					
	Adequate storage and clear labeling according to national / internationally recognized requirements and standards, including the International Chemical Safety Cards (ICSC), Materials Safety Data Sheets (MSDS), of all hazardous substances in chemical workshop (e.g. acids and alkaline solutions)	YCCPP-2 site Storage areas	Visual inspection Inspection of hazardous material/waste register	Hazardous waste and materials stored appropriately and clearly labelled; Materials Safety Data Sheets (MSDS) provided		
Waste Management	Waste Management Plan for operation shall also include a risk assessment associated with the mid-term to long-term storage of hazardous waste and adequate sizing of the storage area, as well as monitoring procedures	YCCPP-2 site Storage areas	Inspection of Waste Management Plan and storage sites	Risks assessed in Waste Management Plan and adequate storage implemented	Regularly during operation	ArmPower

Activity/ Impact	What parameter is to be monitored?	Where is the parameter to be monitored?	How is the parameter to be monitored/ type of monitoring equipment?		When is the parameter to be monitored-frequency of measurement or continuous?	Responsibility for monitoring
			Method	Indicator		
	Train staff in handling and disposal of recyclable, sanitary, solid, liquid and hazardous waste	YCCPP-2 site	Inspection of training records	All staff trained accordingly		
HSE Policy and HSE Management	ArmPower will have a Health, Safety and Environment Management System (HSEMS) in place, according to their HSE Policy, considering IFC/WorldBank EHS guidelines for Thermal Power Plants	YCCPP-2 site	Inspection of relevant documents	HSEMS in place, considering relevant guidelines	Regularly during operation	ArmPower
Employee Health and Safety	Make sure that all staff has a health insurance	YCCPP-2 site	Inspection of workers' health documents	All staff has health insurance	Regularly during operation	ArmPower
	Consider occurrence of poisonous snakes		Inspection of incident and accident reports	No accidents related to poisonous snakes		
Employee Health and Safety	For workers noise levels shall be kept below 80 dB (A), wherever possible. Hand out ear protection devices to all workers, when necessary	YCCPP-2 site	Visual Inspection	Noise level below 80 dB (A); if noise levels are higher: workers fitted with PPE and warning signs installed	Regularly during operation	ArmPower

Activity/ Impact	What <i>parameter is to be monitored?</i>	Where <i>is the parameter to be monitored?</i>	How <i>is the parameter to be monitored/ type of monitoring equipment?</i>		When <i>is the parameter to be monitored-frequency of measurement or continuous?</i>	Responsibility for monitoring
			Method	Indicator		
	Staff will be provided with appropriate protective equipment (PPE) according to RENCO's Occupational Health & Safety Standards and IFC/WorldBank EHS guidelines for Thermal Power Plants		Visual Inspection	All staff provided with and using PPE		
	Train staff accordingly regarding work at heights, electrical and vehicular safety, handling of hazardous materials, use of PPE, hazard avoidance and reduction measures, use of first aid and rescue techniques, emergency response, firefighting, etc.		Inspection of training records	All staff trained accordingly		
	Forbid alcohol and other drugs at YCCPP-2 site		Inspection of incident records	No staff found under influence of alcohol or other drugs		
	Assure transfer of injured staff to hospitals in the case of serious accidents		Inspection of accident reports	Staff transferred to hospital in case of serious accidents		
Employee Health and Safety	Limit occupational exposure to electric or magnetic fields (EMF) by use of shielding materials, signing of relevant areas and training of staff	YCCPP-2 site	Interviews Inspection of training records	Shielding materials in place All workers trained accordingly	Regularly during operation	ArmPower

Activity/ Impact	What <i>parameter is to be monitored?</i>	Where <i>is the parameter to be monitored?</i>	How <i>is the parameter to be monitored/ type of monitoring equipment?</i>		When <i>is the parameter to be monitored-frequency of measurement or continuous?</i>	Responsibility for monitoring
			Method	Indicator		
	Maintain vehicles and machinery regularly and use manufacturer approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure		Inspection of maintenance records	Vehicles regularly maintained and approved parts used		
	Operator's Human Resources Policy shall include international labor standards as defined in ILO (2014)		Inspection of Human Resources Policy	According to international labor standards, fulfilling IFC PS 2		
	Record work-hours as well as all accidents and incidents		Inspection of records	Recording implemented		
	Implement and communicate an accessible grievance mechanism for staff to address any complaints		Inspection of grievance log book Interviews	All grievances adequately treated		
Noise impacts on public	For residents the noise levels may not exceed 50 dB (A) during daytime and 45 dB (A) during night, or a maximum increase of 3 dB(A).	Residential areas near the YCCPP-2 site (up to 5 points)	Instrumental measurement	Noise level below 50 dB (A) during daytime and 45 dB (A) during night Or A maximum increase of 3 dB(A)	5 hours of day-time and night-time measurements, twice per month during commissioning period	ArmPower (results to be reported to Environmental Monitoring and Information Center SNCO, the financing institutions and the external and internal auditors)

Activity/ Impact	What parameter is to be monitored?	Where is the parameter to be monitored?	How is the parameter to be monitored/ type of monitoring equipment?		When is the parameter to be monitored-frequency of measurement or continuous?	Responsibility for monitoring
			Method	Indicator		
Public Health and Safety	Compliance with Performance Guarantees emission levels	YCCPP-2 site	Inspection of monitoring reports of CEMS data Inspection of complaints	Air emissions do not exceed limits of ArmPower's Performance Guarantees No complaints	Regularly during operation	ArmPower (results to be reported to Environmental Monitoring and Information Center SNCO, the financing institutions and the external and internal auditors)
	YCCPP-2 site will be fenced and the entrance gates will be guarded by security staff in order to prevent any unauthorized access.	YCCPP-2 site	Inspection of incidents/ accidents records	No incidents/ accidents regarding public health and safety		ArmPower
Public Health and Safety	Development and implementation of a Security Force Management Plan guided by principles of proportionality, good international practice and national law, is recommended	Construction Site Office of Operator at YCCPP-2	Inspection of security concept and contracts	Arrangements according to good international practice; No complaints from public	Regularly during operation	ArmPower

Activity/ Impact	What <i>parameter is to be monitored?</i>	Where <i>is the parameter to be monitored?</i>	How <i>is the parameter to be monitored/ type of monitoring equipment?</i>		When <i>is the parameter to be monitored-frequency of measurement or continuous?</i>	Responsibility for monitoring
			Method	Indicator		
	Security personnel shall be trained and monitored regarding the use of force and conduct towards the community	Construction Site Office of Operator at YCCPP-2	Inspection of training records Review of recorded security incidents and adaptation of security management , if required	All security staff trained accordingly; No complaints from public; Adaptation of security management, if required		
	Develop and implement Emergency Preparedness and Response Plan	Office of Operator at YCCPP-2	Inspection of documents	Emergency Preparedness and Response Plan implemented		
	Provide appropriate information about Emergency Preparedness and Response Plan to potentially affected communities and individuals	Near the YCCPP-2 site	Interviews with residents	Residents informed accordingly		
Information of public	Undertake regular communication of the company's environmental and social performance	Residents living near to site	Interviews with third parties	Third parties informed accordingly	Regularly during operation	ArmPower

Activity/ Impact	What parameter is to be monitored?	Where is the parameter to be monitored?	How is the parameter to be monitored/ type of monitoring equipment?		When is the parameter to be monitored-frequency of measurement or continuous?	Responsibility for monitoring
			Method	Indicator		
One audit per year by an external internationally experienced auditor	Compliance with ESMP; monitoring data	YCCPP-2 site Office of ArmPower	Inspection of power plant, HSE reports from ArmPower, monitoring data (air emissions, noise emissions, waste water, etc.)	All mitigation measures of ESMP implemented and adaptive measures applied, where necessary; Monitoring data below the defined limit values or regulative measures implemented	One audit per year during the operation phase	External auditor Costs per audit: 10,000 USD

9.2.4 Monitoring during the Decommissioning Phase

As mitigation measures for decommissioning will be mainly the same as for the construction phase, also monitoring measures will be similar. Especially implementation of a Waste Management Plan for all wastes from deconstruction of the power plant will have to be monitored. This includes also the proper storage and disposal of hazardous wastes. Monitoring will be under the responsibility of ArmPower.

9.3 Implementation Arrangements and Capacity Building

The new power plant YCCPP-2 will be constructed by RENCO SPA and operated by ArmPower CJSC, which is a subsidiary company of RENCO SPA and Siemens.

RENCO SPA has a Health, Safety and Environment Policy (2015) in place, in order to meet the requirements, regulations and communities affairs for the health of all persons working under the control of RENCO, environment protection and plants safety. An integrated system for safety, environment and quality has been implemented in compliance to international guidelines and standards (like OHSAS 18001 and ISO 14001 standards). Among others RENCO SPA has also a Social and Cultural Heritage Policy (2016) as well as an Anti-Corruption Policy (2016) and a Code of Ethics in place.

The above mentioned policies and HSE management systems shall also be established at ArmPower CJSC as subsidiary company of RENCO SPA.

RENCO SPA as EPC Contractor has to implement the ESMP within its own site-specific Health, Safety and Environment Management System (HSEMS) in a proper way and shall have an HSE manager on duty throughout the construction period. This HSE officer shall prepare monthly reports of all HSE relevant incidents and accidents as well as possible non-compliance during implementation of the mitigation measures as given in the ESMP. These reports shall be forwarded to the Health, Safety and Environment Manager of ArmPower and the relevant national authorities (like the Ministry of Nature Protection, Ministry of Health) as well as to the external internationally experienced auditor.

An external internationally experienced auditor shall perform quarterly supervision of the implementation of the ESMP and monitor the implementation of the mitigation measures during construction period. The aim of the audits will be to ensure that all mitigation measures are implemented adequately. In case of any discrepancies, the specialist shall implement proper actions to establish compliance with the ESMP. If this is not possible and if the discrepancy is considered to be severe, the person(s) in charge shall be empowered to stop the work immediately until compliance is achieved again. Based on his quarterly supervision and the monthly reports provided by the Health, Safety and Environment Manager

of RENCO, the external auditor will produce narrative analytical quarterly reports on environmental and social performance in the course of the Project and furnish these reports to ADB/ IFC and to ArmPower. Additional site inspections by the external auditor shall be performed during the commissioning phase (one time) and the operational phase (once per year).

The monitoring of noise levels during construction and commissioning phases, of air emissions during commissioning and operation (during operation based on CEMS at the stack), as well as of liquid effluents during operation of YCCPP-2 shall be done by ArmPower and the results shall be shared with the “Environmental Monitoring and Information Center SNCO” of the Ministry of Nature Protection of the RA. During the site visit in July 2017 FICHTNER’s environmental specialist was informed that **there are not enough capacities** at the named institution for implementing additional monitoring programs. Thus, measures for capacity building shall be considered so that in the future spot checks of the monitoring results can be undertaken by this authority. These measures should include employment of additional staff or contracting outside resources for monitoring purposes (or both). Existing staff shall be trained in effective monitoring procedures including knowledge about national and international (ADB, IFC/World Bank) guidelines and limit values.

9.4 Reporting requirements

The results of the monitoring measures foreseen in Section 9.2 of this ESIA shall be compiled in the form of HSE monitoring reports.

During the construction and decommissioning stages, the EPC Contractor (RESCO SPA) shall prepare:

- a daily HSE log;
- HSE incidents and chance finds reports;
- internal HSE audit reports;
- monthly HSE reports compiling all the above.

During operation, ArmPower shall prepare:

- HSE incidents reports;
- internal HSE audit reports;
- monthly HSE reports.

All reports shall be kept within the project’s documentation and be readily available for disclosure to the national authorities, the financing institutions and the external and internal auditors. The reports must include the HSE situation at site and the results of the grievance mechanism (see Stakeholder Engagement Plan in Annex 12.9).

9.5 Adaptive management

The monitoring of the works may reveal the necessity to adapt the mitigation and monitoring measures of the ESMP to specific site conditions not known at the time of preparation of this ESIA. Items which are not anticipated in the ESMP may come up, as well as areas that need improvements. The Contractors shall be ready to handle both cases by adapting the dispositions of this ESIA.

Any changes to the commitments of this ESIA and the ESMP shall not be undertaken without the previous approval of the Project Owner and the Lenders.

9.6 Summary of Costs for Implementation of the EMSP

All costs for mitigation of the impacts during the construction, operation, and decommissioning periods of the Project are included in the regular construction / operational / decommissioning costs. Construction works are foreseen to run for 2.5 years.

Costs for the monitoring of ambient air and ambient noise at the power plant's surroundings are calculated as 145,000 USD. Additional costs are foreseen for **quarterly supervision of the construction sites and one additional site investigation during the commissioning phase**, to be performed by an internationally experienced auditor. One supervision mission is estimated to cost approx. 10,000 USD, including flights and reporting. Thus, the supervision will sum up to 110,000 USD for 10 visits during the 2.5 years of construction period and one visit during commissioning.

A total cost of **255,000 USD** is foreseen (see Table 9-21).

Additional costs of 10,000 USD per year will arise for **yearly audits of the external auditor during the operation phase** of YCCPP-2.

Table 9-21: Monitoring costs for implementation of the ESMP

Parameter	Stage	Frequency and duration	Location	Total cost
Ambient Noise	Construction	Twice per month, 5 hours each time, for 30 months	Up to 5 points in residential areas	50,000 USD
	Commissioning	Twice per month, 5 hours each time, for 12 months	Up to 5 points in residential areas	20,000 USD
Ambient air quality - NO ₂	Commissioning and Operation	Continuously for 24 months	At two locations, one predicted maximum ground level concentration location and one background site.	75,000 USD
<i>SUB- TOTAL</i>				<i>145,000 USD</i>
All EHS issues as per the ESIA	Construction	Every quarter of the year, for 2.5 years	The whole construction site	100,000 USD
	Commissioning	One time	The power plant	10,000 USD
<i>SUB- TOTAL</i>				<i>110,000 USD</i>
TOTAL				255,000 USD *

* Additional costs of 10,000 USD per year will arise for a yearly audit of the external auditor during the operation phase of YCCPP-2.

9.7 Gap Analysis regarding compliance with IFC Performance Standards

The compliance of the Project with the main requirements of the IFC Performance Standards after implementation of the mitigation and monitoring measures given in the ESMPs is analyzed in Table 9-22 below.

Table 9-22: Compliance of the Project with main requirements of IFC Performance Standards (PS)

Main requirements of Performance Standards	Assessment
PS 1: Assessment and Management of Environmental and Social Risks and Impacts	
PS 1: Policy	
Has a formal policy defining the environmental and social objectives and principles that guide the project been established?	Yes; RENCO has Health, Safety and Environment Policy in place and will develop a site specific Health, Safety and Environment Management System (HSEMS) for the Project; this shall also be established at ArmPower which is a subsidiary company of RENCO SPA and Siemens
Is the policy consistent with the principles of the PS or other internationally recognized standards?	Yes; the certified Policy complies to OHSAS 18001 and ISO 14001 standards
PS 1: Identification of risks and impacts	
Is there a process to assess the environmental and social impacts and risks of the project?	Yes; A National Environmental Impact Assessment has been prepared in 2016; Fichtner currently prepares the ESIA study (including ESMP) assessing environmental and social impacts
Have recent environmental and social baseline data at an appropriate level of detail been used in the assessment?	Yes; Site visit by Fichtner's environmental and social experts in 2017 and 2018 including stakeholder interviews; recent reports on geological situation and national EIA study as baseline; reports on groundwater quality and soil contamination at the site have just been prepared; measurements of background air quality and noise levels by Fichtner for Air Dispersion Calculation and Noise Propagation Study as part of the ESIA
Have all relevant risks and impacts been assessed, including the issues identified in PS 2 to 8?	Yes; all relevant impacts assessed in Fichtner's ESIA study. PS 5 and PS 7 are not applicable to the Project
Are the risks and impacts related to the emission of GHG and climate change considered, as well as adaptation opportunities?	Yes; see Section 6.2.5 of Fichtner's ESIA study
Have transboundary effects been considered?	Not applicable
Have the impacts been identified in the context of the project's area of influence?	Yes; assessed Project Area of Influence includes residential areas several km away and some illegal housings in the vicinity of the planned power plant

Main requirements of Performance Standards	Assessment
Have cumulative impacts been assessed?	Yes; Air Dispersion Calculation and Noise Propagation Study as part of Fichtner's ESIA study consider also the existing background levels
Have risks and impacts related to the actions of third parties been assessed?	Yes; if any third parties will be engaged they will have to comply to RENCO's HSE Policy and site-specific HSEMS
Has the assessment considered the findings of plans, studies and assessments prepared by relevant government authorities and other parties directly related to the project?	Yes; National project approval from Ministry of Nature Protection has been given in 2017 based on the national EIA and geological reports; National reports have been used as baseline for Fichtner's ESIA study
Have disadvantaged or vulnerable groups been identified?	Yes; Some illegal residents are located in the vicinity of the planned construction site
If so, do any adverse impacts fall disproportionately on them?	No
PS 1: Management Programs	
Has a program of mitigation and performance improvement measures that addresses identified impacts and risks been developed?	Yes; Environmental and Social Management Plans for construction, operation, and decommissioning phases of the Project are part of Fichtner's ESIA study. Mitigation Measures of the ESMPs will have to implemented by the EPC Contractor (RENCO SPA)
Does the program take into account the engagement process with affected communities?	Yes; Engagement process with affected communities is foreseen; Stakeholder Engagement Plan is part of Fichtner's ESIA study
Does the program include estimates of the resources for implementation?	Yes; Implementation of all mitigation measures during construction, operation and decommissioning phases are part of construction/ operational/ decommissioning budgets
Does the program include definition of the responsibilities for implementation?	Yes; Implementation arrangements are defined in Section 9.2.4 of Fichtner's ESIA study
PS 1: Organizational Capacity and Competency	
Are responsibilities and authorities for implementation of the management program defined and communicated appropriately through the client's organization?	Yes; National project approval has already been given by Ministry of Nature Protection; other authorities (e.g. for waste management, monitoring of air and noise emissions as well as effluents, possible chance finds of cultural goods) are named in Fichtner's ESIA and will be contacted by the client.

Main requirements of Performance Standards	Assessment
Do the persons with responsibility for implementing the management program have the necessary knowledge, skills and experience?	Yes; RENCO has a certified Health, Safety and Environment Policy in place and will establish a HSE Manager for the Project; the same will be done at ArmPower as subsidiary of RENCO
PS 1: Emergency Preparedness and Response	
Are there emergency preparedness and response plans that are commensurate with the level of project risks?	Yes; Emergency preparedness and response plans will have to be developed by EPC Contractor for construction and Operator for operational phase; these plans are part of the mitigation measures given in Fichtner's ESIA study
In the event emergency preparedness and response requires participation of the community and the local governmental agencies, have they been involved?	Yes; Communities and local government authorities will be involved in those plans
PS 1: Monitoring and Review	
Have procedures to monitor and measure on a regular basis the effectiveness of the management program established, including the use of external experts and/or affected communities where appropriate?	Yes; Monitoring the implementation of mitigation measures is part of Fichtner's ESIA study; Monitoring will be done by RENCO's and ArmPower's HSE Managers and an internationally experienced auditor
Is the management program regularly updated based on the results of the monitoring?	Yes; Monitoring reports will update the ESMP regularly, if necessary
Is appropriate environmental and social performance information periodically reported internally to senior management?	Yes; ArmPower's HSE Manager will report the monitoring results to senior management of ArmPower and to internationally experienced auditor
PS1: Stakeholder Engagement	
Has the range of stakeholders for the project been identified?	Yes; see Stakeholder Engagement Plan (including Grievance Redress Mechanism) which is part of Fichtner's ESIA study
Has a Stakeholder Engagement Plan been established?	
Are differentiated measures deemed to allow the participation of those identified as disadvantaged or vulnerable included?	
Has appropriate disclosure of relevant project information to, and consultation with, affected communities been conducted?	Yes; affected communities have been informed and possible concerns collected during site visit of Fichtner's environmental and social experts in 2017; Draft Final ESIA and ESMP was disclosed to public and Public Consultation meeting was performed to finalize ESIA study

Main requirements of Performance Standards	Assessment
Has the disclosure and consultation process been: <ul style="list-style-type: none"> • Timely (early in the process)? • Culturally appropriate (language, gender issues)? • Free of external manipulation, interference, coercion or intimidation? • Transparent? • Meaningful? • Documented? 	Yes; see Stakeholder Engagement Plan (including Grievance Redress Mechanism) which is part of Fichtner's ESIA study
For projects with potentially significant adverse impacts on Affected Communities, has a process of Informed Consultation and Participation been undertaken?	
Are Indigenous Peoples engaged in a process of ICP (Informed Consultation and Participation)?	Not applicable
Was the Indigenous Peoples FPIC (Free, Prior and Informed Consent) obtained?	
PS 1: External Communications and Grievance Mechanisms	
Is there a procedure for receiving external communications, screening and assessing the issues raised and providing answers and adjustments to the management plan?	Yes; Grievance Mechanism is part of Fichtner's ESIA study and of the Stakeholder Engagement Plan; Public Consultation Meeting was performed to finalize ESIA study
Are reports on the environmental and social sustainability of the project publicly available?	Yes; ESIA study and ESMP were disclosed before Public Consultation meeting
Has an effective grievance mechanism for affected communities been established?	Yes; Grievance Mechanism is part of Fichtner's ESIA study and of the Stakeholder Engagement Plan
PS 1: Ongoing reporting for affected communities	
Are (at least) annually reports provided to the affected communities describing the progress with the implementation of the Action Plans on issues involving risks to them and on those issues identified through the consultation/grievance mechanisms?	Yes; see Stakeholder Engagement Plan (including Grievance Redress Mechanism) which is part of Fichtner's ESIA study
PS 2: Labor and Working Conditions	
PS 2: Human Resource Policies and Procedures	
Are appropriate human resources policies and procedures available that address all requirements of PS 2 and national law?	Yes; RENCO has a certified Health, Safety and Environment Policy (2015), a Social and Cultural Heritage Policy (2016), an Anti-Corruption Policy (2016), and a Code of Ethics in place, which shall all also be established at ArmPower as subsidiary company of RENCO
Are the workers provided with information regarding their rights?	

Main requirements of Performance Standards	Assessment
PS 2: Working conditions and terms of employment	
Are any established collective bargaining agreement with workers' organizations respected?	Yes; RENCO has a certified Health, Safety and Environment Policy (2015), a Social and Cultural Heritage Policy (2016), an Anti-Corruption Policy (2016), and a Code of Ethics in place, which shall all also be established at ArmPower as subsidiary company of RENCO.
Is it ensured that the migrant workers are engaged on substantially equivalent terms and conditions to the non-migrant workers carrying similar work?	
<p>Where accommodation services are provided, is it ensured that:</p> <ul style="list-style-type: none"> • Policies on the quality and management of the accommodations and basic services are implemented? • Principles of non-discrimination and equal opportunity guide the accommodation services? • The accommodation's arrangements do not restrict worker's freedom of movement or association? 	
PS 2: Workers' Organizations	
Is there a compliance with the national law in allowing workers to form and join workers organizations?	PS 2 is based on a number of international conventions and instruments, including those of the International Labor Organization (ILO) and the United Nations (UN). All of them are ratified by the Republic of Armenia, except "UN - International Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families" which has only been signed and ratification is still pending. For RENCO's and ArmPower's policies see above.
If national law substantially restricts workers organizations, have there been restrictions imposed to workers to express their grievances and protect their rights organizations?	
PS 2: Non-discrimination and Equal Opportunity	
Is it ensured that employment decisions are not made on the basis of personal characteristics unrelated to job requirements?	Yes; For RENCO's and ArmPower's policies see above. These issues are also part of the ESMPs in Fichtner's ESIA study.
Is harassment, intimidation and/or exploitation of workers, especially women and migrant workers, avoided?	
PS2: Retrenchment	
If any collective dismissal was applied, has an analysis of alternatives to retrenchment been made?	Not applicable
If retrenchment of a significant number of employees is expected, has a plan been developed to implement the retrenchment in compliance with all legal and contractual requirements?	

Main requirements of Performance Standards	Assessment
PS 2: Grievance Mechanism for workers	
<p>Is a grievance mechanism for workers provided to raise workplace concerns that:</p> <ul style="list-style-type: none"> • is easily accessible; • is understandable? • is transparent? • allows anonymous complains? 	Yes; RENCO and ArmPower will establish adequate grievance mechanisms for workers as has been done in many other international projects; this issue is also part of the ESMPs of Fichtner's ESIA study.
PS 2: Child Labor	
Does the project employ children?	No; for RENCO's and ArmPower's policies see above
<p>Where national laws allow the employment of minors:</p> <ul style="list-style-type: none"> • are the provisions of those laws followed by the client? • are minors kept away from hazardous work? • are minors subject to appropriate risk assessment and regular monitoring of health, working conditions and hours of work? 	Not applicable; national law does not allow child labor
PS 2: Forced Labor	
Does the project employ forced labor or trafficked persons?	No; for RENCO's and Armpower's policies see above
PS 2: Occupational Health & Safety (OHS)	
Does the project provide the workers with a safe and healthy work environment?	Yes; RENCO as EPC Contractor will establish site-specific HSE Management System according to its certified HSE Policy and employ an HSE Manager for the project. ArmPower shall do the same for operation. Emergency preparedness and response plans will be developed for the Project. These topics are also part of the ESMPs in Fichtner's ESIA study
Have steps been taken to prevent accidents, injury, and disease?	
Have the workers been trained in occupational health and safety?	
Are occupational accidents, diseases, and incidents documented and reported?	
Is there an emergency prevention, preparedness and response arrangement for the project?	
PS 2: Workers Engaged by Third Parties	
Are there policies and procedures for managing and monitoring the performance of third party employers in relation to the requirements of this PS?	Yes; if any third parties will be engaged they will have to comply to RENCO's HSE Policy and site-specific HSEMS, including grievance mechanism
Is the access of the workers engaged by third parties to a grievance mechanism guaranteed?	
PS 2: Supply Chain	
If there is a high risk of child or forced labor in the primary supply chain, are these risks identified and monitored, and are the necessary steps taken to remedy them?	Yes; supply chain has to comply to RENCO's HSE Policy and site-specific HSEMS

Main requirements of Performance Standards	Assessment
If there is a high risk of significant safety issues related to supply chain workers, is it ensured that the primary suppliers are preventing these situations?	Yes; supply chain has to comply to RENCO's HSE Policy and site-specific HSEMS
In case of need, does the project shift its primary supply chain to suppliers that can demonstrate the compliance with this PS?	
PS 3: Resource Efficiency and Pollution Prevention	
PS 3: Resource Efficiency	
Have the project's operations incorporated resource conservation and energy efficiency measures?	Yes; Power plant will use highly efficient state-of-the-art equipment and will work as closed cycle system
Where GHG emissions (direct plus indirect from purchased electricity) exceed 25,000 tons CO ₂ annually is annual quantification undertaken?	Yes; annual quantification of GHG emissions is part of the operational ESMP in Fichtner's ESIA study
In case the project is a potentially significant consumer of water, have measures to avoid or reduce the water usage been adopted?	Power Plant will work as closed cycle system
PS 3: Pollution Prevention	
Is the release of pollutants avoided/ minimized?	Yes; release of pollutants will be minimized, e.g. by using highly efficient technology like low-NOx burner, cleaning/ neutralizing waste water; air emissions and effluents will be monitored in order to fulfill relevant national and IFC/WB standards
Have the following factors been included in the assessment of potential adverse project impacts: existing ambient conditions; the finite assimilative capacity of the environment; existing and future land use; the project's proximity to areas of importance to biodiversity; and the potential for cumulative impacts?	Yes; most factors included in Fichtner ESIA study; ambient air pollution and noise level are measured as background data; land use, influence on biodiversity and potential for cumulative impacts have been assessed
Is the following hierarchy for waste management followed: avoidance, reduction, recovery, re-usage, treatment, destruction and final environmentally sound disposal?	Yes; EPC Contractor will have to implement Waste Management Plan as part of his HSE Management Plan; these issues are also part of the ESMPs in Fichtner's ESIA study
Are special provisions for hazardous waste disposal considered?	Yes; Hazardous waste will have to be stored in closed, roofed, ventilated, concreted and banded storage areas for final disposal according to mitigation measures of ESMPs in Fichtner's ESIA study

Main requirements of Performance Standards	Assessment
Is the release of hazardous materials avoided/minimized/controlled?	Yes; oily waste water will be led to an oil separator before entering discharge system of YCCPP-1; HRSG blow down and other drainage from steam/water system will be neutralized at the chemical shop of the power plant before discharging
Are hazardous materials which are subject to international bans or phase-outs used?	No
If pesticides are used, is their selection and management consistent with good international industry practice and part of an integrated pest management and/or vector management strategy?	Not applicable, as no pesticides will be used for clearing of construction site or for maintenance during operation, according to the ESMPs in Fichtner's ESIA study
PS 4: Community Health, Safety, and Security	
PS 4: Community Health and Safety	
Has the potential for community risks and impacts associated with the project been evaluated?	Yes; risks and impacts are assessed in Fichtner's ESIA study and mitigation measures presented in the ESMPs
Have preventive and control measures consistent with GIIP been established?	
PS 4: Infrastructure and Equipment Design and Safety	
Have the structural elements of the project been designed, constructed, operated and decommissioned in accordance with GIIP?	Yes; new YCCPP-2 will be constructed as state-of-the-art power plant
PS 4: Hazardous Materials Management and Safety	
Is the potential for community exposure to hazardous materials and substances that may be released by the project avoided or minimized?	Yes; hazardous waste will be stored accordingly on-site; waste water will be cleaned and neutralized; construction site and power plant will be fenced and guarded by security personnel to avoid unauthorized entry; these topics are part of the ESMPs in Fichtner's ESIA study
PS 4: Ecosystem Services	
Have impacts and risks on priority ecosystem services in use by the Affected Communities been identified?	Not applicable
PS 4: Community Exposure to Disease	
Does the project avoid or minimize the potential for community exposure to water-related and vector-borne diseases caused by the project, including influx of labor?	Not applicable
PS 4: Emergency Preparedness and Response	
See PS 1	

Main requirements of Performance Standards	Assessment
PS 4: Security Personnel	
Have security arrangements guided by principles of proportionality, good international practice, and the national law been made?	Yes; Construction site and power plant will be fenced and guarded by security personnel; PS 4 requirements are part of the ESMPs of Fichtner's ESIA study and thus, will have to be implemented by EPC Contractor and Operator; Grievance Mechanism will be implemented
Is it assured that the security personnel has not been implied in past abuses?	
Have the security personnel been provided training in the use of force and conduct towards the community?	
Has the community been provided with a grievance mechanism through which complains regarding the security arrangements can be done?	
PS 5: Land Acquisition and Involuntary Resettlement	
PS 5 is not triggered by the Project: all land for construction/ operation of YCCPP-2 already acquired. No physical relocation. Existing access roads will be used.	
PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	
PS 6: General	
Has the significance of project impacts on biodiversity and ecosystem services been specifically addressed as part of the social and environmental assessment process?	Yes; see Sections 6.1.1 and 6.2.1 and mitigation measures in the ESMPs of Fichtner's ESIA study
Has the practice of adaptive management been adopted?	Not applicable
PS 6: Protection and Conservation of Biodiversity	
Has a hierarchy of avoidance, minimization, restoration and compensation (biodiversity offsets) been considered?	Not applicable
Have natural habitat areas been conversed or degraded? If yes, have the conditions of PS 6 been respected?	No
Have natural habitat areas suffered a net loss of biodiversity?	
Has the implementation of project activities been undertaken in critical habitat? If yes, have the conditions of PS 6 been respected?	
If critical habitat is affected, has a Biodiversity Action Plan been designed to achieve net gains of biodiversity?	Not applicable
Has the implementation of project activities been undertaken in a protected or internationally recognized area? If yes, have the conditions of PS 6 been respected?	No

Main requirements of Performance Standards	Assessment
Do the project activities imply the introduction of alien species and/or of alien species with a high risk of invasive behavior?	No
If applicable, has the intentional introduction of alien species been carried out according to specific regulatory framework?	Not applicable
Have measures been designed to avoid unintentional introduction or spreading of alien species?	
PS 7: Indigenous Peoples	
PS 7 is not triggered by the Project as no groups of Indigenous People are living in the Project Area of Influence.	
PS 8: Cultural Heritage	
PS 8: Protection of Cultural Heritage in Project Design and Execution	
Has cultural heritage been considered as part of the environmental and social assessment?	Yes; see Section 6.3.3 of Fichtner's ESIA study
If the project is located in an area where cultural heritage is expected to be found, has a Chance Find Procedure been established?	No cultural heritage is expected to be found during construction. However, a Chance Find Procedure will be implemented, according to ESMP of Fichtner's ESIA study
Have the Affected Communities who use or have used the cultural heritage for long-standing cultural purposes been consulted?	Not applicable
Is continued access allowed to the cultural site or is an alternative route provided, in case of affectation of sites used for long-standing cultural purposes?	
Has a hierarchy of avoidance, minimization, restoration in situ and restoration off site, and compensation been undertaken?	
If non-replicable cultural heritage needs to be removed, have the following conditions of PS 8 been satisfied?: no technically or financially feasible alternatives existed; the benefits of the projects outweighed the anticipated cultural heritage loss from removal; and removal was conducted by the best available technique.	
If critical heritage is removed, significantly altered, or damaged by the project, have a process of ICP been undertaken with the Affected Communities?	
If the project is located in a legally protected area or a legally defined buffer zone, have the following conditions of PS 8 been satisfied?: compliance with defined regulations and the protected area management plans; consultation with the protected area sponsors and managers, local communities and other key stakeholders? Implementation of additional programs as appropriate to promote and enhance the conservation aims of the protected area.	

Main requirements of Performance Standards	Assessment
PS 8: Project's use of cultural heritage	
If the project will use cultural resources, knowledge, innovations, or practices of local communities embodying traditional lifestyles for commercial purposes, has the client entered a process of ICP?	Not applicable
Have fair and equitable sharing of benefits been ensured?	

After implementation of the mitigation measures and the below defined Environmental and Social Action Plan (ESAP), the Project complies with the requirements of all applicable IFC Performance Standards and ADB Safeguard Requirements.

9.8 Environmental and Social Action Plan

An Environmental and Social Action Plan is presented in this section in order to highlight the most urgent steps for implementation of the mitigation measures given in the ESMPs, naming also the relevant IFC Performance Standards and/or international guidelines and standards.

Table 9-23: Environmental and Social Action Plan including the main mitigation topics

Action	Requirement (IFC Performance Standard, Best Practice)	Responsibility	Implementation Schedule (Timeline)	Target for successful implementation / Reporting requirement
Implementation of a Grievance Redress Mechanism for Project Affected People	IFC PS 1	RENCO as EPC Contractor ArmPower as Operator	In advance of construction; to be valid during construction, operation and decommissioning	Grievance log book and reports on successful handling the grievances
Conduct further hydrological assessment and implement appropriate environmental management of the foreseen groundwater deviation at site including: impacts and mitigation measures for changes to the groundwater profile, both within the site and on neighboring properties; study of water treatment options in the unlikely event that groundwater rises to the surface or needs to be removed from the site and discharged in a different receptor (river or public network); assessment to be approved by IFC and ADB before construction.	IFC PS 4 IFC/ WB General EHS-Guidelines	RENCO as EPC Contractor ArmPower as Operator	In advance of construction	Impact assessment and Management Plan including measures such as informing third parties and provision of water supply alternatives, if necessary
Emergency Preparedness and Response Plans based on robust Quantitative Risk Assessment (QRA) / Hazard	IFC PS 1, 4	RENCO as EPC Contractor	In advance of construction	Emergency Preparedness and Response Plans for construction, operation and

Action	Requirement (IFC Performance Standard, Best Practice)	Responsibility	Implementation Schedule (Timeline)	Target for successful implementation / Reporting requirement
Identification Study (HAZID) taking into account general and site-specific risks (e.g. adjacent power plant, seismic risk, flood risk, etc.)		ArmPower as Operator		decommissioning
Security Force Management Plan guided by principles of proportionality, good international practice and Armenian national law, including training and monitoring of security personnel regarding the use of force and conduct towards the community	<p>IFC PS 1, 4</p> <p>IFC (2017): Good Practice Handbook on Use of Security Forces - Assessing and Managing Risks and Impacts.</p>	<p>RENCO as EPC Contractor</p> <p>ArmPower as Operator</p>	In advance of construction	Security Force Management Plan for construction and for operation developed and implemented according to named requirements
Development of a site-specific Health, Safety and Environment Management Plan (HSEMP), Health, Safety and Environment System (HSEMS) including grievance mechanism for workers, and establishment of HSE officer	<p>IFC PS 2, 3</p> <p>IFC/ WB General EHS-Guidelines</p> <p>IFC/ WB EHS Guidelines for Thermal Power Plants</p> <p>IFC/ WB EHS Guidelines for Electric Power Transmission and Distribution</p>	<p>RENCO as EPC Contractor</p> <p>ArmPower as Operator</p>	In advance of construction, valid during construction, operation and decommissioning phases	<p>Site-specific HSEMP and HSEMS for construction, operation and decommissioning periods;</p> <p>Grievance log book and reports on successful handling the grievances;</p> <p>HSE officers established at RENCO and ArmPower</p>
Development of Waste Management Plan and Waste Management System for construction, operation and decommissioning phases including, for operation: risk assessment associated with the mid-term to long-term storage of hazardous waste and adequate sizing and monitoring frequency of the storage area	<p>IFC PS 3</p> <p>EU Directive 2008/98/EC (Waste Framework Directive)</p>	<p>RENCO as EPC Contractor</p> <p>ArmPower as Operator</p>	In advance of construction	Waste Management Plans according to EU Directive 2008/98/EC

Action	Requirement (IFC Performance Standard, Best Practice)	Responsibility	Implementation Schedule (Timeline)	Target for successful implementation / Reporting requirement
Provision of toilets and sanitary rooms for the workforce at the construction site, separately for men and women, as part of the HSEMP. Sewage water to be led to the sewage water system of YCCPP-1 or installation of septic tanks for collecting sewage water, which then would have to be emptied by a specialized company from time to time.	IFC PS 2, 3 IFC/ EBRD Guidance Note on Workers' Accommodation (2009)	RENCO as EPC Contractor	In advance of construction and during construction phase	Provision of adequate toilets and sanitary facilities and appropriate handling of sewage water Contract with specialized disposal company (if necessary)
Development of Chance Find Procedure regarding historic and cultural goods; and information of the Ministry of Culture about the Project prior to construction, in order to allow the Ministry to perform a proof of occurrence/absence of any cultural or historical goods at the Project site, including a preconstruction field survey, if deemed necessary by the Ministry	IFC PS 8	RENCO as EPC Contractor	In advance of construction to be valid during construction	Chance Find Procedure established as well as training program for workforce. Ministry of Culture informed about the Project
Development of site-specific non-discriminatory hiring and wage policy; Employment of local people for construction works (offer job opportunities in nearby villages and Yerevan); Improve recruitment of women for construction works	IFC PS 2 Guidelines of International Labor Organization (ILO)	RENCO as EPC Contractor ArmPower as Operator	In advance of construction	Work contracts according to guidelines of International Labor Organization (ILO)
Development of a Traffic Management Plan including among others transport of workers, planning of truck movements, short-term closure of roads (if necessary: including details about road use (by whom and for what purpose) and alternative routes), etc.	IFC PS 2, 3, 4	RENCO as EPC Contractor	In advance of construction	Transport of workers implemented; additional traffic due to construction adapted to existing traffic situation

Action	Requirement (IFC Performance Standard, Best Practice)	Responsibility	Implementation Schedule (Timeline)	Target for successful implementation / Reporting requirement
Air quality monitoring campaign to be repeated in next spring in order to cover all seasons of an annual cycle	IFC PS 3, 4	RENCO as EPC Contractor	In advance of construction	Spring Monitoring Report
Two years of continuous ambient air quality monitoring during the operational phase with continuous methods (at hourly intervals) at two locations, one predicted maximum ground level concentration location and one background site.	IFC PS 3, 4	ArmPower as Operator	During commissioning and operation	Monitoring reports prepared and disclosed to the financing agencies
Based on the monitoring results, analyze the need for further mitigation measures for air quality impacts	IFC PS 3, 4	ArmPower as Operator	During commissioning and operation	Monitoring reports prepared and disclosed to the financing agencies
Development of a Decommissioning Plan and of a Detailed Decommissioning Plan	IFC PS 2, 3, 4	ArmPower as Operator	Decommissioning Plan: At least 5 years before closure of YCCPP-2 Detailed Decommissioning Plan : At least 18 months before closure of YCCPP-2	Decommissioning Plan prepared and implemented

10. Overall Findings, Conclusion, and Recommendations

The main possible impacts of the Project will be contamination of soil and water, impacts on health and safety of workers and the public, , air and noise emissions, and liquid effluents from the new power plant.

Negative environmental and social impacts of the Project will be low or medium, if all proposed mitigation measures of the ESMPs are implemented. There will be no severe social impacts from the Project; no land acquisition or related resettlement will be necessary. Regular **monitoring of noise, air emissions and ground level concentrations of air pollutants and air emissions as well as liquid effluents** during construction and /or operation phase shall be performed, in order to guarantee adherence to relevant national and/or international limit values.

The calculations undertaken with a Noise Propagation Model for YCCPP-2 have shown that the operation of **the new plant will not produce any significant increase of the noise pressure at the sensitive receptors** (complies with the IFC standard of keeping the noise impacts to an a maximum increase of 3 dB in the background levels).

Based on the Air Dispersion Calculation results, a Good Engineering Practice stack height of 66 meters (GEP stack height) will be built for the power plant to guarantee the **compliance with the air quality standards** at the ground level (instead of the originally foreseen 35 meters stack).

Positive impacts are related to **creating job opportunities**, especially during construction. New job opportunities during operation may be created if investment on training of qualified workers is done. The additional power generation will increase the total output of electric energy, providing a more reliable power supply countrywide.

An evaluation is currently ongoing regarding the management of groundwater during construction and operation. No abstraction, discharge or other use of contaminated groundwater is to occur. The current proposal is to install sub-surface drainage to permanently **deviate groundwater around the site**. The Client will conduct further hydrological assessment and implement appropriate environmental management of this solution, to be approved by IFC and ADB before construction.

In summary, it can be concluded that the proposed Project of Yerevan Steam and Gas Combined Cycle Power Plant (YCCPP-2) **can be implemented without having significant adverse impacts on the ecological and social environment**, if all mitigation measures proposed in the ESMPs and the ESAP are implemented.

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12. Annexes

12.1 Communication from Yerevan Municipality - illegal dwellings



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Հարգելի պարոն Կուկուրակի

Ի պատասխան Երևանի քաղաքապետին հասցեագրված Ձեր 07.11.2017թ. գրության Երևանի Շենգավիթ վարչական շրջանում նախատեսվող ՀՇԳՑ-2 էլեկտրակայանի կառուցման կապակցությամբ բարձրացված հարցերի վերաբերյալ տեղեկացնում ենք, որ նախատեսվող ՀՇԳՑ-2 էլեկտրակայանից դեպի հյուսիս-արևելք ընկած հարակից տարածքներում Շենգավիթ վարչական շրջանի համար մշակված գոտիավորման նախագծով քաղաքաշինական ծրագրային գործունեություն չի նախատեսվում: ՀՇԳՑ-2 էլեկտրակայանի շինարարությունը որևէ սոցիալական բացասական ազդեցություն չի կարող ունենալ շինարարական հրապարակից նշված հեռավորության վրա գտնվող կացարանների հետագա ճակատագրի վրա: Միաժամանակ այդ կացարանների և դրանց բնակիչների հետ կապված հետագա գործողությունները որևէ գույքային, սոցիալական և ֆինանսական հետևանքներ չեն կարող առաջացնել ՀՇԳՑ-2 էլեկտրակայանի շինարարության ծրագրի համար:

Տ.ԲԱՐՍԵՂՅԱՆ

Ձեռ. 07 514 150

(BLANK OF)
YEREVAN MUNICIPALITY
MAIN ARCHITECTURE OF YEREVAN

10.11.2017

N^o 50/2-71827

To the general director
Of "ArmPower" CJSC
Mr. C. Cucurachi

Dear Mr. Cucurachi,

In response to Your letter of 07.11.2017 addressed to the Yerevan Mayor, on the questions arisen for the planned CCPP-2 construction in the Shengavit administrative area, we inform, that in the adjacent areas situated to the north-east of the CCPP-2, a planned action of urban development is not foreseen by the project of the developed zoning for the Shengavit administrative area. The CCPP-2 construction cannot have any social negative impact on the further destiny of dwellings situated in the indicated distance from the construction site. At the same time, the further actions regarding those dwellings and their inhabitants cannot cause any property, social and financial consequences for the CCPP-2 construction project.

T. Barseghyan

12.2 Communication from Veolia Djur CJSC on water supply



Ջուր

«Արմփաուեր» ՓԲԸ
Ք. Կուկուրակիին
/հասցեն՝ ք. Երևան, Վ. Սարգսյան 10/

Ելից/ԳԳ/15193/24.11.17

Երևան 24 նոյեմբերի 2017թ.

Առարկան՝ Պարզաբանում դիմումի վերաբերյալ

Հարգելի պարոն Կուկուրակի,

Ի պատասխան Ձեր 17.11.2017թ. դիմումի՝ հայտնում եմ, որ տեխնիկական պայմանը տրված է տեխնիկական բոլոր չափորոշիչների հաշվառմամբ:

Տեղեկացնում եմ նաև, որ սահմանված կարգով աշխատանքները սկսելուց առաջ անհրաժեշտ է ԿՕ/574 տեխնիկական պայմանի հիման վրա կազմված նախագծային փաստաթղթերը համաձայնեցնել «Վեոլիա Ջուր» ՓԲԸ-ի հետ:

Հարգանքով՝

Գործառնական տնօրեն

Գոռ Գրիգորյան

Պատասխանատու՝
Մ. Միրզոյան
Շեռ.՝ 011 59 03 86



Հայաստանի Հանրապետություն
ք. Երևան, 375025
Արովյան փ. 66՞
Հեռ./ֆաքս (+374 10) 56-93-57

66a St. Abovyan
375025 Yerevan
Republic of Armenia
Tel./fax (+374 10) 56-93-57



To the general director of "Armpower" CJSC C. Cucurachi,
/address: 10 V. Sargsyan str., Yerevan/

N 15193/24.11.17

Yerevan, 24 November, 2017

Subject: Clarification about the application letter

Dear Mr. Cucurachi,

As a reply to your application letter of 17.11.2017, I would like to inform you that the Technical specification has been provided taking into account all the technical norms and criteria

I also inform you that before starting the works in accordance with the established procedure it is necessary to agree the design documents, compiled according to the technical specification N KO/574, with "Veolia Jur" CJSC.

Best regards,

Executive director

Gor Grigoryan

Responsible
M. Mirzoyan
Tel: 011 59 03 86

66a St. Abovyan
375025, Yerevan,
Republic of Armenia
Tel./Fax (+374 10) 56-93-57



«ԱՐՄՓԱՈՒԵՐ» ՓԲԸ գլխավոր տնօրեն՝
պարոն Բ. Կուկուրակիին

Ելից/ԿՕ/ 2076 / 07.12.2017թ.

Երևան, 07 դեկտեմբեր, 2017թ.

Առարկա՝ Հարցում

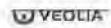
Հարգելի պարոն Կուկուրակի,

Ի պատասխան հարցման՝ տեղեկացնում ենք, որ տրամադրված տեխնիկական պայմանով նախատեսված ջրաքանակը հաշվարկված է այն սկզբունքով, ինչը բացառում է այլ բաժանորդների հաշվին ջրաքանակի տրամադրումը մեկ այլ օբյեկտի և չի կարող հանգեցնել վերջիններիս ջրամատակարարման վատթարացմանը:

Հարգանքով,

«Վեոլիա Ջուր» ՓԲԸ
«Արևելք» ՏՏ տնօրեն՝
Կարապետ Օհանյան





Armpower CJSC

To the general director C. Cucurachi

N KO/2076 /07.12.2017

Yerevan, 07 December, 2017

Subject- Inquiry

Dear Mr. Cucurachi,

As a reply to your inquiry we would like to inform you that the water amount foreseen by the provided technical specification has been calculated according to the principle that excludes the water amount provision to another object at the expense of other subscribers and can't result in the latters' water supply deterioration.

Regards,

Karapet Ohanyan,

Technical Director of "Arevelk"
"Veolia jur" CJSC

12.3 Record of Meetings

Date	Agency/ Institution	Place	Name of Person consulted	Reason for Visit
04.07.2017	RENCO SPA	Yerevan	Gegham Baklachev (RENCO), Vram Tevosyan (Consecoard LLC)	Discussion of technical and environmental issues of construction and operation of YCCPP-2
04.07.2017	Municipality of Kharberd village	Kharberd	Kamo Kakoyan (Mayor of Kharberd), Gegham Baklachev, Vram Tevosyan	Introducing the Project; discussing possible concerns
04.07.2017	Municipality of Ayntap village	Ayntap	Karen Sargsyan (Mayor of Ayntap), Gegham Baklachev, Vram Tevosyan	Introducing the Project; discussing possible concerns
05.07.2017	YCCPP-2 site	Yerevan	Gegham Baklachev, Vram Tevosyan	Visit of site and surrounding area
05.07.2017	RENCO SPA	Yerevan	Gabriele Colletta (RENCO engineer), Vram Tevosyan	Discussion of technical issues of construction and operation of YCCPP-2
06.07.2017	Municipality of Yerevan, Staff of Head of Erebuni Administrative District	Yerevan	Edgar Mkrtchyan (Head of Department), Gegham Baklachev, Vram Tevosyan	Introducing the Project; discussing possible concerns
06.07.2017	Aarhus Center	Yerevan	Silva Ayvazyan (Coordinator of Yerevan Aarhus Center), Gegham Baklachev, Vram Tevosyan	Introducing the Project; discussing environmental and social concerns
06.07.2017	Environmental Monitoring and Information Center	Yerevan	Shahnazaryan Gayane (Deputy Director), Gegham Baklachev, Vram Tevosyan	Discussing monitoring of stack emissions and of ambient air pollution
06.07.2017	YCCPP-1	Yerevan	Arkadi Gevorgyan (Chief Engineer), Gegham Baklachev, Vram Tevosyan	Discussing technical and environmental issues of operation of YCCPP-1
07.07.2017	Municipality of Yerevan, Environmental Department	Yerevan	Avet Martirosyan (Head of Environmental Department), Gegham Baklachev, Vram Tevosyan	Introducing the Project; discussing possible concerns
07.07.2017	Municipality of Yerevan, Staff of Head of Shengavit Administrative District	Yerevan	Armen Sargsyan (Head of Department), Gegham Baklachev, Vram Tevosyan	Introducing the Project; discussing possible concerns
07.07.2017	RENCO SPA	Yerevan	Avetik Horkannisyan (RENCO Engineer), Gegham Baklachev, Vram Tevosyan	Discussion of technical and environmental issues of construction and operation of YCCPP-2

12.4 Analysis of Oil in the Contaminated Soil from Construction Site

BERATUNG ANALYTIK PLANUNG	WESSLING WESSLING GmbH Impexstraße 5 · 69190 Walldorf www.wessling.de				
WESSLING GmbH, Impexstraße 5, 69190 Walldorf GefaÖ GmbH - Gesellschaft für angewandte Ökologie und Umweltplanung Herr Dr. Roland Marthaler Impexstraße 5 69190 Walldorf	Geschäftsfeld: Umwelt Ansprechpartner: J. Thomsen Durchwahl: +49 6227 8 209 96 Fax: +49 6227 8 209 15 E-Mail: Julian.Thomsen@wessling.de				
<h3>Prüfbericht</h3> <h4>Jerevan CCPP-2</h4>					
Prüfbericht Nr.	CWA17-016172-1	Auftrag Nr.	CWA-06752-17	Datum	18.07.2017
Probe Nr.	17-109040-01				
Eingangsdatum	10.07.2017				
Bezeichnung	Stelle 1				
Probenart	Feststoff allgemeiner				
Probenahme	06.07.2017				
Probenahme durch	Auftraggeber				
Probennehmer	Jonas Mertin				
Probengefäß	Tüte				
Anzahl Gefäße	1				
Untersuchungsbeginn	11.07.2017				
Untersuchungsende	18.07.2017				
Probenvorbereitung					
Probe Nr.	17-109040-01				
Bezeichnung	Stelle 1				
Gesamtmasse der Originalprobe	g	200			
Polychlorierte Biphenyle (PCB)					
Probe Nr.	17-109040-01				
Bezeichnung	Stelle 1				
PCB Nr. 28	mg/kg	OS	<0,05		
PCB Nr. 52	mg/kg	OS	<0,05		
PCB Nr. 101	mg/kg	OS	<0,05		
PCB Nr. 118	mg/kg	OS	<0,05		
PCB Nr. 138	mg/kg	OS	<0,05		
PCB Nr. 153	mg/kg	OS	<0,05		
PCB Nr. 180	mg/kg	OS	<0,05		
Summe der 6 PCB	mg/kg	OS	-/-		
PCB gesamt (Summe 6 PCB x 5)	mg/kg	OS	-/-		
Seite 1 von 4					
Deutsche Akkreditierungsstelle DIN-ISO/IEC 17025	Durch die DAkkS nach DIN EN ISO/IEC 17025 akkreditiertes Prüflaboratorium. Die Akkreditierung gilt für die mit * markierten Prüfverfahren. Eine detaillierte Auflistung unserer akkreditierten Prüfverfahren befindet sich in der Urkunde des DAkkS auf unserer Internetseite unter www.wessling.de. Messergebnisse beziehen sich ausschließlich auf die angegebenen Prüfobjekte. Prüfberichte dürfen ohne Genehmigung der WESSLING GmbH nicht auszugsweise vervielfältigt werden.				Geschäftsführer Julia Wessling, Florian Wessling AB Steinfurt 493 1153

Prüfbericht Nr.	CWA17-016172-1	Auftrag Nr.	CWA-06752-17	Datum	18.07.2017
Probe Nr.					17-109040-01
Summe der 7 PCB		mg/kg	OS	-/-	



Deutsche
 Akkreditierungsstelle
 DAF-14152-01-00

Durch die DAkkS nach DIN EN ISO/IEC 17025 akkreditiertes Prüflaboratorium. Die Akkreditierung gilt für die mit A markierten Prüfverfahren. Eine detaillierte Auflistung unserer akkreditierten Prüfverfahren befindet sich in der Mitbringerdatei der DAkkS auf unserer Internetseite unter www.wessling.de. Messergebnisse beziehen sich ausschließlich auf die angegebenen Prüfobjekte. Prüfberichte dürfen ohne Genehmigung der WESSLING GmbH nicht auszugewisselt vervielfältigt werden.

Geschäftsführer
 Julia Weßling, Florian Weßling
 AB-Steinfurt RRB 1953

Prüfbericht Nr. **CWA17-016172-1** Auftrag Nr. **CWA-06752-17** Datum **18.07.2017**

Probe Nr.	17-109040-02
Eingangsdatum	10.07.2017
Bezeichnung	Stelle2
Probenart	Feststoff allgemein
Probenahme	06.07.2017
Probenahme durch	Auftraggeber
Probenahmer	Jonas Martin
Probengefäß	Tüte
Anzahl Gefäße	1
Untersuchungsbeginn	11.07.2017
Untersuchungsende	18.07.2017

Probenvorbereitung

Probe Nr.	17-109040-02
Bezeichnung	Stelle2
Gesamtmasse der Originalprobe	g 200

Polychlorierte Biphenyle (PCB)

Probe Nr.	17-109040-02	
Bezeichnung	Stelle2	
PCB Nr. 28	mg/kg OS	<0,05
PCB Nr. 52	mg/kg OS	<0,05
PCB Nr. 101	mg/kg OS	<0,05
PCB Nr. 118	mg/kg OS	<0,05
PCB Nr. 138	mg/kg OS	<0,05
PCB Nr. 153	mg/kg OS	<0,05
PCB Nr. 180	mg/kg OS	<0,05
Summe der 6 PCB	mg/kg OS	-/-
PCB gesamt (Summe 6 PCB x 5)	mg/kg OS	-/-
Summe der 7 PCB	mg/kg OS	-/-



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Beschäftigte:
 Julia Weßling, Florian Weßling
 AB Steinfurt HRB 1953

Prüfbericht Nr. **CWA17-015172-1** Auftrag Nr. **CWA-06752-17** Datum **18.07.2017**

Abkürzungen und Methoden

Polychlorierte Biphenyle (PCB)

DIN EN 15006^A

ausführender Standort

Umweltanalytik Walldorf

OS

Originalsubstanz

Umweltanalytik Walldorf



Julian Thomsen
M. Sc. Biogeowissenschaften
Sachverständiger Umwelt und Wasser

Seite 4 von 4



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Beschäftigter:
Julia Weßling, Florian Weßling
AB Standort 1818 1913

12.5 Report on Groundwater Quality and Possible Soil Contamination from August 2017

12.6 Noise Propagation Study

12.7 Waste Water Temperature Study (steady state), ArmPower

12.8 Air Dispersion Calculation

12.9 Stakeholder Engagement Plan

12.10 Legal Framework of Earth Cover Pollution Standardization in Armenia and Results of the YCCPP-2 Territory Research, Consecord 2018

12.11 Report on Soil Analysis, Groundwater and Hrazdan River Water Quality from February 2018

**12.12 Legal Framework of Air Emissions Standardization in Armenia
and Assessment of the planned YTPP-2 Emissions, Consecord
2018**

12.13 Public Consultation Meeting at Yerevan 10th February 2018

Report
On Monitoring Services
Yerevan, August 11, 2017

Based on the contract signed between "Renco Armestate" LLC and "Consecoard" LLC on 14.07.2017, the specialists of "Consecoard" LLC carry out monitoring of Yerevan TPP-2 construction site, which includes:

- topsoil, surface water and groundwater sampling according to the list submitted by the Client,
- organizing the tests in the appropriate licensed laboratory according to the List of Materials and Indicators Provided by the Client,
- analysis of results and comparison with sanitary norms in the Republic of Armenia.

Currently, "Consecoard" LLC specialists have conducted all samplings:

1. Land
 - from the central part of the area allocated for construction,
 - from the roadside,
 - near the pile of barrels of used oils existing in the area
2. Water
 - water leak during drilling of the area. Sampled water taken during drilling of a site for construction. The water was taken from the wells 7.9 m and 2.8 m, dug for sampling near the BH 1 (x – 457072.44, y – 4440369.06) and BH 17 (x – 457316.96, y – 4440491.54) wells for geological survey. Sampling was carried out 3 hours after the drilling works to ensure water simplicity.
 - water running through the pipe in the central part of the construction site,
 - outflow of canal water from the operating Yerevan TPP1

The sampling was conducted by the methodology of the Monitoring Center of the Ministry of Nature Protection of the Republic of Armenia with the participation of the representative of Renco company: Gegham Baklachev.

The collected samples have been moved to the “Laboratory of Environmental Monitoring and Information Center” SNCO of the Ministry of Nature Protection of the Republic of Armenia.

The results and data analysis are presented below.

Table 1. Water, common indicators:

№	Measured indicator	Unit of measurement	The results of analysis			The method of analysis
			Sample 1	Sample 2	Sample 3	
1	Hydrogen indicator (pH)	-	7.25	6.68	8.34	Electrochemical
2	Dissolved oxygen	mgO ₂ /l	1.34	7.37	6.61	Electrochemical
3	Mineralization	mg/l	1708	111	786	Electrochemical
4	BOD ₅	mgO ₂ /l	1.50	1.19	6.80	Electrochemical
5	COD ₅ ¹	mgO ₂ /l	288	136	416	Oxidation by bichromate

¹ The COD value is high since the laboratory test was performed weeks after sampling.

Table 2. Water, Metals and Organic Compounds:

№	Measured indicator	Unit of measurement	The results of analysis			The method of analysis
			Sample 1	Sample 2	Sample 3	
6	Lithium	Mg/l	0.0340	0.0038	0.0212	ICP-MS ²
7	Beryllium	Mg/l	<10 ⁻⁶	<10 ⁻⁶	<10 ⁻⁶	ICP-MS
8	Boron	Mg/l	0.9258	0.0259	0.2678	ICP-MS
9	Natrium	Mg/l	269.5	6.8	95.5	ICP-MS
10	Magnesium	Mg/l	18.8	5.8	24.0	ICP-MS
11	Aluminum	Mg/l	0.0795	0.0052	0.0097	ICP-MS
12	Total phosphorus	Mg/l	0.0798	0.1148	0.2157	ICP-MS
13	Potassium	Mg/l	2.4	2.4	8.2	ICP-MS
14	Calcium	Mg/l	171.1	14.8	28.8	ICP-MS
15	Titan	Mg/l	0.0110	0.0037	0.0020	ICP-MS
16	Vanadium	Mg/l	0.3475	0.0213	0.0092	ICP-MS
17	Chrome	Mg/l	0.0079	0.0010	0.0063	ICP-MS
18	Iron	Mg/l	0.2262	0.0337	0.0828	ICP-MS
19	Manga	Mg/l	0.0818	0.0009	0.0020	ICP-MS
20	Cobalt	Mg/l	0.0017	0.0007	0.0002	ICP-MS
21	Nickel	Mg/l	0.0029	0.0003	0.0012	ICP-MS
22	Copper	Mg/l	0.0034	0.0006	0.0033	ICP-MS
23	Zinc	Mg/l	3.0628	0.0025	0.0038	ICP-MS
24	Arsen	Mg/l	0.0541	0.0011	0.0059	ICP-MS
25	Selen	Mg/l	0.0054	0.0002	0.0014	ICP-MS
26	Strontium	Mg/l	2.2267	0.0821	0.2446	ICP-MS
27	Molybdenum	Mg/l	0.0588	0.0009	0.0485	ICP-MS

² The applied method: Inductively coupled plasma mass spectrometry (ICP-MS)

28	Cadmium	Mg/l	0.00017	0.00001	0.00014	ICP-MS
29	Tuna	Mg/l	0.00109	0.00020	0.00041	ICP-MS
30	Antimony	Mg/l	0.00015	0.00010	0.00008	ICP-MS
31	Barium	Mg/l	0.0268	0.0070	0.0219	ICP-MS
32	Lead	Mg/l	0.0011	0.0002	0.0005	ICP-MS
33	Benzene	Mg/l	<0,0001	-	<0,0001	Gas chromatography
34	Toluene	Mg/l	<0,0001	-	0.001	Gas chromatography
35	Oktan	Mg/l	<0,0001	-	<0,0001	Gas chromatography
36	Ethylbenzene	Mg/l	<0,0001	-	<0,0001	Gas chromatography
37	Xylol	Mg/l	<0,0001	-	<0,0001	Gas chromatography
38	Nona	Mg/l	<0,0001	-	0.00014	Gas chromatography
39	Mixture of alkanes (C ₁₀ H ₂₂ -C ₂₂ H ₄₆)	Mg/l	3.474	-	2.758	Gas chromatography

According to RA Government Decree “ On defining water quality norms for each water basin management area taking into consideration the peculiarities of the Locality,” (RA Government Decree N 75-N, dated on 27 January 2011,) the surface water quality assessment system in Armenia distinguishes five class statuses for each grade: "excellent" (1st grade), "good" (2nd grade), "mediocre" (3rd class); "Insufficient" (grade 4) and "bad" (5th grade).

The government's decision envisages maximum permissible concentrations for all classes, in case of exceeding them, the flow to water resources is prohibited.

Yerevan Thermal Power Plant territory is located in Hrazdan river basin(watershade) management area. According to "Armeconitoring"'s reference outcomes on " Ecological Monitoring of the RA Environment" for 2015, the water in the lower stream of the Hrazdan River is "bad" (5th grade).

Below are the 5 th class limits for the Hrazdan River basin management, along with the results of the analysis.

Table 3. Water quality comparative data. General indicators

№	Comparable index	Unit of measurement	Norms by Water Quality Classes					The average result of the analysis
			I	II	III	IV	V	
1	2	3	4	5	6	7	8	9
1	Hydrogen indicator (pH)	-	6.5-9	6.5-9	6.5-9	6.5-9	<6.5 >9	7.25 - 8.34
2	Dissolved oxygen	mgO ₂ /l	>7	>6	>5	>4	<4	1.34 - 7.37
3	Mineralization	mg/l	74	148	1000	1500	>1500	111 - 1708

4	BOD ₅	mgO ₂ /l	3	5	9	18	>18	1.19 - 6.80
5	Benzene	Mg/l	-	-	-	-	-	<0,0001
6	Toluene	Mg/l	-	-	-	-	-	0.001
7	Octane	Mg/l	-	-	-	-	-	<0,0001
8	Ethylbenzene	Mg/l	-	-	-	-	-	<0,0001
9	Xylol	Mg/l	-	-	-	-	-	<0,0001
10	Nona	Mg/l	-	-	-	-	-	0.00014
11	Mixture of alkanes (C ₁₀ H ₂₂ - C ₂₂ H ₄₆)	Mg/l	-	-	-	-	-	2.758 – 3.474

Table 4. Water quality comparative data. Metals

№	Comparable index	Unit of measurement	Norms by Water Quality Classes					The average result of the analysis
			I	II	III	IV	V	
1	Lithium	mkg/l	5	5	5	<2500	>2500	3.8 – 34.0
2	Beryllium	mkg/l	0.014	0.028	0.056	100	>100	< 0.001
3	Boron	mkg/l	9	450	700	1000	>2000	25.9 – 925.8
4	Natrium	mg/l	5	10	20	40	>40	6.8 – 269.5
5	Magnesium	mg/l	2,8	50	100	200	>200	5.8 – 24.0
6	Aluminum	mkg/l	65	130	260	5000	>5000	5.2 – 79.5
7	Total phosphorus	mg/l	0,025	0,2	0,4	1	>1	0.08 – 0.2157
8	Potassium	mg/l	1,5	3,0	6,0	12,0	>12,0	2.4 – 8.2
9	Calcium	mg/l	9,7	100	200	300	>300	14.8 – 171.1
10	Titanium	mg/l	-	-	-	-	-	0.002 – 0.011
11	Vanadium	mkg/l	1	2	4	8	>8	9.2 – 34.79
12	Chrome	mkg/l	1.0	11.0	100	250	>250	1.0 – 7.9
13	Iron	mg/l	0,08	0,16	0,5	1	>1	0.0337 – 0.226
14	Manga	mkg/l	5	10	20	40	>40	0.9 – 81.8
15	Cobalt	mkg/l	0,14	0,28	0,56	1,12	>1,12	0.2 – 1.7
16	Nickel	mkg/l	1.0	11.0	50	100	>100	0.3 – 2.9
17	Copper	mkg/l	3.0	23.0	50	100	>100	0.6 – 3.4
18	Zinc	mkg/l	3.0	100	200	500	>500	2.5 – 3063.0
19	Arsen	mkg/l	0,13	20	50	100	>100	1.1 – 54.1
20	Selene	mkg/l	0,5	20	40	80	>80	0.2 – 5.4
21	Strontium	mg/l	-	-	-	-	-	0.081 – 2.2267
22	Molybdenum	mkg/l	7	14	28	56	>56	0.9 – 58.8
23	Cadmium	mkg/l	0,02	1,02	2,02	4,02	>4,02	0.01 – 0.17
24	Tin	mkg/l	0,09	0,18	0,36	0,72	>0,72	0.2 – 1.09
25	Antimony	mkg/l	0,2	0,38	0,76	1,52	>1,52	0.08 – 0.15
26	Barium	mkg/l	9	18	36	1000	>1000	7.0 – 26.8
27	Lead	mkg/l	0,3	10,3	25	50	>50	0.2 – 1.1

As can be seen from the table, the results of all sampling tests are within the limits of this class of water, and consequently, this quality water can be directed to the downstream of Hrazdan River, without additional cleaning.

2. Land

Based on the characteristics of soil analysis, preliminary analysis have been performed for some indicators, the results of which are given below.

External inspection: brown soil and ground, with the average content of rock material.

Vegetal and sub-vegetal layer, 13 -22 cm:

pH- in water extract ` 6.5 – 7.3

The sum of absorbed cations, m/eqv 100g in land: 28.5 – 32.2.

Table 5. Soil quality data. Metals

N	Measured index	Unit	Measured value			Method applied
			Sample 1	Sample 2	Sample 3	
6	Lithium	g/kg	0.0061	0.0175	0.0140	ICP-MS
7	Beryllium	g/kg	0.0004	0.0012	0.0010	ICP-MS
8	Boron	g/kg	0.0373	0.0435	0.0440	ICP-MS
9	Sodium	g/kg	6.0	15.7	10.3	ICP-MS
10	Magnesium	g/kg	2.4	14.8	8.7	ICP-MS
11	Aluminium	g/kg	9.17	73.24	45.77	ICP-MS
12	General Phosphorus	g/kg	0.28	0.84	0.64	ICP-MS
13	Potassium	g/kg	5.8	14.9	10.9	ICP-MS
14	Calcium	g/kg	18.2	83.4	44.4	ICP-MS
15	Titanium	g/kg	1.72	4.40	3.24	ICP-MS
16	Vanadium	g/kg	0.0633	0.1329	0.1010	ICP-MS
17	Chromium	g/kg	0.0174	0.0957	0.0518	ICP-MS
18	Iron	g/kg	5.77	41.04	22.07	ICP-MS
19	Manganese	g/kg	0.1579	0.8231	0.4255	ICP-MS
20	Cobalt	g/kg	0.0077	0.0179	0.0164	ICP-MS
21	Nickel	g/kg	0.0218	0.0549	0.0472	ICP-MS
22	Copper	g/kg	0.0167	0.0691	0.0354	ICP-MS
23	Zinc	g/kg	0.0454	0.1010	0.0588	ICP-MS
24	Arsenic	g/kg	0.0086	0.0118	0.0110	ICP-MS

25	Selenium	g/kg	0.0018	0.0012	0.0043	ICP-MS
26	Strontium	g/kg	0.1022	0.3144	0.1845	ICP-MS
27	Molybdenum	g/kg	0.0101	0.0049	0.0106	ICP-MS
28	Cadmium	g/kg	0.00008	0.00025	0.00016	ICP-MS
29	Tin	g/kg	0.00049	0.00206	0.00098	ICP-MS
30	Antimony	g/kg	0.00027	0.00086	0.00039	ICP-MS
31	Barium	g/kg	0.0779	0.4139	0.2195	ICP-MS
32	Lead	g/kg	0.0065	0.0369	0.0129	ICP-MS

The applied method: Inductively coupled plasma mass spectrometry (ICP-MS)

The results of soil survey and general indicators analysis indicate that soil quality is in line with the general characteristics of the region and is within the limits of permitted norms.

V. Tevosyan, director of "Consecoard" LLC

Yerevan 2 CC Power Plant ArmPower CJSC

Noise Impact Study

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Table of Contents

1. Scope of the Report	1-1
2. Brief Project Description	2-1
3. Methodology	3-2
4. Noise sources	4-1
5. Noise Propagation Model	5-1
5.1 Software used for simulation: Sound Plan	5-1
5.2 Model runs	5-2
5.1.1 Setting boundary conditions	5-2
5.2 Setting the sound sources	5-5
5.2.1 Calculation settings	5-6
5.2.2 Sound pressure levels "ante-operam"	5-7
5.2.3 Calculation of the sound contribution to the most exposed sensitive receptors	5-10
5.2.4 Calculation of noise maps	5-12
6. Predictive noise limit compliance check	6-1
7. Conclusions	7-1
8. Annexes	8-1

List of Figures

Figure 3-1:	Geographic overview of the project.....	3-2
Figure 3-2:	Detailed geographic overview of the project.....	3-3
Figure 5-1:	The computational area.....	5-3
Figure 5-2:	A geodatabase 3D view of the computational area.....	5-4
Figure 5-3:	Sensitive receptors potentially impacted	5-7
Figure 5-4:	Position of the calculation points along the Plant fence	5-11

1. Scope of the Report

This Noise Propagation Study has been produced as part of the ESIA Report.

A Noise Calculation (NC) was produced for this purpose for the new power plant (YCCPP-2) site. The NC has been done by using the propagation model SoundPLAN (Braunstein + Berndt GmbH). The model determines sound propagation based on the provisions of ISO 9613 - 2. This model is widely used in EU noise mapping projects.

The application of the model allowed determining whether the noise levels emitted by the new plant will represent a nuisance to the surrounding areas, i.e., if the resulting ambient noise will be above the national and international standards.

2. Brief Project Description

To partially reduce the gap between the offer and demand of electric energy foreseen in the Republic of Armenia for the next years, the MOE has signed for the construction of a new 254 MW Combined Cycle type Power Plant, gas fired (the CCGT), in the surroundings of Yerevan city.

The electrical power shall be generated by means of a gas turbine driven generator and, at the same time, steam shall be produced from heat recovery from the GT exhausts. The steam will be fed to a steam turbine, driving an additional power generation unit.

The technology of the most modern gas turbine improving the overall efficiency of the thermal cycle joined with the low environmental impact makes the natural gas fired combined cycle technology, at present, an ideal solution in power sectors.

The Project is a combined cycle plant in a multi-shaft arrangement. The plant will consist of a Gas Turbine (GT) with generator, a Steam Turbine (ST) with generator, a Heat Recovery Steam Generator (HRSG) and other associated equipment and systems.

The plant will be designed for highly efficient operation and for high reliability and availability.

The multi-shaft arrangement is a proper solution with its high flexibility allowing different modes of operation and easy maintenance.

3. Methodology

The aims of this study are:

- calculation of noise emission contributions at the sensitive receptors determined by the CCGT operation;
- predictive definition of the acoustic pressure at the sensitive receptors during CCGT operation;
- predictive verification of the compliance with the applicable limits at sensitive receptors.

On the basis of the Project data, the sound contribution of the CCGT during operation at the most exposed sensors was calculated.

The values thus obtained were compared to the applicable limits.

The new 254 MW Yerevan Combined Cycle Power Plant (“CCPP”) will be located in the vicinity of Yerevan city, in the area adjacent to the existing Yerevan CCPP, currently managed by the Yerevan TPP CJSC.



Figure 3-1: Geographic overview of the project

The following figure shows the location of the Power Plant.



Figure 3-2: Detailed geographic overview of the project

The first step of the Noise Calculations has been to state the area potentially most affected by the Project’s noise emissions, defined as Assessment area.

4. Noise sources

The whole plant has been designed with particular attention to limit the noise emissions.

The most relevant noise sources will be located inside soundproofed cabin/buildings to minimize noise propagation.

The acoustic enclosure for Gas Turbine and Generator is located over the Gas Turbine thermal block and the generator. It includes the sidewalls for the exhaust gas diffuser area.

The acoustical enclosure is designed and suitable for indoor application, i.e. the thermal block compartment, the generator compartment and the exhaust gas diffuser area compartment are located inside a building.

The main purposes of the acoustic enclosure and the related installations are:

- To reduce the noise emissions generated by the Gas Turbine thermal block, the exhaust gas diffuser and the generator
- To cool down the Gas Turbine set environment during operation.

The acoustical enclosure is completely equipped with structural steel frame, acoustic panels (removable for maintenance), penetration elements for cabling and piping, fully automatic ventilation system, access stairs and ladders, industrial grade/self-closing access doors with panic bars and internal lighting, emergency lighting and small power outlets.

5. Noise Propagation Model

The calculation of the predictive noise propagation was performed in accordance with the ISO 9613-2.

The calculation was performed through SoundPlan (open field propagation simulation software) after setting the model parameters:

- contour setting (geomorphological-acoustic parameters of the propagation environment);
- calculation settings;
- characterization of sound emission sources.

5.1 Software used for simulation: Sound Plan

SOUND PLAN is an open-field sound propagation simulation program and is one of the most used software in environmental noise studies. Modeling of sound propagation is done through a numerical calculation model called 'search angle method'. Starting from every single point of reception considered in the simulation of sound propagation, SOUND PLAN simulates a series of search rays that propagate uniformly in all directions and, for each of them, the software analyzes the physical-geometric and acoustic characteristics of the propagation environment, determines the 'path' leading to the sound source by applying known properties on the direction of propagation of the sound rays.

Therefore, for each sound radius that reaches the source, it applies the attenuating factors related to the acoustic phenomena affected by the ray (the attenuating factors are evaluated quantitatively by means of the ISO 9613-2) and then, it sums, at the receiving point considered, all the contributions made by the sound rays that had reached at least one sound source.

For this numeric procedure to be executed in a reasonable time by the computer, using Sound Plan it is possible to make 'settings' on the accuracy of the calculation model and in particular on:

- the incremental value of the angle that identifies two contiguous rays of search;
- the maximum number of reflections to be considered for the search radius before its contribution is considered null;
- the circular width of the field of research.

Sound Plan is basically based on three modules:

- a 'geo-database'
- a calculation module
- a result display module

In the geo-database, the propagation environment is represented in the three dimensions and the surfaces of the same are acoustically characterized. Emission sources are also located, each of which must be associated with acoustic characterization (source spectrum or total source sound pressure level).

By the calculation module it's possible to select the calculation standard to be used and once selected, the standard can be 'set' in the values of the propagation environment conditions.

The result display module renders the calculation results according to the purpose of the calculation.

5.2 Model runs

The model has been set up and launched. The results have been collected and analyzed.

The Set up of the model has implied the input of all basic data into the software. This has included information regarding the location of sensitive receptors, the noise emission and the technical data of the new YCCPP-2 including terrain data, and dimensions of the nearby structures. The following aspects have been considered

- The soil use and occupation (including sensitive receptors)
- The terrain characteristics:
- The Plant's noise emissions and technical data.

5.1.1 Setting boundary conditions

The propagation area considered is the installation area of the Project Center and its immediate vicinity and is such as to include sensitive receptors identified.

The calculation of the contribution of the sound sources has been carried out on an area of the territory so that the effects of the sound can be considered as null.

In order to cover within the spatial scope of the study the sensitive receptors identified a computational area of about 3 km x 3 km was considered.

The geo-database was built through a detailed plan of the area.

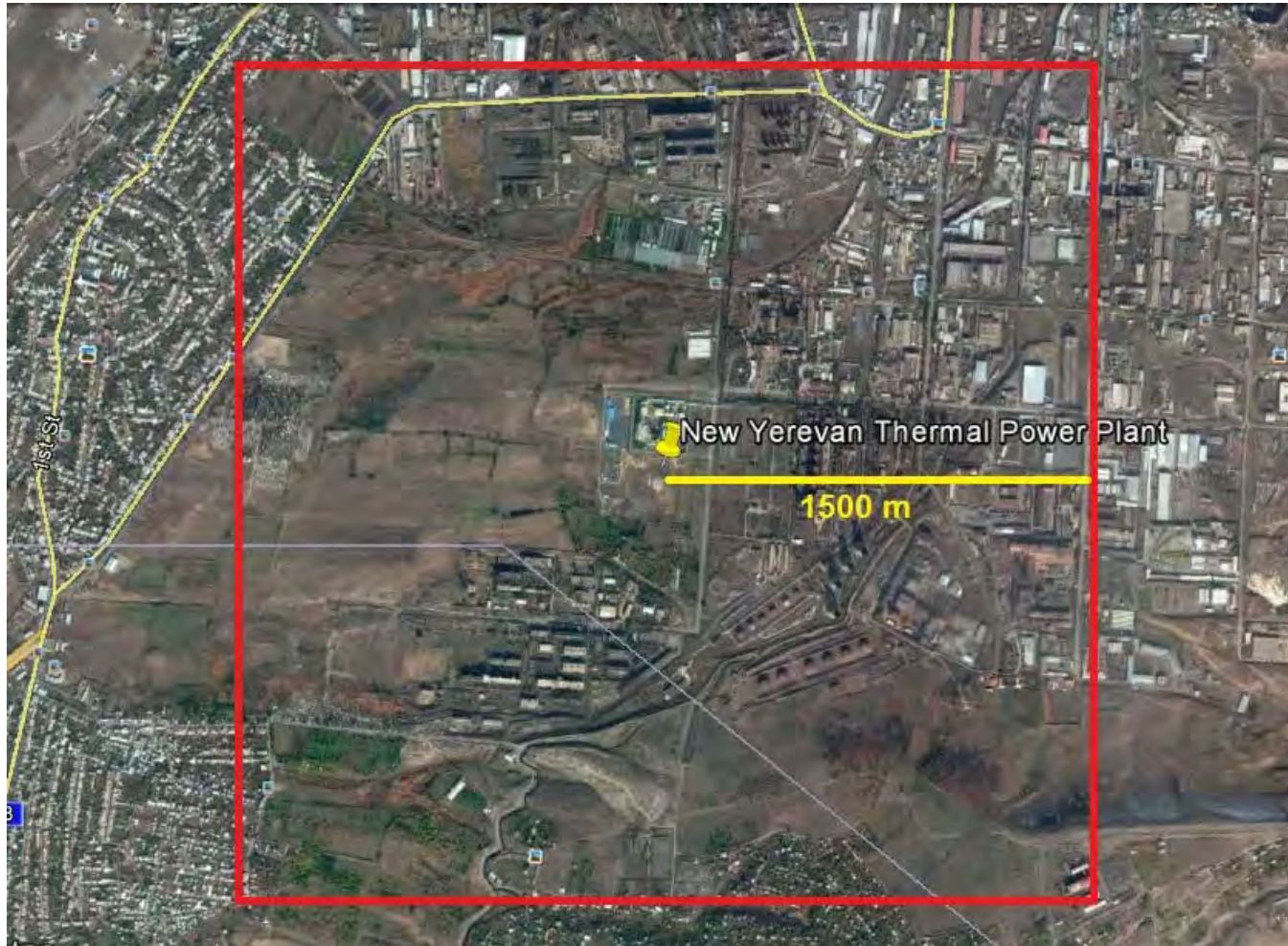


Figure 5-1: The computational area

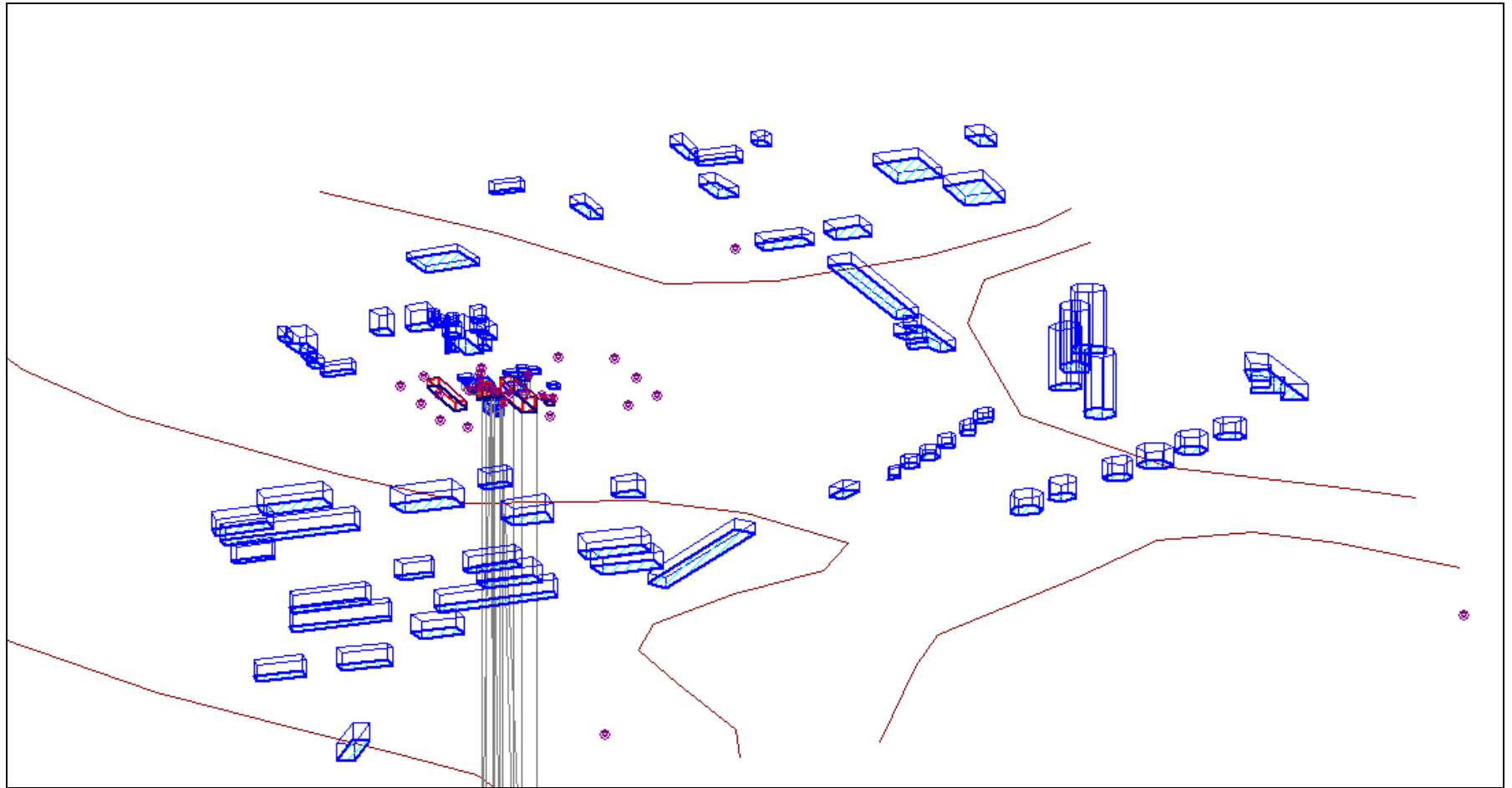


Figure 5-2: A geodatabase 3D view of the computational area

5.2 Setting the sound sources

The allocation of the sound emission to the various components of the plant was made in analogy to the technical specifications for the purchase of the various equipment, according to the designers' instructions according to the values reported in the Table 5-1.

Table 5-1: Sound pressure level of the most relevant sources considered in the model

Item	Source	Lp(A) (@1m) [dB(A)]
HRSG	Lateral Walls	71
	Roof	71
Air Intake GT	Intake	77
HRSG Diffusor	All surfaces	70
Main Machine Building (GT, ST)	All surfaces	60
Stack	External surfaces	75
	Mouth	80
Close cycle heat exchanger	All surfaces	75
Cooling Towers	All surfaces	80
Main Transformer	All surfaces	80
Units Transformer	All surfaces	75
Fuel Gas Booster Compressors Building	All surfaces	80
Auxiliary Boiler	All surfaces	60

Some sound sources have been modeled as areal sources and others as point sources.

The surfaces of buildings are acoustically considered as good reflectors (as is also indicated in ISO 9613-2). This is a typical assumption in the study of environmental noise propagation where 'natural screens' to be considered always have a significant thickness that, following the formulation proposed by ISO 9613-2 for the assessment of the sound pressure level loss at a reflection, is equivalent to the loss of 1 dB at every reflection.

The allocation of the sound power to the different components of the plant was made in analogy to the technical specifications for the purchase of the various equipment, according to the designers' instructions.

The following cautionary assumptions were made in the calculation model parameters setting:

- Continuous operation 24hours / day - 365 days / year (continuous operation both during the diurnal reference period and during the night reference period)
- Operating characteristics characterized by cautionary sound levels if compared to those guaranteed

5.2.1 Calculation settings

In order to obtain good accuracy results, the search angle method through which SOUND PLAN performs the calculation was set by initializing the relevant parameters with the following values:

- Incremental value of the search beam angle = 2°
- Maximum number of reflections (after which the contribution of the search radius is considered null) = 3

The settings made on the parameters of the calculation standard are as follows:

Table 5-2: Calculation settings

Environmental Conditions	Humidity	70%
	Temperature	10°C
	Atmospheric pressure	1013,25 mbar
Diffractions Calculations	Contribution limits due to diffractions	Single diffraction=20dB
		Double diffraction=25dB
	Values assumed for the parameters in the formulations of ISO 9613 for calculating the diffractions	C1=3
		C2=20
C3=0		

5.2.2 Sound pressure levels "ante-operam"

Sensitive receptors that could potentially be more impacted by noise were detected through a site survey. They are reported in the Figure below.

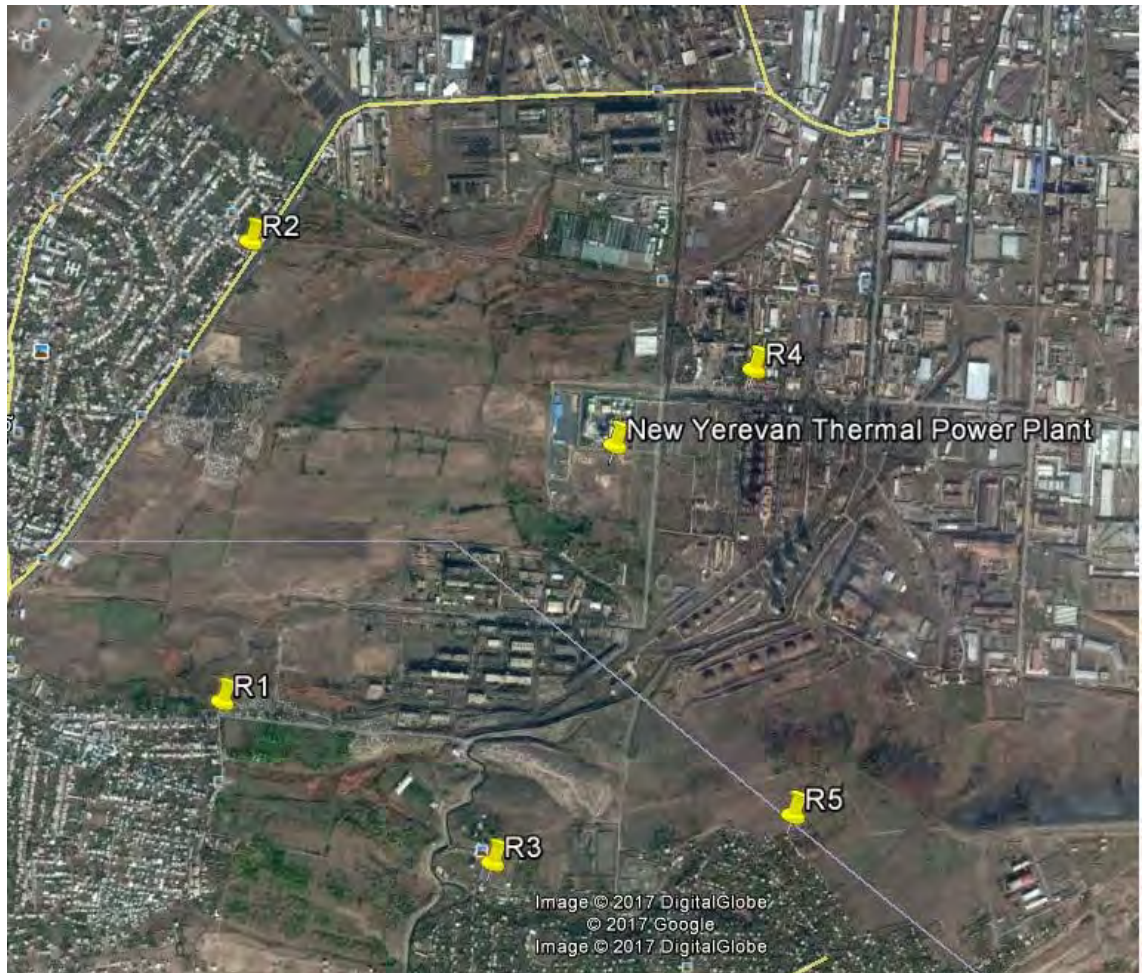


Figure 5-3: Sensitive receptors potentially impacted

According to the Sanitary Norms N2-III-11.3:

- the applicable noise limits In the residential areas are 45 dBA during the Night time and 55 dBA during the Day time

In the industrial areas the limits fluctuate from 50 dBA to 80 dBA depending on the category of works.

The said limits are referred to the total environment noise (the power plant contribution including the current sound pressure (“ante operam” sound pressure)).

The applicable national and international limits to the sensitive receptors potentially impacted are shown in the Tables below.

Table 5-3: Applicable limits to the sensitive receptors potentially impacted - National limits

Point of measurement	Time	TLV (equivalent to sound level), [dB(A)]
(Work-day and Weekend)		
R1	Day-time	55
	Night-time	45
R2	Day-time	55
	Night-time	45
R3	Day-time	55
	Night-time	45
R4	Day-time	70
	Night-time	70
R5	Day-time	55
	Night-time	45

Table 5-4: Limit values for noise regarding population - IFC/WB General EHS Guidelines

Receptor	One Hour L_{Aeq} (dB A)	
	Daytime 7:00 – 22:00	Night-time 22:00 – 7:00
Residential; institutional; educational	55	45
Industrial; commercial	70	70
Noise impacts should not exceed the levels given above, or result in a maximum increase in background levels of 3 dB (A) at the nearest receptor location off-site.		

In order to characterize the acoustic climate at the sensitive receptors, noise measurements were performed at each of them during the survey. For the measurement report, refer to the report “Noise and PM10 Baseline Study” rev.01 dated August 2017.

In the Table 5-5 the summary of the measurements outcome is reported.

Table 5-5: Current sound pressure (“ante operam”) at the sensitive receptors

Point of measurement	Wind speed (m/s)	Time of measurement	Leq(A) [dB(A)]
Work-day			
R1	<1.7	Day-time	49.8
	<1.8	Night-time	47.1
R2	<1.9	Day-time	72.6
	<2.3	Night-time	62.4
R3	<1.8	Day-time	48.1
	<1.7	Night-time	40.0
R4	<1.6	Day-time	53.6
	<1.9	Night-time	57.3
R5	<1.7	Day-time	36.2
	<2.0	Night-time	39.4
Weekend			
R1	<1.5	Day-time	43.4
	<2.1	Night-time	49.0
R2	<1.8	Day-time	72.8
	<2.5	Night-time	59.2
R3	<1.9	Day-time	43.9
	<2.0	Night-time	33.9
R4	<1.8	Day-time	56.4
	<2.0	Night-time	57.2
R5	<1.5	Day-time	35.6
	<1.8	Night-time	34.2
<p>“Ante operam” Day-time noise evaluation Based on the noise measurement results conducted during work-days and weekend days, it can be concluded that noise equivalent levels in/near the residential areas were generally within the TLV except the point R2 (located in front of the highway), where the noise level exceeded the 55 dBA normative value. This can be explained by the movement of heavy vehicles and high traffic density along the highway</p> <p>“Ante operam” Night-time noise evaluation Equivalent noise levels during work-days and weekend days at measurement points R3 and R5 are within the 45 dBA TLV. Noise levels at point R1 during both work-days and weekend days were slightly exceeding the TLV (2.1 dBA and 4 dBA accordingly). This is due to the availability of background night noise from the facilities located in the vicinities. As a result of night-time measurements, the equivalent noise level at point R 2 (located in front of the highway) is above the 45 dBA TLV (see). The reason is high traffic density along the highway even at night-time.</p>			

5.2.3 Calculation of the sound contribution to the most exposed sensitive receptors

The calculation of the sound pressure level generated by the operation of the Power Plant towards the sensitive receptors has been performed by positioning the sensitive receptors in the model geodatabase. The calculation outcomes are reported in the Table below.

Table 5-6: Calculation outcomes: Sound Pressure generated by the Plant operation at the sensitive receivers

ID Receptor	Reference period (Work-day and Weekend)	Sensitive receptor applicability	Sound level contribution LAeq [dB(A)]
R1	<i>Day time</i>	Yes	32,5
	<i>Night time</i>	Yes	32,5
R2	<i>Day time</i>	Yes	38,0
	<i>Night time</i>	Yes	38,0
R3	<i>Day time</i>	Yes	34,9
	<i>Night time</i>	Yes	34,9
R4	<i>Day time</i>	Yes	42,7
	<i>Night time</i>	Yes	42,7
R5	<i>Day time</i>	Yes	31,8
	<i>Night time</i>	Yes	31,8

In addition calculation points along the Plant fence have been considered. The calculation outcomes are reported in the Table below.

Table 5-7: Calculation outcome: Sound Pressure generated by the Plant operation at the Plant fence.

ID Fence Point	Sound level contribution LAeq [dB(A)]
P East 1	51,3
P East 2	51,6
P East 3	51,5
P North 1	64,0
P North 2	57,3
P North 3	53,1
P South 1	54,2
P South 2	59,6
P South 3	60,2
P West 1	62,6
P West 2	67,9
P West 3	66,2

The calculation point along the fence have been positioned as shown in the Figure below.

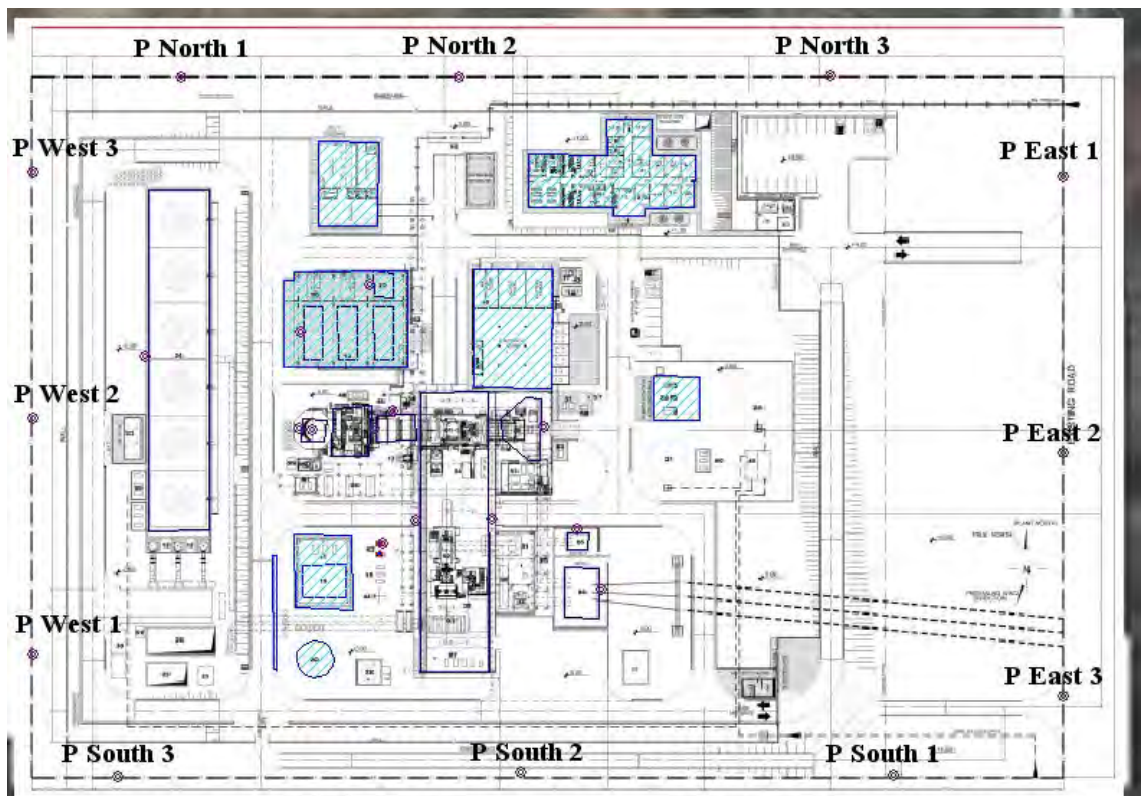


Figure 5-4: Position of the calculation points along the Plant fence

5.2.4 Calculation of noise maps

Through the calculation model also the noise maps have been generated.

The noise maps represent the sound pressure level curves, generated by the Plant during operation at the quotas of:

- +2 m from the ground level (Annex A)
- +10 m from the ground level (Annex B)

6. Predictive noise limit compliance check

The predictive noise pressure at the sensitive receptors has been calculated by adding the value of the background noise sound pressure to sound level contribution calculated by the model.

The formula used is the following:

$$Lpi_r = 10Log(10^{\frac{Lpe_r}{10}} + 10^{\frac{Lpf}{10}})$$

Where:

- Lpi_r is the predicted noise pressure value at the 'r' sensitive receptor
- Lpe_r is the Sound level contribution of the Plant at the 'r' sensitive receptor
- Lpf is the current back ground sound level

The calculation outcomes are shown in the Table 6-1. As measurement point 'Noise 4' is located in an industrial area, limit values for industrial areas have been used for this point. However, as this measurement point is located near to the illegal housings northeast of YCCPP-1, Table 6-2 shows the relevant noise pressure at this point under consideration of limit values (international = national) for residential areas.

The results provide a comparison to the national and the international noise limit values. The international limit values (IFC EHS General Guidelines) have the particularity that, whenever the background levels are presently above the applicable limits, a maximum increase of 3 dB(A) due to a project is accepted. This is evaluated in the tables below.

As indicated in Table 6-1 and Table 6-2, where the predicted noise pressure is higher than the applicable limits, this is due to the high background 'ante operam' noise pressure. Contribution from the operation of YCCPP-2 in these cases will be negligible (0.00 – 0.18 dB(A)). This complies with the IFC standard of not exceeding an increase of 3 dB in the background levels.

Table 6-1: Predicted noise pressure at the sensitive receptors and “post – operam” noise limits compliance check

ID Receptor	Reference period	Applicable limit	“Ante operam” sound pressure LAeq [dB(A)]	“Ante operam” noise limits compliance check	Sound level contribution LAeq [dB(A)]	Predicted noise (“post operam”) pressure value LAeq [dB(A)]	Predicted (“post operam”) noise limits compliance check
Work-day							
R1	Day time	55	49,8	Compliant	32,5	49,88	Compliant
	Night time	45	47,1	Not compliant: In this case, a max. increase of 3 dB (A) is allowed for „post operam“	32,5	47,25	Compliant: the maximum increase is of +0,15 dB (A)
R2	Day time	55	72,6	Not compliant: In this case, a max. increase of 3 dB (A) is allowed for „post operam“	38,0	72,60	Compliant: the maximum increase is of +0,00 dB (A)
	Night time	45	62,4	Not compliant: In this case, a max. increase of 3 dB (A) is allowed for „post operam“	38,0	62,42	Compliant: the maximum increase is of +0,02 dB (A)
R3	Day time	55	48,1	Compliant	34,9	48,30	Compliant
	Night time	45	40,0	Compliant	34,9	41,17	Compliant
R4	Day time	70	53,6	Compliant	42,7	53,94	Compliant
	Night time	70	57,3	Compliant	42,7	57,45	Compliant
R5	Day time	55	36,2	Compliant	31,8	37,55	Compliant
	Night time	45	39,4	Compliant	31,8	40,10	Compliant
Weekend							
R1	Day time	55	43,4	Compliant	32,5	43,74	Compliant
	Night time	45	49,0	Not compliant: In this case, a max. increase of 3 dB (A) is allowed for „post operam“	32,5	49,10	Compliant : the maximum increase is of +0,10 dB (A)
R2	Day time	55	72,8	Not compliant: In this case, a max. increase of 3 dB (A) is allowed for „post operam“	38,0	72,80	Compliant : the maximum increase is of +0,00 dB (A)
	Night time	45	59,2	Not compliant: In this case, a max. increase of 3 dB (A) is allowed for „post operam“	38,0	59,23	Compliant : the maximum increase is of +0,03 dB (A)
R3	Day time	55	43,9	Compliant	34,9	44,41	Compliant

ID Receptor	Reference period	Applicable limit	“Ante operam” sound pressure LAeq [dB(A)]	“Ante operam” noise limits compliance check	Sound level contribution LAeq [dB(A)]	Predicted noise (“post operam”) pressure value LAeq [dB(A)]	Predicted (“post operam”) noise limits compliance check
	Night time	45	33,9	Compliant	34,9	37,44	Compliant
R4	Day time	70	56,4	Compliant	42,7	56,58	Compliant
	Night time	70	57,2	Compliant	42,7	57,35	Compliant
R5	Day time	55	35,6	Compliant	31,8	37,11	Compliant
	Night time	45	34,2	Compliant	31,8	36,17	Compliant

Table 6-2: Predicted noise pressure at the sensitive receptors and “post – operam” noise limits compliance check - measurement point ‘Noise 4’

ID Receptor	Reference period	Applicable limit - <u>residential areas</u>	“Ante operam” sound pressure LAeq [dB(A)]	“Ante operam” noise limits compliance check	Sound level contribution LAeq [dB(A)]	Predicted noise (“post operam”) pressure value LAeq [dB(A)]	Predicted (“post operam”) noise limits compliance check
Work-day							
R4	Day time	55	53,6	Compliant	42,7	53,94	Compliant
	Night time	45	57,3	Not compliant: In this case, a max. increase of 3 dB (A) is allowed for „post operam“	42,7	57,45	Compliant : the maximum increase is of + 0.15 dB (A)
Weekend							
R4	Day time	55	56,4	Not compliant: In this case, a max. increase of 3 dB (A) is allowed for „post operam“	42,7	56,58	Compliant : the maximum increase is of + 0.18 dB (A)
	Night time	45	57,2	Not compliant: In this case, a max. increase of 3 dB (A) is allowed for „post operam“	42,7	57,35	Compliant : the maximum increase is of + 0.15 dB (A)

7. Conclusions

The assessment of the acoustic impact associated with the New CCGT has been carried out applying a predictive mathematic model to the actual project data.

The calculation has been performed in accordance with the calculation models defined in the ISO 9613-2 standard. The calculation was performed through the SoundPlan software after setting the model parameters.

The sensitive receivers that are more exposed to the new Power Plant operation noise have been detected. The current noise level pressure at the said sensitive receivers have been assessed by an acoustic survey.

The applicable reference noise limit are prescribed by The Sanitary Norms N2-III-11.3.

The final calculation outcomes have shown the compatibility of the New CCGT operation with the applicable noise limits.

The New CCGT operation will not produce any significant increase of the noise pressure at the sensitive receptors. In particular:

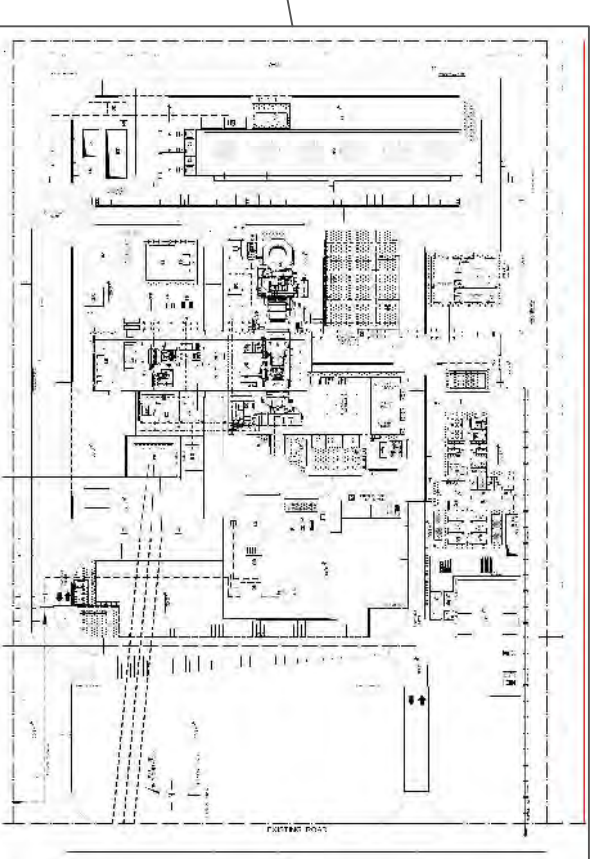
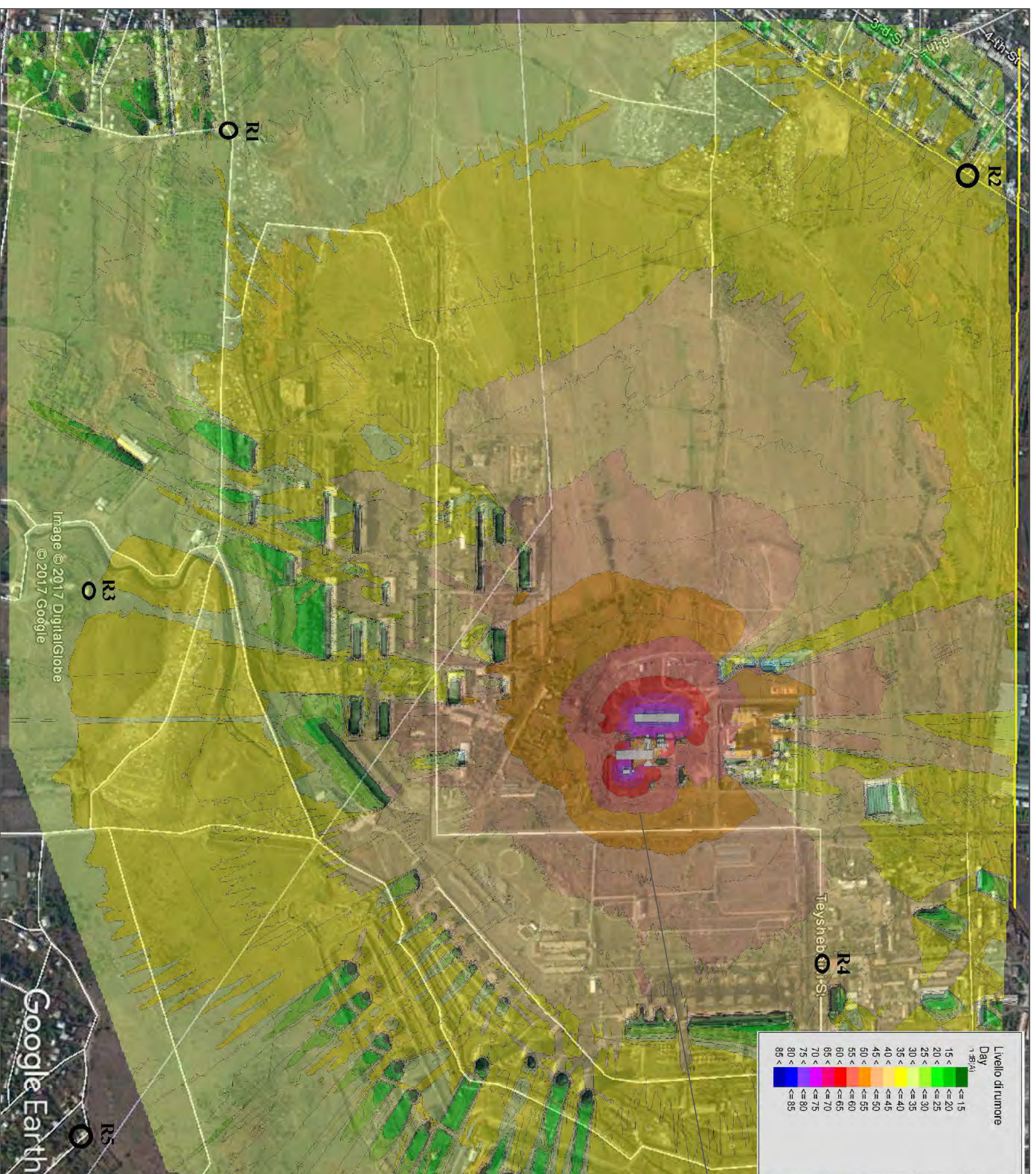
- where the current noise pressure is under the applicable limits, the New CCGT operation will not produce any exceedance of the said limit, either during the daytime or during the night time
- where the current noise pressure is already over the applicable limits, the New CCGT operation will produce a negligible contribution, respecting the IFC standard of not exceeding an increase of 3 dB in the background levels.

As last consideration, it has to be underlined that, although at the CCGT fence no sensible receivers are present, the Sound level contribution of the New CCGT operation will be significantly below the applicable industrial areas noise limits.

8. Annexes

Annex A – noise map at +2m

Annex B – noise map at +10m

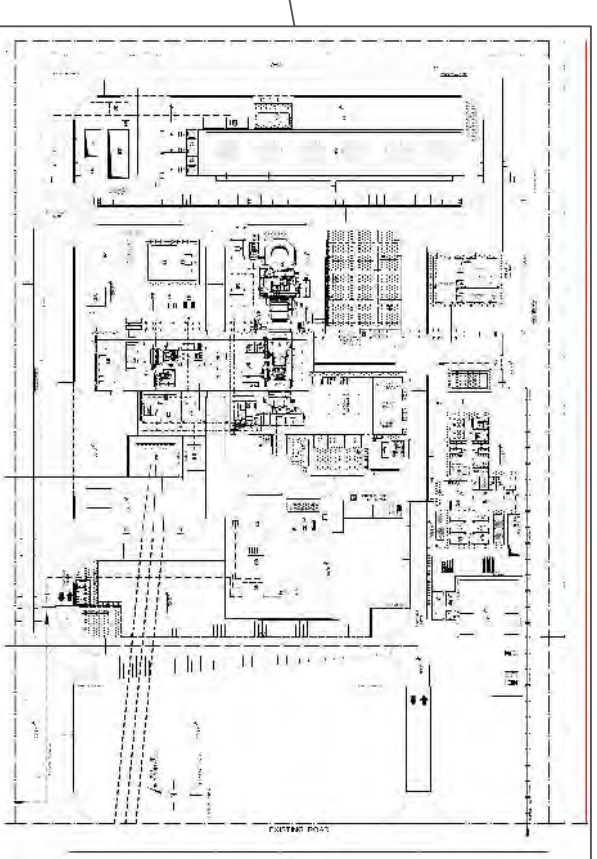
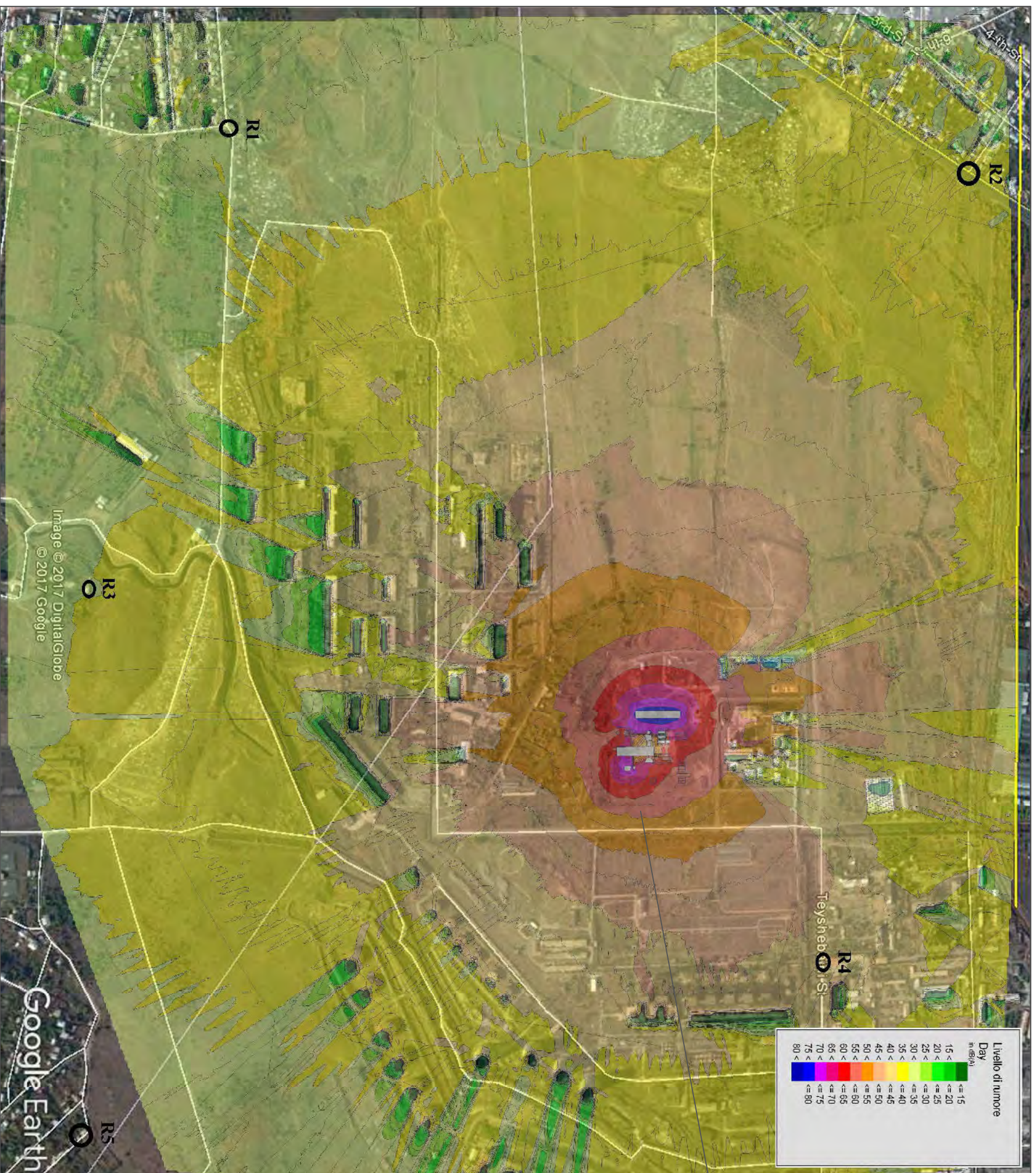


Plant layout

Item	Source	L _p (A) (@1m) [dB(A)]
HRSG:	Lateral Walls	71
	Roof	71
Air Inlet GT	Inlet	77
LIRSG Diffuser	All surfaces	70
Main Machine Building (G.L. SI)	All surfaces	60
Stack	External surfaces	75
	Mouth	80
Close cycle heat exchanger	All surfaces	75
Cooling Towers	All surfaces	80
Main Transformer	All surfaces	80
Units Transformer	All surfaces	75
Fuel Gas Booster Compressors Building	All surfaces	80
Auxiliary Boiler	All surfaces	60

Most relevant Noise emission items considered in the Plant project

Annex A	
Noise emissions - 2 m height noise map	



Plant layout

Item	Source	$L_{p(A)} (@1m)$ [dB(A)]
HRSG:	Lateral Walls	71
	Roof	71
Air Inlet GT	Inlet	77
LIRSG Diffuser	All surfaces	70
Main Machine Building (G.L. SI)	All surfaces	60
Stack	External surfaces	75
	Mouth	80
Close cycle heat exchanger	All surfaces	75
Cooling Towers	All surfaces	80
	All surfaces	80
Main Transformer	All surfaces	80
Units Transformer	All surfaces	75
Fuel Gas Booster Compressors Building	All surfaces	80
Auxiliary Boiler	All surfaces	60

Most relevant Noise emission items considered in the Plant project

Annex B	
Noise emissions - 10 m height noise map	

ARMPower	<i>Customer:</i>	ARMPower CJSC	<i>Cpy n.:</i>		<i>Cls</i>	-
	<i>Plant Location:</i>	Yerevan - Armenia	<i>Ctr n.:</i>	Q040- WW-TEMPERATURE	<i>Rev</i>	02
	<i>Project:</i>	Armenia 250 MW CCGT	<i>Page 1 of 12</i>			

**WASTE WATER TEMPERATURE PROFILE STUDY
(STEADY STATE)**

<i>Cpy n.:</i>		<i>Cls</i>	-
<i>Ctr n.:</i>	Q040- WW-TEMPERATURE	<i>Rev</i>	02
<i>Page 2 of 12</i>			

CONTENTS

1	INTRODUCTION.....	3
1.1	Site Location.....	3
1.2	The Project.....	3
2	SCOPE.....	4
2.1	Temperature Profile Models (steady state).....	4
2.2	Main Design Basis and assumptions follows:.....	4
2.3	Calculation.....	6
2.3.1	Winter Season temperature Case.....	6
2.3.2	Summer Season temperature Case.....	9
3	Conclusion.....	11

<i>Cpy n.:</i>		<i>Cls</i>	-
<i>Ctr n.:</i>	Q040- WW-TEMPERATURE	<i>Rev</i>	02
<i>Page 3 of 12</i>			

1 INTRODUCTION

Ministry of Energy (MOE) of Republic of Armenia has planned, inside a wider program of develop of production of Energy in the Country, to improve the total efficiency of the existing power plant by replacing the older and lower efficient power units with the most modern steam gas combined cycle power generation technology.

To partially reduce the gap between the offer and demand of electric Energy foreseen in the Republic of Armenia for the next years, the MOE has signed for the construction of a new 250 MW (nominal) combined cycle type power plant, gas fired, to be built on the clean and empty field adjacent to the existing YCCPP-1, in the vicinity of Yerevan city.

1.1 SITE LOCATION

The new 250MW Yerevan Combined Cycle Power Plant (“YCCPP2”) will be located in the vicinity of Yerevan city, in the area adjacent (on the west side lot) to the existing Yerevan CCPP-1, currently managed by the Yerevan TPP CJSC.

1.2 THE PROJECT

The YCCPP2 Project consists of a nominal 250MW power output power plant, combined cycle as per latest state-of-the art, located in the vicinities of the existing power plant sharing some of the utilities and facilities necessary for its operation. The power output will be assured by a single gas turbine driven electric generator train, which flue gas will be used to produce high pressure stem for additional power recovery through a steam turbine driven electric generator. The Project will be designed for more efficient operation and for higher reliability and availability.

2 SCOPE

The aim of the present study is the evaluation of the water effluent temperature profile from YCCPP2 Power Plant battery limit, up to the existing Hrazdan River during both winter and summer condition:

- Waste water temperature discharge from 25°C in winter to 34,2 in summer season ;
- Lowest River Temperature (Maximum DT between waste water and the receptor-river temperature) during winter season;
- Highest Cooling Water outlet temperature during summer season

As a general note, it shall be considered that the dilution factor due to the very huge flow rate and velocity of the river, has not been considered in the present calculation. These factors could be taken into account to justify, themselves, the negligible environmental impact of the YCCPP-2 waste water on the Hrazdan river. In this regard, data from YCCPP-1 report "YEREVAN TPP CJSC COMBINED CYCLE POWER PLANT (CCPP) STANDARDS OF MAXIMUM ALLOWABLE OUFLOW (MOA) OF HARMFUL SUBSTANCES POURED INTO THE SEWERAGE COLLECTOR AND WATER RESOURCES" state the following river characteristics:

- Flow Rate: around 80.000 m3/hour
- Velocity: 2m/sec

2.1 TEMPERATURE PROFILE MODELS (STEADY STATE)

Two dedicated heat transfer model have been adopted depending the specific trunk line discharge section considered.

Basically we have two main trunk line:

1. Trunk line 1: From tie-in point up to Existing Pit;
2. Trunk line (open channel) : From existing pit to Hrazdan river

Calculation has been done for two main season average temperature: Winter season temperature and Summer season temperature.

2.2 MAIN DESIGN BASIS AND ASSUMPTIONS FOLLOWS:

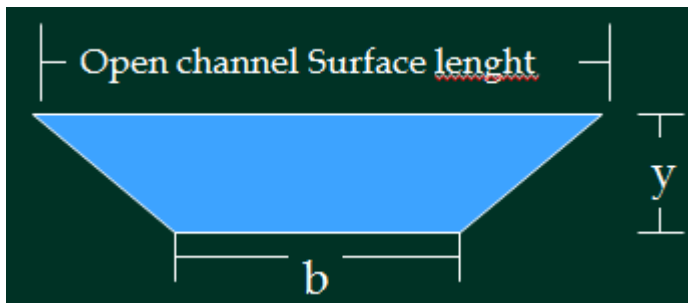
Trunk line 1:

- Length: 1000 meters
- Material: cement pipe
- Manning Factor : 0.013
- Concrete roughness: 3.05 10⁻⁴
- Pipe tickness: 0.04 meter
- ID : 0.297 meters
- Slope 1/100
- Flowrate 100 m3/h

Trunk line 2 (open channel):

- Trapezoidal channel
- Flowrate 100 m3/h
- Assumed water velocity = 1.5 m/sec

Cpy n.:		Cls	-
Ctr n.:	Q040- WW-TEMPERATURE	Rev	02
Page 5 of 12			



- Assumed wind speed : 3 m/sec and 1 m/sec respectively during Winter and Summer season
- Assumed Humidity : 75 % and 45 % respectively during Winter and Summer season
- Assumed T water at Tie-in point : 25 °C and 34 °C respectively during Winter and Summer season
- Assumed length of open channel surface (section) : 1 meter
- Calculated open channel Area (assuming 1 meter surface section length) : 0.018 m²
- No credit has been taken for the Radiation heat flux effect due to the sunlight
- No credit has been taken for the sensible heat term;
- No credit has been taken for the heat transfer rate due to the internal channel surface.

2.3 CALCULATION

2.3.1 Winter Season temperature Case

Trunk line 1 (buried cement pipe) calculation

Temperature drop along cement trunk line has been calculated assuming that the only heat transfer rate envisaged is belonging to wetted pipe area. Basically the heat dissipation (due to the lower ground temperature assumed as 10 °C) will take place by means the temperature difference between inlet pipe water and outlet pipe bulk material.

To evaluate the liquid depth in the pipe (due to the gravity flow) the manning equation has been adopted:

Manning Equation :	$Q = 1/n \times A \times R_h^{2/3} \times S^{1/2}$				
Consider a liquid depth as D/5 meters as first guess					
Liquid Depth	y	0.0594	m		
Manning Factor	n	0.013			
Radius	R	0.1485	m		
Centre Angle	2θ	106.2602047	°		
Liquid Section	A	0.020448929	m ²		
Wetted Perimeter	P	0.275406447	m		
Hydraulic Radius	Rh = A/P	0.07425	m		
Hydraulic diameter	Dh = 4Rh	0.297	m		
Slope in the line	s	0.0100			
Froude Number $Fr = V / \sqrt{g \times D}$					
<i>(From McGraw-Hill_20Piping_20Handbook_20_287E_29)</i>					
Liquid Velocity	V	1.36	m/s		
Full Pipe Area	At	0.07	m ²		
Full Pipe Velocity	Vt	0.40	m/s		
Froude Number	Fr =	0.23501859	≤ 0.3 in order to be selfventing		
Conclusion					
Considering a slope of 10 meters every 1000 meters a 297 Internal Diameter Pipe with a liquid depth of 0.0594 m shall be calculated.					

Liquid Exit Temperature Calculation

INPUT DATA			
Pipeline Length	L	1000	m
Elevation change	Y	10	m
Pipeline Internal Diameter	ID	0.297	m
Burial depth to center	h	1.15	m
Inlet Temperature	T1	25	°C
Ground Temperature	Tg	10	°C
Ground Thermal Conductivity	k	1.49	kcal/hm°C
Mass Flow	M	100000	kg/h
Specific Heat	Cp	1	kcal/kg°C
Factor j	j	426.5	kgm/kcal

Heat Transfer Factor calculation			
$\alpha = 2h/D$	α	7.74	
$s = 2k\pi/[\ln(x+(x^2-1)^{1/2})]$	s	3.42	kcal/hm°C
Heat Flow Ratio per unit lenght calculation			
$a = s/MCp$	a	0.000034	1/m
Asymptotic Temperature calculation			
$T_a = T_g - (J \times DP + Y/(j \times C_p))/aL$	(Joule Thomson Effect not considered; $J \times DP = 0$)		
	T_a	9.31	°C
Downstream Temperature calculation			
$T_2 = (T_1 - T_a) \times e^{-aL} + T_a$	T_2	24.5	°C
Therefore calculated duty relevant temperature drop from 25 to 24.5 °C is calculated as follows:			
$\Delta Q = (25-24.5) \times 1 \times 100000$	Delta Q	50000	Kcal/h
Assuming that only a part of the pipe surface will be affected by the heat flux, a 60% of the heat flow will be considered: 30000 kcal/h			
Hence:			
$30000 = \Delta T \times 1 \times 100000$	Delta T	0.3	°C
As result the exit pipe temperature shall be reasonable assumed as 24.7 °C .			

Trunk line 2 (open channel) calculation

Since the water is flowing through an open channel, we assume that the evaporative heat flux across the air-water interface is the most significant factor in dissipation of stream heat (Parker and Krenkel 1969).

Special consideration must be taken in addressing the simulation of evaporation rates, since the evaporation flux is the energy process in which streams dissipate most heat energy, and therefore, contributes most to decreases in water column temperature.

The vapor pressure gradient between the water surface (e_s) and the air (e_a) directly above the stream drives evaporation (i.e. the vaporization of water molecules) when the gradient is positive ($e_a - e_s$). Only when the air is saturated does evaporation cease to occur ($e_a = e_s$). The evaporative flux can be calculated as a summation of the sensible carried with evaporated water vapor and the product of the latent heat of evaporation (LHV), density of water (ρ_w) and the rate of evaporation (\bar{E}). The energy needed for water to change from a liquid to a gas, the latent heat of vaporization (LHV), is a function of water temperature (McCutcheon 1989).

The **evaporative flux** can be calculated as follows (Eq. 1):

(Eq. 1)
$$\Phi_{\text{evaporation}} = \rho_{H_2O} \cdot L_e \cdot \bar{E}$$

Where L_e is the latent heat of vaporization expressed as (eq.2):

(Eq.2)
$$L_e = 1000 \cdot (2501.4 + (1.83 + T_w))$$

While \bar{E} is the evaporation rate. The Mass transfer evaporation rate can be calculated considering the Dingman equation (Dingman 2002).

(Eq.3).....
$$\bar{E} = f(\bar{W}) \cdot (e_s - e_a)$$

Where e_s is calculated as

(Eq.4).....
$$e_s = 6.1275 \cdot e^{\left(\frac{17.27 \cdot T_{wi}}{237.3 + T_{wi}}\right)}$$

And e_a is calculated as

(Eq.5).....
$$e_a = \frac{H}{100\%} \cdot e_s$$

(Eq.6).....
$$f(\bar{W}) = a + b \cdot \bar{W}$$

From the above equation the Evaporation Flux is calculated considering the following step:
Using for Eq 4 and 5 followings coefficient respectively

- $e_s = 31.2$
- $e_a = 23.4$

Using Eq. 6 $f(W)$ is equal to 1.4×10^{-8} considering the followings coefficient

- $a = 5 \times 10^{-9}$
- $b = 3 \times 10^{-9}$

By using Dingman equation the Evaporation mass rate is

- $\bar{E} = 1.4 \times 10^{-8} (31.2 - 23.4) = 1.1 \times 10^{-7}$
- $L_e = 1000 \times (2501.4 (1.83+ 24.7 \text{ °C})) = 2527930 \text{ J/kg}$

$\Phi_{\text{evaporation}} = 1000 \times 2527930 \times 1.1 \times 10^{-7} = 276 \text{ W/m}^2$

In order to estimate the temperature changes along the entire open channel we can reasonably assume that the heat load for each m^2 of the channel is **276 W**.

Water will be exposed for this specific heat load during the time (sec) needed to reach river discharge located at 7000 meter far away. Hence the total time required to reach the river is:

$7000 \text{ [meter]} / 1.5 \text{ [m/sec]} = 4667 \text{ sec}$

The calculated Duty associated to 4667 sec is:

$276 \text{ W} \cdot 4667 \text{ [sec]} = 1288963 \text{ J} = \Delta Q$

The Mass of water considered for 1 meter of specific water surface is calculated as follows:

Mass water = Volume $\times \rho_w = 0.018 \cdot 1000 = 18 \text{ kg}$

Therefore the heat load associated to 18 kg of water mass can be expressed also as:

$\Delta Q = M \text{ cp } \Delta T$

And the calculated ΔT is : $(1288963 \text{ [J]}) / (18 \text{ [kg]} \cdot 4186 \text{ [J/Kg °C]}) = 17.1 \text{ °C}$

So the final Winter Case waste water temperature into the river is **7.6 °C**.

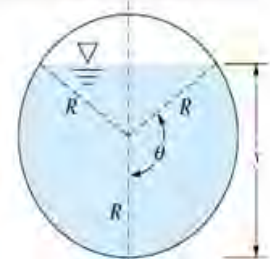
2.3.2 Summer Season temperature Case

Trunk line 1 (buried cement pipe) calculation

Temperature drop along cement trunk line has been calculated assuming that the only heat transfer rate envisaged is belonging to wetted pipe area. Basically the heat dissipation (due to the lower ground temperature assumed as 10 °C) will take place by means the temperature difference between inlet pipe water and outlet pipe bulk material.

To evaluate the liquid depth in the pipe (due to the gravity flow) the manning equation has been adopted:

Manning Equation :	$Q = 1/n \times A \times R_h^{2/3} \times S^{1/2}$		
Consider a liquid depth as D/5 meters as first guess			
Liquid Depth	y	0.0594	m
Manning Factor	n	0.013	
Radius	R	0.1485	m
Centre Angle	2θ	106.2602047	°
Liquid Section	A	0.020448929	m ²
Wetted Perimeter	P	0.275406447	m
Hydraulic Radius	Rh = A/P	0.07425	m
Hydraulic diameter	Dh = 4Rh	0.297	m
Slope in the line	s	0.0100	
Froude Number	$Fr = V / \sqrt{(g \times D)}$		
<i>(From McGraw-Hill_20Piping_20Handbook_20_287E_29)</i>			
Liquid Velocity	V	1.36	m/s
Full Pipe Area	At	0.07	m ²
Full Pipe Velocity	Vt	0.40	m/s
Froude Number	Fr =	0.23501859	≤ 0.3 in order to be selfventing
Conclusion			
Considering a slope of 10 meters every 1000 meters a 297 Internal Diameter Pipe with a liquid depth of 0.0594 m shall be calculated.			



Liquid Exit Temperature Calculation

INPUT DATA			
Pipeline Length	L	1000	m
Elevation change	Y	10	m
Pipeline Internal Diameter	ID	0.297	m
Burial depth to center	h	1.15	m
Inlet Temperature	T1	34	°C
Ground Temperature	Tg	10	°C
Ground Thermal Conductivity	k	1.49	kcal/hm°C
Mass Flow	M	100000	kg/h
Specific Heat	Cp	1	kcal/kg°C
Factor j	j	426.5	kgm/kcal

Heat Transfer Factor calculation			
$\alpha = 2h/D$	α	7.74	
$s = 2k\pi/[\ln(x+(x^2-1)^{1/2})]$	s	3.42	kcal/hm°C
Heat Flow Ratio per unit length calculation			
$a = s/MCp$	a	0.000034	1/m
Asymptotic Temperature calculation			
$T_a = T_g - (J \times DP + Y/(j \times Cp))/aL$ (Joule Thomson Effect not considered; $J*DP = 0$)			
	Ta	9.31	°C
Downstream Temperature calculation			
$T_2 = (T_1 - T_a) \times e^{-aL} + T_a$	T2	33.2	°C
Therefore calculated duty relevant temperature drop from 25 to 24.5 °C is calculated as follows:			
$\Delta Q = (25-24.5) \times 1 \times 100000$	Delta Q	83042	kcal/h
Assuming that only a part of the pipe surface will be affected by the heat flux, a 60% of the heat flow considered:			
		49825	kcal/h
Hence:			
$49825 = \Delta T \times 1 \times 100000$	Delta T	0.5	°C
As result the exit pipe temperature shall be reasonable assumed as 33.5 °C .			

Trunk line 2 (open channel) calculation

Using for Eq. 4 and 5 followings coefficient respectively:

- $e_s = 51.9$
- $e_a = 23.4$

Using Eq. 6 $f(W)$ is equal to 3.5×10^{-9} considering the followings coefficient:

- $a = 2.5 \times 10^{-9}$
- $b = 1.0 \times 10^{-9}$

By using Dingman equation the Evaporation mass rate is

- $\dot{E} = 3.5 \times 10^{-9} (51.9 - 23.4) = 1 \times 10^{-7}$
- $Le = 1000 \times (2501.4 (1.83 + 33.5 \text{ °C})) = 2536730 \text{ J/kg}$

$\Phi_{\text{evaporation}} = 1000 \times 2536730 \times 1 \times 10^{-7} = 253 \text{ W/m}^2$

In order to estimate the temperature changes along the entire open channel we can reasonably assume that the heat load for each m^2 of the channel is **253 W**.

Water will be exposed for this specific heat load during the time (sec) needed to reach river discharge located at 7000 meter far away. Hence the total time required to reach the river is:

$7000 \text{ [meter]} / 1.5 \text{ [m/sec]} = 4667 \text{ sec}$

The calculated Duty associated to 4667 sec is:

$253 \text{ W} * 4667 \text{ [sec]} = 1182675 \text{ J} = \Delta Q$

The Mass of water considered for 1 meter of specific water surface is calculated as follows:

Mass water = Volume x $\rho_w = 0.018 * 1000 = 18 \text{ kg}$

Therefore the heat load associated to 18 kg of water mass can be expressed also as:

$\Delta Q = M c_p \Delta T$

And the calculated ΔT is : $(1182675 \text{ [J]}) / (18 \text{ [kg]} * 4186 \text{ [J/Kg } ^\circ\text{C]}) = 15.7 \text{ } ^\circ\text{C}$

Summer Case waste water temperature into the river is : **17.8 °C.**

Considering a lower evaporation rate due to the solar radiation effect (assumed as 20% of the evaporation flux) the new calculated ΔQ is:

$\Delta Q = 1182675 \text{ [J]} * 0.8 = 946140 \text{ J}$

The calculated ΔT is : $(946140 \text{ [J]}) / (18 \text{ [kg]} * 4186 \text{ [J/Kg } ^\circ\text{C]}) = 12.6 \text{ } ^\circ\text{C}$

Summer lower evaporation Case waste water temperature into the river is : **20.9 °C.**

3 CONCLUSION

The final estimated waste water temperatures at Hrazdan river discharge (as per above mentioned calculation procedure and assumption) is reported in the here below table 1.

The Cooling Water outlet temperature for seasonal cases, is reported in respect to waste water temperature into the river

SEASON	Cooling Tower Discharge Temp [°C]	Water Effluent Discharging in Hrazdan River Temp [°C]	Seasonal Hrazdan River Temp (Average 2015-2016) [°C]	Temperature Change ΔT [°C]	Deviation from Hrazdan River Temp (< 3°C) [°C]
WINTER	25.0	7.6	10.3	17.1	-2.7
SUMMER	34.0	17.8	20.5	15.7	-2.7

Table 1 Water Temperatures

The outlet water temperature as per above calculation results to be in compliance with the seasonal average values of Hrazdan river being always below the 3 degree threshold limit. (refer to table 1)

Seasonal average values of Hrazdan river have been calculated according the following assumptions.

For winter season the following months have been considered for average value calculation:

- January
- February
- November
- December

For Summer season the following months have been considered for average value calculation:

- May
- June
- July
- August

For Season average River temperature refer to Table 2:

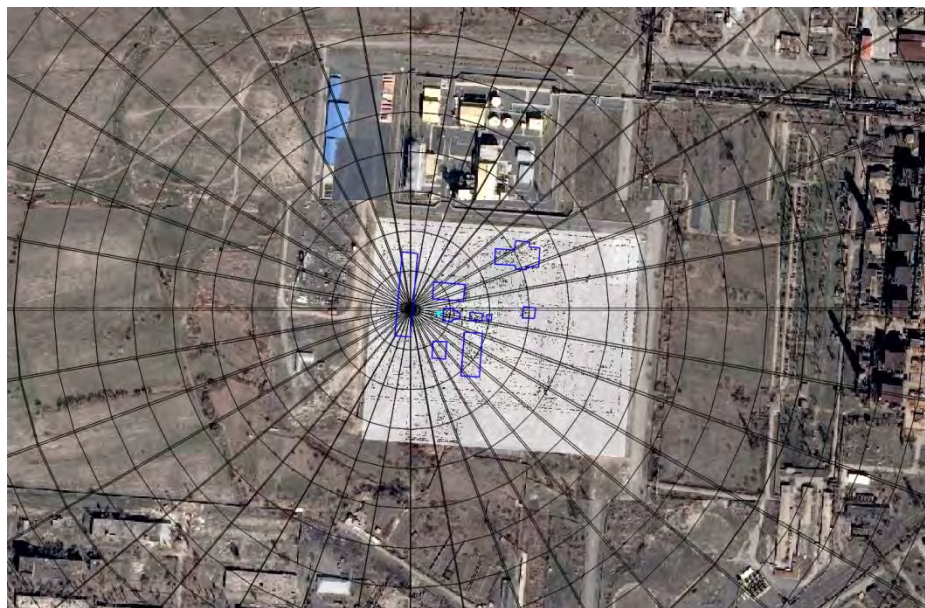
Month	2015	2016	
	[°C]	[°C]	
1	9.8	9.7	
2	10.8	10.8	
3	12.1	11.8	
4	15.7	14.4	
5	19.4	17.8	
6	21.2	19.4	
7	22.7	20.2	
8	23.6	19.8	
9	20.7	16.9	
10	17.6	13.5	
11	13.6	10.1	
12	10.2	7.6	
	[°C]	[°C]	Average (2015-2016) [°C]
Winter average Temp Month (1-2-11-12)	11.1	9.6	10.3
Summer average Temp Month (5-6-7-8)	21.7	19.3	20.5

Table 2 Average water Temperature of Hrazdan river

Yerevan 2 CC Power Plant

Armpower CJSC

Air Dispersion Calculation



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Table of Contents

Disclaimer	I
Table of Contents	II
List of figures	I
List of abbreviations and acronyms	II
1. Scope of the Report	1-1
2. Project Site	2-1
3. Air Emissions and Air Quality Legislation	3-1
3.1 Air Emission Limits	3-1
3.2 Air Quality Standards	3-2
4. Baseline Data	4-1
4.1 Affected area and receptors	4-1
4.2 Meteorological Data	4-2
4.3 Terrain data	4-3
4.4 Emission Data	4-6
4.5 Baseline Air Quality Data - Summer and Autumn 2017; Winter 2017/2018	4-8
4.5.1 PM ₁₀	4-9
4.5.2 SO ₂ and NO ₂	4-10
4.5.3 Treatment of the baseline data - NO ₂	4-11
4.5.4 Baseline assessment - conclusion and future work	4-13
5. Air Dispersion Calculation	5-1
5.1 Air Quality Model	5-1
5.2 Calculation Scenarios	5-1
5.2.1 Note on Scenarios A and C	5-2
5.3 Buildings and downwash effects	5-3
5.4 ADC Results	5-3
5.4.1 CO - Short-time MAC	5-4
5.4.2 CO - 8 hours International AQS	5-7
5.4.3 NO ₂ - Short-time MAC and 1 hour International AQS	5-10
5.4.4 NO ₂ - Annual International AQS	5-13
6. Summary of the results	6-1

7. Conclusion	7-1
8. References	8-1
9. Annexes	9-1
9.1 Annex 1: PM ₁₀ Baseline Studies	9-1
9.2 Annex 2: NO ₂ and SO ₂ Baseline Studies	9-2
9.3 Annex 3: Temperature statistics in Yerevan - Winter 2017 vs. historical data (raw data source: accuweather.com)	9-1

List of tables

Table 3-1: IFC emission guidelines for facilities larger than 50 MW with combustion turbines (IFC, 2008).....	3-1
Table 3-2: Performance Guarantees for YCCPP-2 - air emissions.....	3-2
Table 3-3: National and ECD Ambient Air Quality Standards.....	3-3
Table 4-1: Emission data for YCCPP-2 and YCCPP-1	4-7
Table 4-2: Baseline air quality measurement results - PM ₁₀	4-10
Table 4-4: Baseline air quality measurement results - SO ₂	4-11
Table 4-5: Multiplying factor to convert 24 hour concentrations to 1 hr concentrations (adapted from EPA, 1992).....	4-12
Table 4-6: Multiplying factor for point sources to convert 1 hour concentrations to annual periods (EPA, 1992).....	4-12
Table 4-7: Measured and calculated NO ₂ baseline concentrations in the project area	4-12
Table 5-1: Maximum simulated 1 hr CO GLC and comparison with the air quality standards	5-4
Table 5-2: Maximum simulated 8 hr CO GLC and comparison with the air quality standards	5-7

List of figures

Figure 2-1:	Location of the future Yerevan - 2 PP (source of the topographic map: URL 1)	2-2
Figure 2-2:	Overview of the immediate surroundings of the Yerevan Power Plants 1 and 2	2-3
Figure 4-1:	Location of the affected area	4-1
Figure 4-2:	Closer view of the affected area	4-2
Figure 4-3:	Wind rose for the years 2014-2016 (wind blowing from)	4-3
Figure 4-4:	Representation of the terrain of the affected area	4-4
Figure 4-5:	Landscape/terrain at the site and its surroundings (Fichtner, July 2017)	4-6
Figure 4-6:	Baseline Monitoring Points - Air Quality	4-8
Figure 5-1:	Maximum simulated 1 hr CO GLC - indicative cumulative effects - YCCPP-1 + YCCPP-2	5-5
Figure 5-2:	Maximum simulated 1 hr CO GLC - indicative cumulative effects - YCCPP-1 + YCCPP-2 - closer view of the higher values	5-6
Figure 5-3:	Maximum simulated 8 hr CO GLC - indicative cumulative effects - YCCPP-1 + YCCPP 2	5-8
Figure 5-4:	Maximum simulated 8 hr CO GLC - indicative cumulative effects - YCCPP-1 + YCCPP-2 - closer view of the higher values	5-9
Figure 5-7:	Maximum simulated 1 hr NO ₂ GLC - Scenario B - YCCPP 2 only	5-11
Figure 5-8:	Maximum simulated 1 hr NO ₂ GLC - Scenario B - YCCPP 2 only- closer view of the higher values	5-12
Figure 5-12:	Maximum simulated 1 yr NO ₂ GLC - Scenario B - YCCPP 2 only - closer view of the higher values	5-15

List of abbreviations and acronyms

AQS = Air Quality Standard(s)
CC = Combined Cycle
CO = Carbon Monoxide
ECD = European Council Directive(s)
ELV = Emission Limit Values
IFC = International Finance Corporation
MAC = Maximum Allowable Concentration
masl = meters above sea level
NG = Natural Gas
NO₂ = Nitrogen Dioxide
PP = Power Plant
UHC = Unburned hydrocarbon(s)
WB = World Bank
YCCPP = Yerevan Combined Cycle Power Plant

1. Scope of the Report

The Ministry of Energy (MOE) of the Republic of Armenia plans to improve the total output capacity of its electric energy production, complementing the power units of the existing Yerevan Combined Cycle Power Plant (YCCPP-1) with a more modern and efficient power plant. For this reason a new gas fired Combined Cycle Power Plant of 234 MWe (YCCPP-2) is planned to be built at the site next to the existing YCCPP-1.

RENCO SPA will be the EPC Contractor for this Project, which will be operated by ArmPower CJSC, a subsidiary company of RENCO SPA.

In order to obtain financing from the International Financing Corporation (IFC) and the Asian Development Bank (ADB), a bankable Environmental and Social Impact Assessment (ESIA) Report to the YCCPP-2 (“the Project”) on the basis of the relevant World Bank Group’s guidelines has to be delivered to IFC and ADB for review and approval.

Fichtner is providing Technical Advisory Services to Armpower CJSC (“Project Company” or “Client”), including the elaboration of the bankable ESIA. The present report presents the Air Dispersion Calculation performed for the Project, and is part of the ESIA.

The objective of the study is to assess the contribution of the air emissions of the YCCPP-2 to the air quality in the area, and to indicate whether the national and international air quality standards are expected to be fulfilled or not. The assessment ultimately leads to the determination of the conditions required to fulfill these standards. The criteria pollutants CO and NO₂ are subject of analysis in this context.

The Air Dispersion Calculation is performed using the dispersion modeling software BREEZE AERMOD (version 8.0.0.39 from 2017), based on a U.S. EPA (United States Environmental Protection Agency) Regulatory Model.

2. Project Site

The YCCPP-2 will be located in the city of Yerevan, Armenia, nearby the existing YCCPP-1 in an industrial area (Figure 2-1 and Figure 2-2). The coordinates of the site center are approximately:

- Northing: 40°6'48.06"N;
- Easting: 44°29'49.55"E;
- Zone: 38T (WGS 84).

Noragvit (a residential district of Yerevan) is located approx. 1,350 m to the west, Ayntap (a major village in the Ararat Province) is located approx. 1,500 m to the south west, Kharberd (another major village in the Ararat Province) is located 1,200 m to the south, and the nearest residential areas of the Erebuni District are located approx. 1,200 m north east of the proposed plant site. Right at the vicinity of the site there are some temporary houses, as well as former industrial buildings and a local Fire Service Training Center. There is no one living within the site.

Nearby the Project site, there is one non-operational power plant and many other active industrial plants:

- YCCPP-1
- “Plant of Pure Iron” OJSC
- “Armenian Molybdenum Production” LLC
- “Nairit 1” and “Nairit 2” Chemical Plants
- Others

Information about the air emissions of other active industrial plants in the area could only be obtained for the YCCPP-1, since this power plant is from the same complex as the new YCCPP-2. The other neighboring industrial plants belong to companies unrelated to the developers of the Yerevan power plants 1 and 2, who shared only some limited information with the Client. Such data did not have enough detail to be used in the ADC.

The site is located close to the Erebuni Airport, and the E 117 highway.

Although the present study focus on the impacts of the Yerevan - 2 PP on the air quality, it would be necessary to consider as well the emissions of the existing neighboring plants, road and airport for a complete analysis. Since there is a large number of air emission sources in the area, and it is not possible to obtain data for all of them, a baseline air quality assessment has been undertaken. Please see Section 4.5 for further details.

The future installation of other industrial plants in the area cannot be reasonably foreseen at this stage.



Figure 2-1: Location of the future Yerevan - 2 PP (source of the topographic map: URL 1)



Figure 2-2: Overview of the immediate surroundings of the Yerevan Power Plants 1 and 2

3. Air Emissions and Air Quality Legislation

In order to protect human health, vegetation and/or properties from the negative effects of air pollution, limits are imposed to:

- the concentrations of the pollutants that are emitted from various sources - air emission limits; *and to*
- the concentrations of the pollutants that are present in the atmosphere - air quality standards.

In several countries, these limits (or standards) are defined in the national laws/regulations, but there are also internationally accepted values like the ones from the World Bank Group Guidelines or the European Union Directives.

The air emission limits represent the maximum concentrations that are allowed in the flue gas coming out of the source (a stack, in this case) and are given in mg of pollutant per normal m³ of dry flue gas (mg/Nm³). The N stands for “Normal conditions”: temperature of 0°C and atmospheric pressure of 101.3 kPa.

The air quality standards (AQS) state the maximum concentrations that are allowed in the ambient air, in this case, in the airshed surrounding the power plant. The standards are presented in µg of pollutant per m³ of ambient (exterior) air (µg/m³). For gaseous pollutants, the results of the air quality monitoring shall be standardized at a temperature of 293 K (20°C) and an atmospheric pressure of 101.3 kPa.

This chapter presents the national and international standards for air emissions and for air quality that are applicable to the project.

3.1 Air Emission Limits

The International Finance Corporation (IFC, World Bank Group) defined emission guidelines (EG) for facilities with a power input larger than 50 MW_{th} using gas turbines (Table 3-1).

Pollutant	EG for combustion turbines; facilities > 50 MW _{th}
	Natural Gas
NO ₂	51 mg/Nm ³
Dry gas, excess O ₂ content	15%
Temperature flue gas	0°C

Table 3-1: IFC emission guidelines for facilities larger than 50 MW with combustion turbines (IFC, 2008)

There are no national air emission limits for thermal power plants. The specifications for Yerevan 2 demand the compliance with the performance

guarantee values for CO, NO₂ and Unburned Hydrocarbons (UHC) as shown in Table 3-2.

Pollutant	Performance Guarantees
CO	30 mg/Nm ³
NO ₂	50 mg/Nm ³
UHC	10 mg/Nm ³
Dry gas, excess O ₂ content	15%
Temperature flue gas	0°C
Load	From 70% to 100%

UHC: Unburned Hydrocarbons

Table 3-2: Performance Guarantees for YCCPP-2 - air emissions

The performance guarantee values for NO₂ comply with the IFC emission guidelines. No emission guidelines are defined by IFC for CO. For the project at hand, and based on the specific natural gas composition, the emissions of UHC may include pollutants such as methane (85 to 96% of the gas is composed of methane), ethane, propane, butane, and pentane. IFC does not define emission guidelines for UHC in general nor for any of the listed chemicals in particular.

3.2 Air Quality Standards

The Air Quality Standards are defined according to the different levels of danger that the pollutants pose depending on the exposition period. This way, the standards are defined for different time frames, allowing the protection against the short term acute impacts, the medium term impacts and the long term impacts.

IFC states that emissions from projects shall not result in pollutant concentrations in the ambient air that reach or exceed the relevant ambient air quality guidelines and standards by applying the national legislated standards or, in their absence, the World Health Organization (WHO) Guidelines or other internationally recognized sources like the U.S. EPA (United States Environmental Protection Agency) or the European Council Directives (ECD).

The IFC recommends, in addition, that the emissions from a single project should not contribute with more than 25% of the applicable ambient air quality standards to allow additional, future sustainable development in the same airshed. This implies that even when a ground level concentration (GLC) of a certain pollutant respects the air quality standard, it shall be evaluated whether it is below or above 25% of that standard. This is also assessed in the present study.

Table 3-3 presents the national ambient air quality standards, or MAC - maximum allowable concentrations (established by Governmental Decree

Nr. 160-N of 2 February 2006), and the standards defined by the European Council Directive 2008/50/EC that are applicable to the project.

Pollutant	Averaging period	Air Quality Standards [$\mu\text{g}/\text{m}^3$]		
		National MAC	ECD	
CO	Short-time	5,000	-	
	24 hours	3,000	-	
	Max. daily 8 hour mean	-	10,000	
NO ₂	Short-time	200	-	
	1 hour	-	200 <i>Not to be exceeded more than 18 times per year</i>	
	24 hours	40	-	
	1 year	-	40	
UHC	Methane	-	-	
	Ethane	-	-	
	Propane	-	-	
	Butane	Short-time	200,000	-
	Pentane	Short-time	100,000	-
		24 hours	25,000	-
PM ₁₀	Maximum	300	-	
	24 hours	60	50 <i>Not to be exceeded more than 35 times per year</i>	
	1 year	-	40	
SO ₂	Maximum	500	-	
	1 hour	-	350 <i>Not to be exceeded more than 24 times per year</i>	
	24 hours	50	125 <i>Not to be exceeded more than 3 times per year</i>	

Table 3-3: National and ECD Ambient Air Quality Standards

The ECD 2008/50/EC does not set a limit for the type of UHC that are expected from natural gas operation (methane, ethane, propane, butane, and pentane). The limits shown in Table 3-3 for butane and pentane are based on the national legislation, but seem to be overly permissive. In fact, the national air quality monitoring network does not measure hydrocarbons (WHO, 2003), for what there is not a real experience on the application of

the standards for UHC. Given this, these standards are not be used in the present ADC, and **focus is provided on CO and NO₂**.

Although PM₁₀ and SO₂ are not expected to be emitted by the YCCPP - 2, these standards are mentioned as they are of importance for the air quality baseline assessment shown in Section 4.5.

It shall be noted that the national MAC for 24 hr NO₂ of 40 µg/m³ corresponds to the ECD limit for annual averages. This shows that this national MAC is very stringent when compared to the international standards.

According to the RA Regulation Nr. 1673-N of 27 December 2012, to determine the specific emission limits for projects such as power plants, an air dispersion calculation shall be undertaken that evaluates the compliance with the short time MACs. The short time MAC for CO is 5,000 µg/m³ and for NO₂ is 200 µg/m³ (for residential areas). Therefore, in what regards compliance with national requirements, focus is only provided in this study to the short-time MACs. To evaluate compliance with international requirements, compliance with all applicable ECD air quality standards is also assessed.

4. Baseline Data

4.1 Affected area and receptors

The air quality standards considered in this study are defined for protection of human health. Given this, the study will focus particularly on the analysis of the air quality effects in areas where human presence exists. An area of 314 km² around the power plant is defined as the eventually affected area for air pollution impacts. This includes the neighboring settlements up to 10 km in all directions counting from the stack of the YCCPP-2 (Figure 4-1).

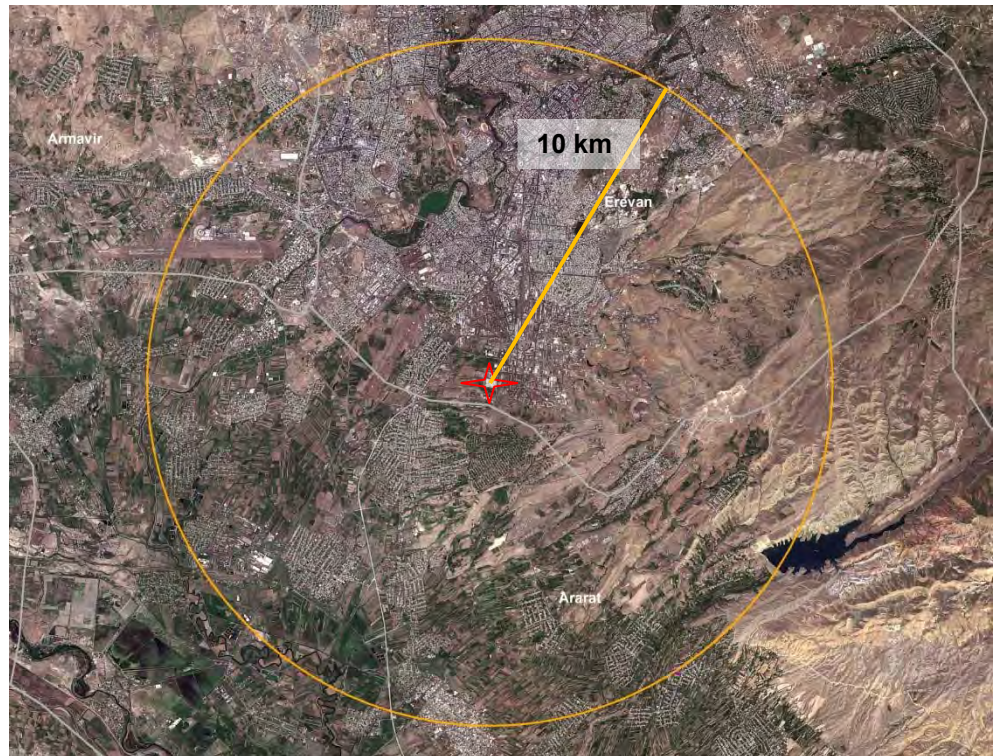


Figure 4-1: Location of the affected area

In the direct proximity of the power plant (up to 1 km), there are some temporary informal houses to the northeast and southeast, deactivated industries and the local Firefighters Training Center to the southwest, a non-operational power plant to the east, and agricultural fields/pastures to the west and northwest (Figure 4-2).



Figure 4-2: Closer view of the affected area

4.2 Meteorological Data

In order to conduct the Air Dispersion Calculation, recent meteorological data from a monitoring station located nearby the project site (Zvartnots Airport) have been analyzed. The data set includes information such as wind speed and direction, cloud cover, temperature, sensible heat flux, surface roughness, etc.

Figure 4-3 presents the wind rose for the years 2014 to 2016. It shows that the prevailing winds blow from northeast (NE). The wind rose also indicates that the more frequent wind speeds are between 1.5 and 3 m/sec, which is equivalent, in the Beaufort scale, to the levels “light air” and “light breeze”.

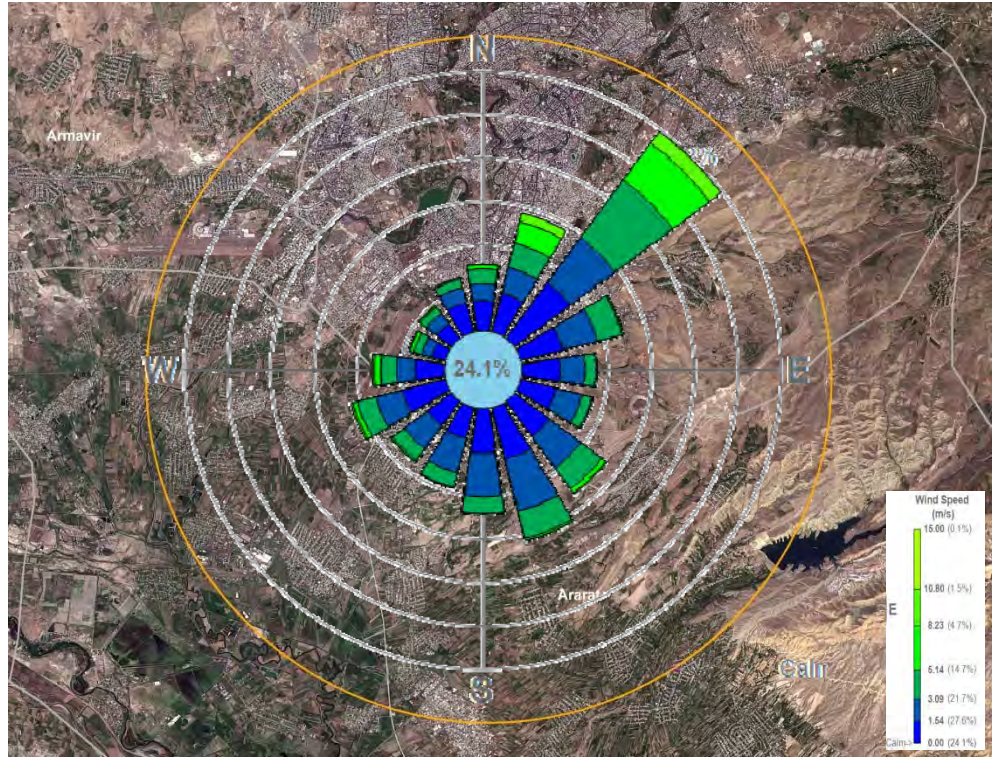


Figure 4-3: Wind rose for the years 2014-2016 (wind blowing from)

4.3 Terrain data

To account for the different heights above sea level of the sensitive receptors and the plants, terrain data were acquired. These allow a 3D representation of the terrain of the assessment area and a more accurate simulation of the pollutants' distribution. Figure 4-4 shows a representation of the area's terrain.

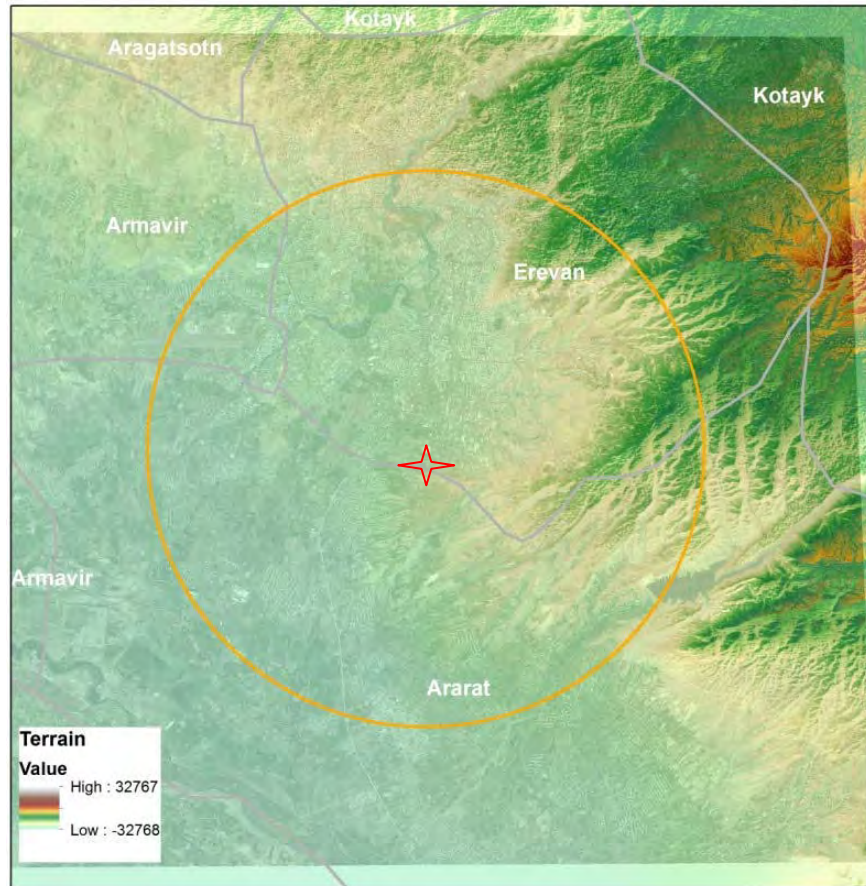


Figure 4-4: Representation of the terrain of the affected area

The project site is located at a height of ca. 930 masl. The terrain and the immediate surroundings are generally flat. Around 3 km to the east of the plant the terrain becomes more elevated where the Gegham mountains begin (Figure 4-5).







Figure 4-5: Landscape/terrain at the site and its surroundings (Fichtner, July 2017)

4.4 Emission Data

To the date of writing this report, emission data of YCCPP-1 and forecast emission data for YCCPP-2 could be obtained (see Table 4-1). Complete data for other neighboring plants could not be obtained, since these belong to companies unrelated to the developers of the Yerevan power plants 1 and 2, who shared only some limited information with the Client. Such data did not have enough detail to be used in the ADC.

Parameter	New YCCPP-2		Existing YCCPP-1	
	Value	Source	Value	Source
Number of stacks	1	Tender specifications/Client	1	Site visit
Location of stacks [m; WGS 84, Zone 38T]	Easting: 457,128		Easting: 457,150	
	Northing: 4,440,461		Northing: 4,440,617	
Height of stacks [m]	35 - 66 (TBD)		45	
Diameter of stacks (inner) [m]	6.23		6.7	
Flue gas exit temperature [K]	370		399	
Flue gas exit velocity [m/s]	20		19	
Actual* flue gas exit flow [m ³ /s] per stack	606		670	Calculated based on information collected during the site visit
Concentration CO [mg/Nm ³] dry, 15% O ₂	30		0.86	Client
Concentration NO ₂ [mg/Nm ³] dry, 15% O ₂	50		43.4	
Concentration UHC [mg/Nm ³] dry, 15% O ₂	10	-	-	
Emission rate CO [g/s] per stack	12.4	Calculated based on information provided by the Client	0.4	Calculated based on information provided by the Client
Emission rate NO ₂ [g/s] per stack	20.6		18.0	
Emission rate UHC [g/s] per stack	4.1		NA	

TBD = To be determined

* Actual means at the actual conditions of temperature, pressure, moisture and O₂ content of the flue gas

Table 4-1: Emission data for YCCPP-2 and YCCPP-1

4.5 Baseline Air Quality Data - Summer and Autumn 2017; Winter 2017/2018

A baseline air quality assessment has been undertaken in July/August 2017 (Summer), October/November 2017 (Autumn), and December 2017/January 2018 (Winter) in the Project Area of Influence, including the specific areas where the highest pollution levels resulting from the operation of the YCCPP - 2 are expected.

The primary objective of this assessment was to determine if the Project's airshed is degraded or non-degraded. A degraded airshed is one where the applicable air quality standards are exceeded (IFC, 2007). With this objective, the ground level concentrations (GLC) of PM₁₀, SO₂ and NO₂ have been monitored in 5 different locations as shown in Figure 4-6. Although PM₁₀ and SO₂ are virtually not expected to be emitted by the YCCPP - 2, it is important to determine their concentrations to assess whether the airshed is degraded or not.



● Baseline monitoring - Air Quality

Figure 4-6: Baseline Monitoring Points - Air Quality

The measurement point Air 1 is situated in industrial area near the southeast border of YCCPP - 1, between the local Firefighters Training Center and an abandoned production facility. The measurement point Air 2 is placed approx. 1,700 m to the south-west of YCCPP - 2; it is located near the northeast border of the Ayntap community between the cemetery and private cultivated gardens. Points Air 1 and Air 2 are located downwind the main wind direction. The measurement point Air 3 is placed in an industrial area near the northern border of the YCCPP - 2. The points Air 4 and Air 5 have been defined after one test model run, being located in the areas where the highest GLC of NO₂ resulting from the operation of YCCPP - 2 are expected.

4.5.1 PM₁₀

The complete reports of the measurements of PM₁₀ can be found in Annex 1 to this ADC.

The dust concentration was measured by using the dust particle meter DT-96 in accordance with the GOST 17.2.4.05-83 - “Environmental protection. Atmosphere. Gravimetric method for determination of suspended dust particles”.

The equipment collected 5 daily measurements of 5 minutes along 5 days between 27.07.2017 and 05.08.2017 (Summer), along 5 days between 28.10.2017 and 04.11.2017 (Autumn), and along 30 days between 17.12.2017 and 03.02.2018 (Winter). The results are presented in Table 4-2.

The baseline data for PM₁₀ has been collected as averages of 5 minutes sampled 5 times per day, meaning that 25 minutes of data have been sampled per day. Electronic equipment to undertake continuous monitoring like the ones used, for example, in the European Union, is not readily available in Armenia. Monitoring with such equipment would allow a direct comparison of the measured values with the air quality standards. Because such equipment is not available, such comparison is hindered. One can however state, as a reasonable approximation, that the averaged values assessed on these campaigns correspond to approximations of 1 hour averages. The corresponding daily (24hr) and annual (1yr) averages are expected to be lower than the presented 1 hour averages.

According to the results shown in Table 4-2, the air quality standards for PM₁₀ are presently respected in the area.

Point	PM ₁₀ [µg/m ³]	PM ₁₀ [µg/m ³]	PM ₁₀ [µg/m ³]	Air Quality Standards [µg/m ³]			
	Average 5 mins in 5 days	Average 5 mins in 5 days	Average 5 mins in 30 days	National MAC		ECD	
	Summer 17	Autumn 17	Winter 17/18	Max.	24 hr	24 hr	1 yr
Air 1	11.4	17.7	6.3	300	60	50	40
Air 2	18.2	21.0	6.6				
Air 3	18.2	28.6	6.4				
Air 4	N.A.	18.4	6.0				
Air 5	N.A.	23.4	6.1				

N.A. = Not Available

Table 4-2: Baseline air quality measurement results - PM₁₀

4.5.2 SO₂ and NO₂

The complete reports of the measurements of gases (SO₂ and NO₂) can be found in Annex 2 to this ADC.

The baseline concentration of gases in the project area has been measured with diffusion tubes, which is the method used in the national monitoring network. The tubes have been placed in monitoring points Air 1 to Air 5 for 7 days in Summer, 10 days in Autumn and 30 days in Winter. The resulting GLC has been determined in the Laboratory of Environmental Monitoring and Information Center of the Ministry of Nature Protection (Table 4-3 and Table 4-4).

Point	NO ₂ [µg/m ³]	NO ₂ [µg/m ³]	NO ₂ [µg/m ³]	Air Quality Standards [µg/m ³]			
	Average 7 days	Average 10 days	Average 30 days	National MAC		ECD	
	Summer 17	Autumn 17	Winter 17/18	Max.	24 hr	1 hr	1 yr
Air 1	16.0	4.3	15.8	200	40	200	40
Air 2	11.9	4.7	16.0				
Air 3	21.3	4.5	20.2				
Air 4	20.1	4.7	16.7				
Air 5	9.2	4.7	19.4				

Table 4-3: Baseline air quality measurement results - NO₂

Point	SO ₂ [µg/m ³]	SO ₂ [µg/m ³]	SO ₂ [µg/m ³]	Air Quality Standards [µg/m ³]			
	Average 7 days	Average 10 days	Average 30 days	National MAC		ECD	
	Summer 17	Autumn 17	Winter 17/18	Max.	24 hr	1 hr	24 hr
Air 1	19.4	18.7	25.4	500	50	350	125
Air 2	22.1	26.7	17.6				
Air 3	28.4	19.7	23.2				
Air 4	N.A.	26.2	17.1				
Air 5	N.A.	33.5	26.0				

N.A. = Not Available

Table 4-4: Baseline air quality measurement results - SO₂

The Autumn measurements of NO₂ show a significant difference to those of the other seasons. This may be explained by the rainy weather that was felt during the Autumn measurement campaign. The Winter and the Summer averages are not significantly different, unlike what would be expected (i.e., it is normally expected that the GLC of pollutants in Winter are higher). This may be explained by the abnormally mild weather felt in Yerevan during the Winter sampling period (see Annex 3 for related temperature graphics).

The baseline data for gases has been collected as averages of several days. Electronic equipment to undertake continuous monitoring like the ones used, for example, in the European Union, is not readily available in Armenia. Monitoring with such equipment would allow a direct comparison of the measured values with the air quality standards. Because such equipment is not available, such comparison is hindered. One can however state, as a reasonable approximation, that the averaged values assessed on each monitoring point correspond to approximations of 24 hour averages.

According to the results shown in Tables 4-3 and 4-4, the national and international 24 hr air quality standards for SO₂ and NO₂ are presently respected in the area. The following section depicts a calculation of the 1 hour and annual averages of NO₂ based on a recognized U.S. EPA methodology.

4.5.3 Treatment of the baseline data - NO₂

NO₂ baseline data needs to be used as an input to the model with the objective of assessing the cumulative impacts of the YCCPP-2 in the hourly and annual NO₂ ground level concentrations. As described in the previous section, the concentrations resulting from the monitoring campaign can be approximated to daily (24 hr) averages. Based on EPA, 1992, the following

multiplying factor has been developed to convert the 24 hr averages into 1 hr averages:

Multiplying Factor - to convert 24 hr to 1 hr
2.5

Table 4-5: Multiplying factor to convert 24 hour concentrations to 1 hr concentrations (adapted from EPA, 1992)

The conversion of 1 hour averages into other averaging periods can be done as well. In the present case, there is the need to estimate annual averages. This is done by applying the multiplying factor shown in Table 4-6 below to the 1 hr value.

Averaging period	Multiplying Factor - to convert 1 hr to other averaging periods
Annual	0.08

Table 4-6: Multiplying factor for point sources to convert 1 hour concentrations to annual periods (EPA, 1992)

In order to assess the cumulative impacts of the YCCPP-2 in the worse case scenario possible, the highest GLC detected during the sampling period are used to represent the baseline/existing 24 hr concentrations. The 1 hr and 1 yr concentrations are calculated based on the multiplying factors shown in the previous tables. The results are found below. They show that presently all national and international standards are respected in the area.

Point	NO ₂ [µg/m ³]			Air Quality Standards [µg/m ³]			
	24 hr (measured highest value) *	1 hr (calculated) **	Annual (calculated) ***	National MAC		ECD	
				Max.	24 hr	1 hr	1 yr
Air 1	16.0	40.0	3.2	200	40	200	40
Air 2	16.0	40.0	3.2				
Air 3	21.3	53.2	4.3				
Air 4	20.1	50.2	4.0				
Air 5	19.4	48.5	3.9				

* See Table 4-3

** Using the multiplying factor shown in Table 4-5

*** Using the multiplying factor shown in Table 4-6

Table 4-7: Measured and calculated NO₂ baseline concentrations in the project area

4.5.4 Baseline assessment - conclusion and future work

The results show that the airshed surrounding the future YCCPP - 2 can be classified as **non-degraded** regarding the pollutants PM₁₀, SO₂ and NO₂. New monitoring campaigns will be undertaken in Spring 2018 to capture the seasonal variations in the pollutant's GLC, and reinforce or adapt this conclusion.

5. Air Dispersion Calculation

5.1 Air Quality Model

The Air Dispersion Calculation was performed using the dispersion modeling software BREEZE AERMOD, version 8.0.0.39 (from 2017), which predicts pollutant concentrations from continuous point, flare, area, line, volume and open pit sources. This steady-state plume model is a US-EPA Regulatory Model.

The simulations performed with BREEZE AERMOD for each of the pollutants CO and NO₂ result in worst case scenarios, that is, the software outputs the maximum concentrations expected to be found in the area due to the operation of the plants.

The NO₂ results were obtained after application of the following ratios to the simulations of NO_x:

- Short term (1 hour) NO₂ results are calculated by applying a rate of 50% to the modeled short term NO_x results;
- Long term (annual) NO₂ results are assumed to be 100% of the modeled long term NO_x results.

This approach is valid for short range modeling and is recommended by the Air Quality Modelling and Assessment Unit from the United Kingdom's Environment Agency as a worst case approach¹. Such conversion ratios are only considered appropriate for combustion processes, where no more than 10% of the emitted NO_x is in form of NO₂. This is applicable for the project at hand.

One of the objectives of the ADC is determining the height that the stacks of the plant shall have so that the national and international air quality standards (AQS) are fulfilled at the next receptor points in every scenario. Three stack heights are considered: 35 meters (as planned by design), 43 meters (alternative design 1) and 66 meters (alternative design 2).

5.2 Calculation Scenarios

Altogether 3 scenarios are simulated:

- Baseline scenario, or **Scenario A** - considers only the baseline air quality data collected in the area for NO₂; for CO, it considers the contribution of YCCPP-1.
- Project scenario, or **Scenario B** - considers the isolated operation of YCCPP-2;

¹ http://webarchive.nationalarchives.gov.uk/20140328232919/http://www.environment-agency.gov.uk/static/documents/Conversion_ratios_for_NOx_and_NO2_.pdf

- Cumulative scenario, or **Scenario C** - considers the baseline air quality data *and* the operation of the YCCPP-2 (determination of cumulative impacts) for NO₂; for CO, it considers the operation of YCCPP - 1 and YCCPP - 2.

Each of the scenarios is simulated for a stack height of 35 meters (design), for a stack height of 43 meters (alternative design 1), and for a stack height of 66 meters (alternative design 2).

5.2.1 Note on Scenarios A and C

In respect for international requirements, it is important to understand the quality of the airshed before the project is implemented (baseline - Scenario A). Only considering the baseline it is possible to understand the cumulative impact of the project (Scenario C). In simple terms, the following applies:

$$\textit{Scenario C} = \textit{Scenario A} + \textit{Scenario B}$$

The baseline (Scenario A) can be determined in two alternative ways:

- a) Data regarding all surrounding industries and other emission sources is made available, and given as an input to the model; the model will then simulate the impacts of the existing sources in the air quality in the area; *or*
- b) An air quality monitoring campaign is undertaken at site.

For CO:

The contribution of all other surrounding sources for the existing CO GLC (option a) could not be considered, due to a lack of important technical and emission data - only data for YCCPP-1 was made available. For this reason, for this pollutant Scenarios A and C are indicative only. Considering the usually very low ambient concentrations of CO, and the comparably very permissive ambient air quality standards, this approximation is deemed to be acceptable, and an air quality campaign for CO was not undertaken.

For NO₂:

In the same way as for CO, the contribution of all other surrounding sources for the existing NO₂ GLC (option a) could not be considered, due to a lack of important technical and emission data - only data for YCCPP-1 was made available. For this reason, Fichtner undertook a baseline air quality monitoring campaign in Summer 2017, Autumn 2017, and Winter 2017/2018 (option b). The highest GLC sampled in each monitoring point are used to represent Scenario A for this pollutant.

5.3 Buildings and downwash effects

The term „building downwash“ describes the effect that wind flowing over or around buildings has on pollutant plumes released from nearby stacks. Essentially, buildings create a cavity of recirculating winds in the area near the buildings, and these building cavities cause increased vertical dispersion of plumes emitted from stacks on or near the buildings. Building downwash often leads to elevated concentrations downwind of affected stacks (Wanger, A., 2011).

For the present ADC, a 3D model of the main buildings of both power plants YCCPP-1 and YCCPP-2 has been set up and included in the model in order to account for eventual downwash effects. Based on this, AERMOD calculated the Good Engineering Practice stack height - GEP stack height - following the recommendations of the IFC EHS guidelines. The GEP stack height is the one that avoids the creation of downwash effects. For the case of YCCPP-2, the GEP stack height is of 66 meters.

5.4 ADC Results

This Section contains the results of the simulations performed with BREEZE AERMOD for each of the pollutants CO and NO₂ for all the different averaging periods for which the applicable standards are defined.

The results are presented in the form of:

- Tables showing the **maximum simulated ground level concentrations** (GLC) in the assessment area for all scenarios. The respective comparison with the Air Quality Standards is made. The tables show in addition the percentage of the AQS which the maximum GLC represent.
- **Plot maps** of the maximum simulated GLC for selected outputs.

It is **important to note** that the results shown represent maximum GLC. The maximum GLC are expected in different times and locations for each scenario. This implies that there is not a direct correlation between the maximum GLCs simulated for the three scenarios.

As explained in Section 3.2, to assess compliance with national requirements only the short-time MACs are evaluated (the short time MAC for CO is 5,000 µg/m³ and for NO₂ is 200 µg/m³). On the other hand, to assess compliance with international requirements, the fulfillment of all defined applicable AQS is assessed.

5.4.1 CO - Short-time MAC

The national legislation defines a short-time MAC for CO of 5,000 µg/m³. A definition of “short-time” is given in the national legislation as a 2 hours period. In this study the comparison is made with the simulated 1-hour values. The ECD does not define a 1-hour AQS for CO.

The comparison of the model results with the national MAC shows that the MAC is expected to be respected throughout the entire assessment area in all scenarios for all stack heights (Table 5-1). The contribution of YCCPP-2 represents less than 25% of the applicable AQS (i.e., 1.9% for 35 meters stack, 1.8% for 43 meters stack, and 1.1% for 66 meters stack), being in line with IFC’s recommendation for a future sustainable development in the area.

Time period	CO maximum modeled GLC [µg/m ³]			Air Quality Standards [µg/m ³]	
	Stack YCCPP-2: 35 m (original design)	Stack YCCPP-2: 43 m (alternative design)	Stack YCCPP-2: 66 m (GEP stack height)	National MAC	ECD
Indicative SCENARIO A - Only YCCPP-1					
1 hour / Short time	2.0	2.0	2.0	5,000	-
SCENARIO B - Only YCCPP-2					
1 hour / Short time	92.5	88.5	53.9	5,000	-
	<i>% of the AQS: 1.9%</i>	<i>% of the AQS: 1.8%</i>	<i>% of the AQS: 1.1%</i>		
Indicative SCENARIO C - YCCPP-1 + YCCPP-2					
1 hour / Short time	93.9	89.9	55.2	5,000	-

Standard is not exceeded
 Standard is exceeded

Table 5-1: Maximum simulated 1 hr CO GLC and comparison with the air quality standards

The concentration plots for the simulation of the Scenario C with a 66 meters stack (Figure 5-1 and Figure 5-2) show that the higher values are found in the areas to the east and southeast of the power plants’ area. All the high values are below the AQS.

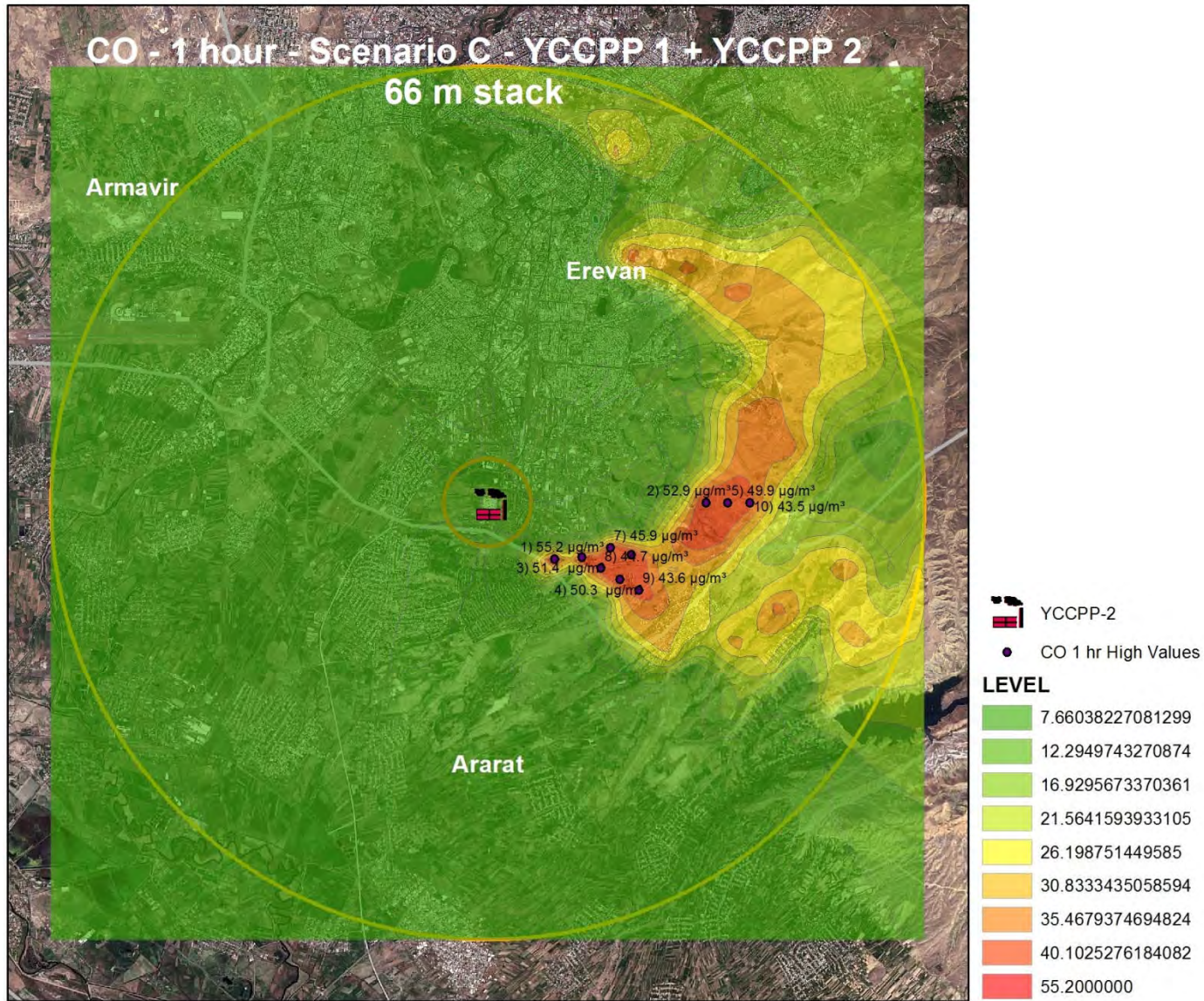


Figure 5-1: Maximum simulated 1 hr CO GLC - indicative cumulative effects - YCCPP-1 + YCCPP-2

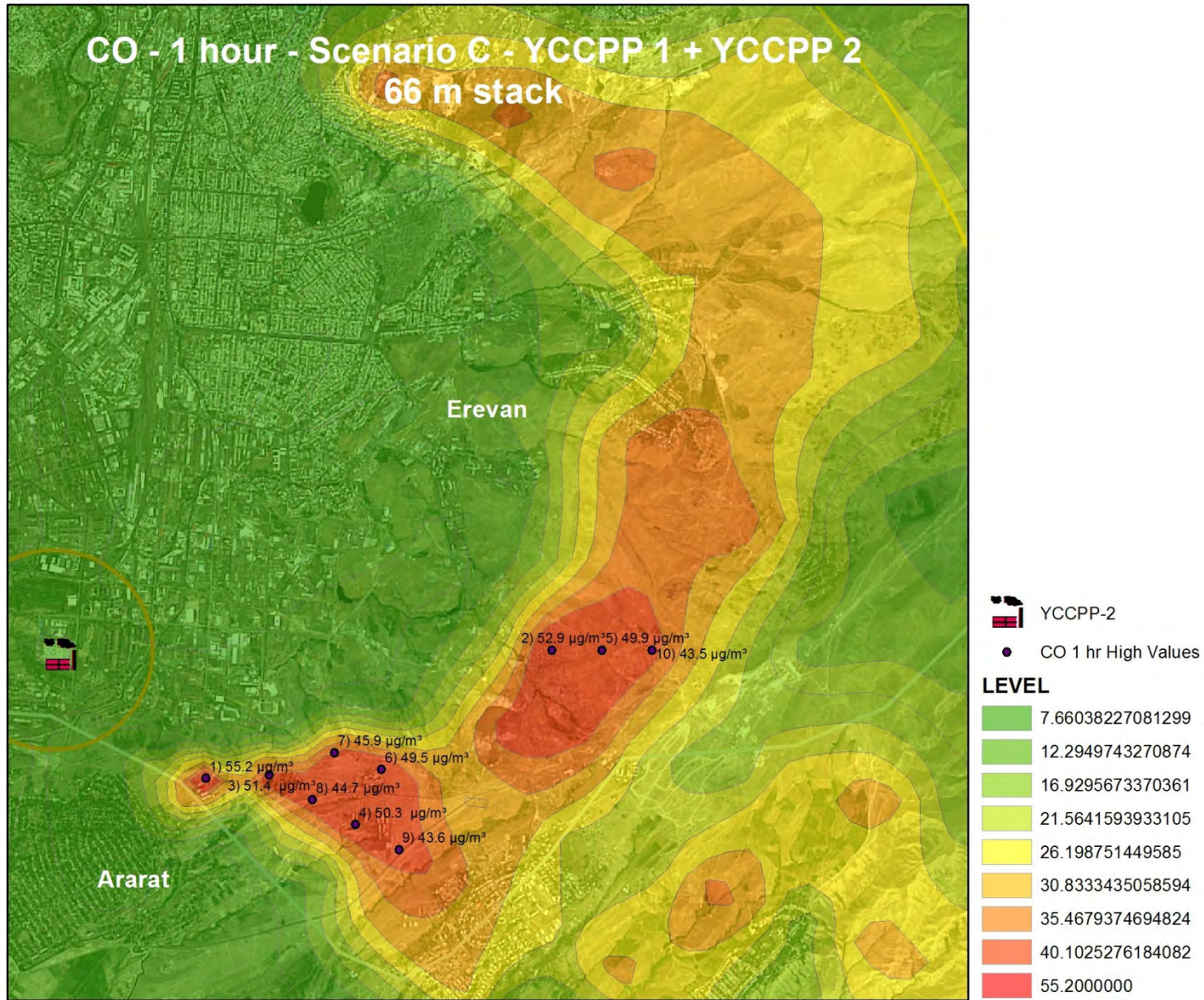


Figure 5-2: Maximum simulated 1 hr CO GLC - indicative cumulative effects - YCCPP-1 + YCCPP-2 - closer view of the higher values

5.4.2 CO - 8 hours International AQS

The ECD defines an 8-hours air quality standard for CO, unlike the Armenian legislation. The model results (Table 5-2) show that no difficulties are expected regarding fulfillment of this standard in any of the scenarios.

The contribution of YCCPP-2 represents less than 25% of the applicable AQS for all stack heights (i.e., 0.6% and 0.3%), being in line with IFC's recommendation for a future sustainable development in the area.

Time period	CO maximum modeled GLC [$\mu\text{g}/\text{m}^3$]			Air Quality Standards [$\mu\text{g}/\text{m}^3$]	
	Stack YCCPP-2: 35 m (original design)	Stack YCCPP-2: 43 m (alternative design)	Stack YCCPP-2: 66 m (GEP stack height)	National MAC	ECD
Indicative SCENARIO A - Only YCCPP-1					
8 hours	0.98	0.98	0.98	-	10,000
SCENARIO B - Only YCCPP 2					
8 hours	59.5	57.8	30.9	-	10,000
	% of the AQS: 0.6%	% of the AQS: 0.6%	% of the AQS: 0.3%		
Indicative SCENARIO C - YCCPP-1 + YCCPP 2					
8 hours	60.3	58.6	31.8	-	10,000

Standard is not exceeded
 Standard is exceeded

Table 5-2: Maximum simulated 8 hr CO GLC and comparison with the air quality standards

The concentration plots for Scenario C (66 meters stack height) (Figure 5-3 and Figure 5-4) show that the absolute cumulative maximum of $31.8 \mu\text{g}/\text{m}^3$ is found in the areas to the east and southeast of the power plants' area. All the high values are below the AQS.

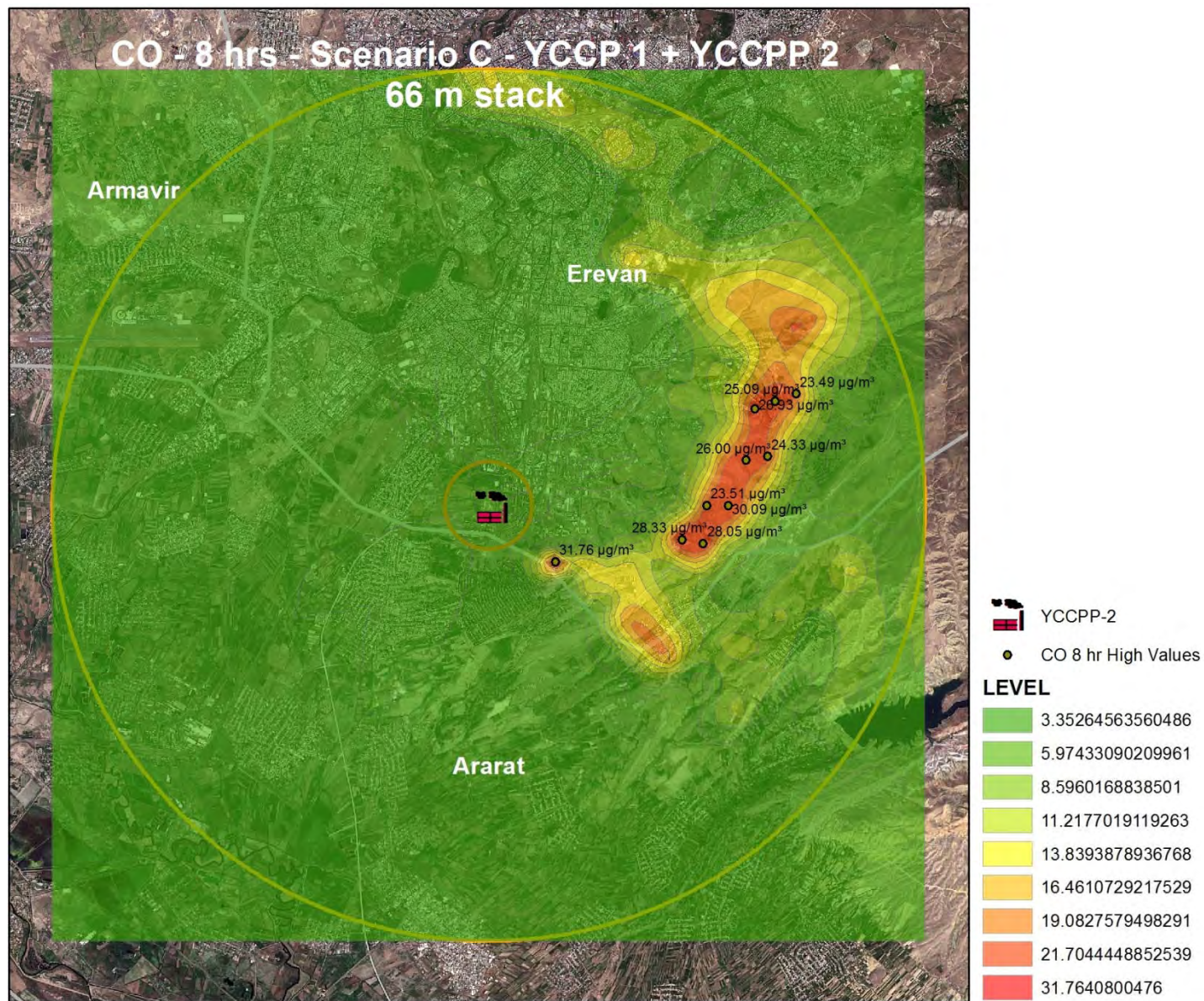


Figure 5-3: Maximum simulated 8 hr CO GLC - indicative cumulative effects - YCCPP-1 + YCCPP 2

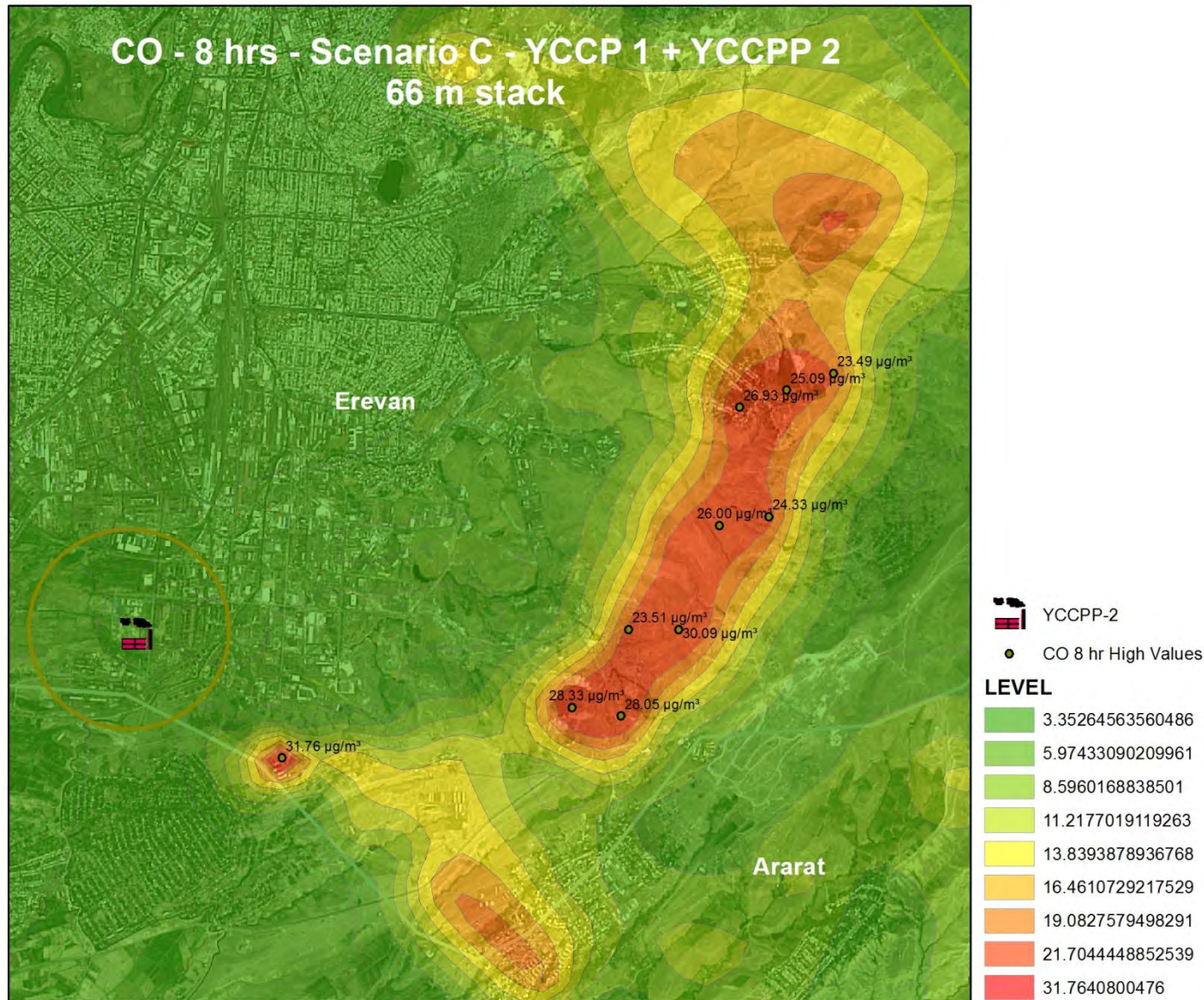


Figure 5-4: Maximum simulated 8 hr CO GLC - indicative cumulative effects - YCCPP-1 + YCCPP-2 - closer view of the higher values

5.4.3 NO₂ - Short-time MAC and 1 hour International AQS

The national legislation defines a short-time MAC for NO₂ of 200 µg/m³. A definition of “short-time” is given in the national legislation as a 2 hours period. In this study the comparison is made with the simulated 1-hour values. The ECD defines a 1 hour standard of 200 µg/m³ for NO₂.

Table 5-4 shows that the maximum modeled 1 hr NO₂ GLCs are expected to be below the national and the international standards throughout the entire assessment area for all scenarios and all stack heights.

The results of Scenario B show that the effect of YCCPP-2 is expected to represent more than 25% of the standards for a 35 meters stack (i.e., 38.5%) and for a 43 meters stack (i.e. 36.7%), but less than 25% of the standards for a 66 meters stack. In other words, if the power plant is built with a GEP stack height, the IFC recommendation for a future sustainable development in the area is respected.

Time period	NO ₂ maximum modeled GLC [µg/m ³]			Air Quality Standards [µg/m ³]	
	Stack YCCPP-2: 35 m (original design)	Stack YCCPP-2: 43 m (alternative design)	Stack YCCPP-2: 66 m (GEP stack height)	National MAC	ECD
SCENARIO A - Baseline data					
1 hour / Short time	40.0 - 53.2	40.0 - 53.2	40.0 - 53.2	200	200 18 times/year
SCENARIO B - Only YCCPP-2					
1 hour / Short time	77	73.5	44.7	200	200 18 times/year
	% of the AQS: <i>38.5%</i>	% of the AQS: <i>36.7%</i>	% of the AQS: 22.3%		
SCENARIO C - Cumulative impacts					
1 hour / Short time	127.0 - 130.2	113.5 - 126.7	84.7 - 97.9	200	200 18 times/year

Standard is not exceeded
 Standard is exceeded

Table 5-3: Maximum simulated 1 hr NO₂ GLC and comparison with the air quality standards

Figure 5-5 (overview) and Figure 5-6 (close-up) show the maximum concentration plots for Scenario B with a 66 meters stack height. The plots show that the higher values are expected to be found in the industrial and residential areas to the east and to the southeast of the YCCPP-1 and 2. These higher values are, however, below the national MAC and the international AQS.

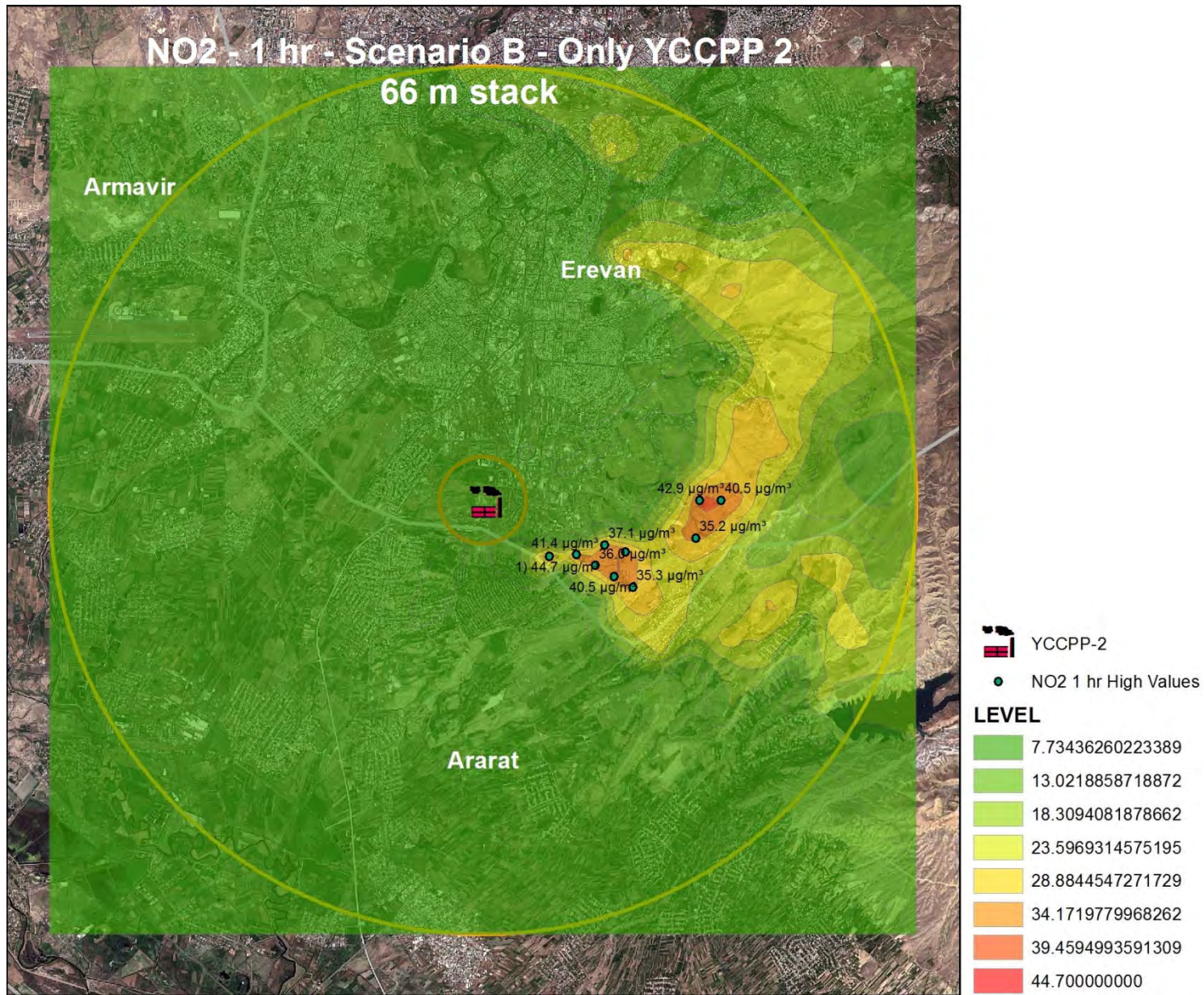


Figure 5-5: Maximum simulated 1 hr NO₂ GLC - Scenario B - YCCPP 2 only

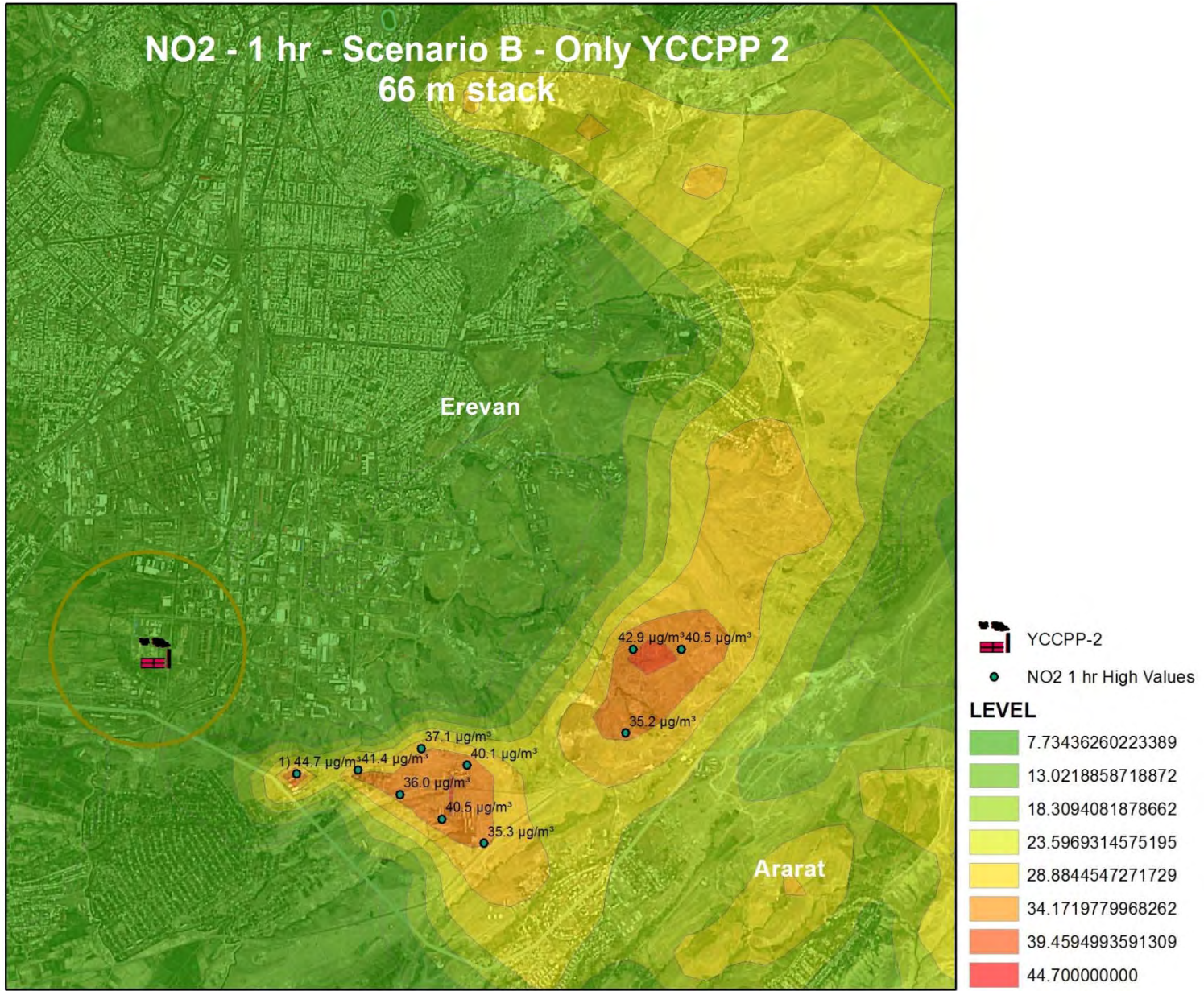


Figure 5-6: Maximum simulated 1 hr NO₂ GLC - Scenario B - YCCPP 2 only- closer view of the higher values

5.4.4 NO₂ - Annual International AQS

The predicted annual NO₂ values in the project area are very low. The comparison with the applicable air quality standard (only ECD) reveals that this is not expected to be exceeded (Table 5-4).

The maximum increment in the NO₂ annual mean represents far less than 25% of the ECD AQS, which respects IFC's dispositions regarding future sustainable development in the area.

Time period	NO ₂ maximum modeled GLC [$\mu\text{g}/\text{m}^3$]			Air Quality Standards [$\mu\text{g}/\text{m}^3$]	
	Stack YCCPP-2: 35 m (original design)	Stack YCCPP-2: 43 m (alternative design)	Stack YCCPP-2: 66 m (GEP stack height)	National MAC	ECD
SCENARIO A - Baseline data					
1 year	3.2 - 4.3	3.2 - 4.3	3.2 - 4.3	-	40
SCENARIO B - Only YCCPP 2					
1 year	1.0	1.0	0.8	-	40
	% of the AQS: 2.5%	% of the AQS: 2.5%	% of the AQS: 2.0%		
SCENARIO C - Cumulative impacts					
1 year	4.2 - 5.3	4.2 - 5.3	4.0 - 5.1	-	40
 Standard is not exceeded Standard is exceeded					

Table 5-4: Maximum simulated annual NO₂ GLC and comparison with the air quality standards

Figure 5-7 and Figure 5-8 show the maximum GLC plots for Scenario B (only YCCPP-2) for a 66 meters stack. The plots show that the maximum GLC are expected very close to the power plant. These maximum GLC are below the applicable standard.

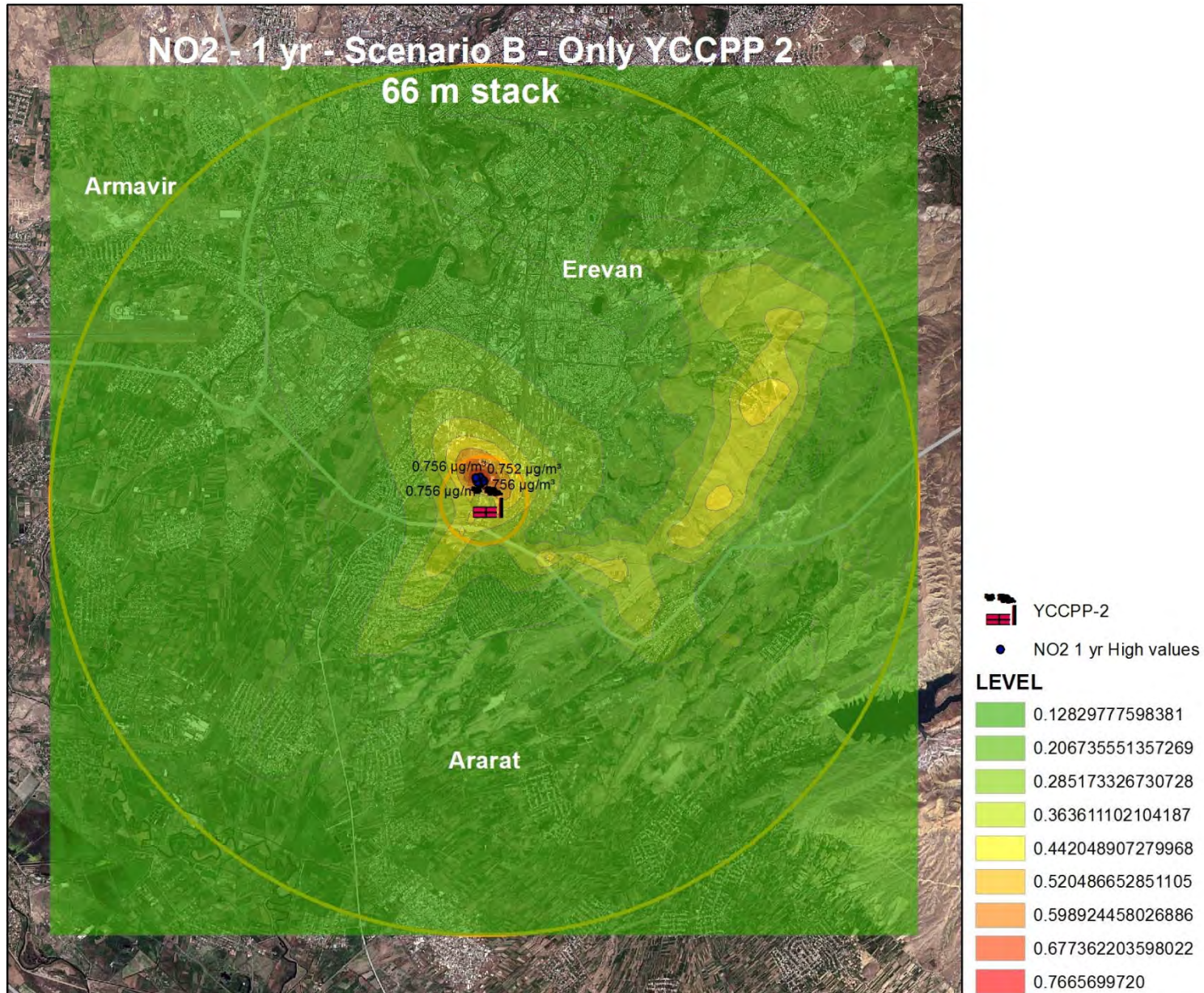


Figure 5-7: Maximum simulated 1 yr NO₂ GLC - Scenario B - YCCPP 2 only

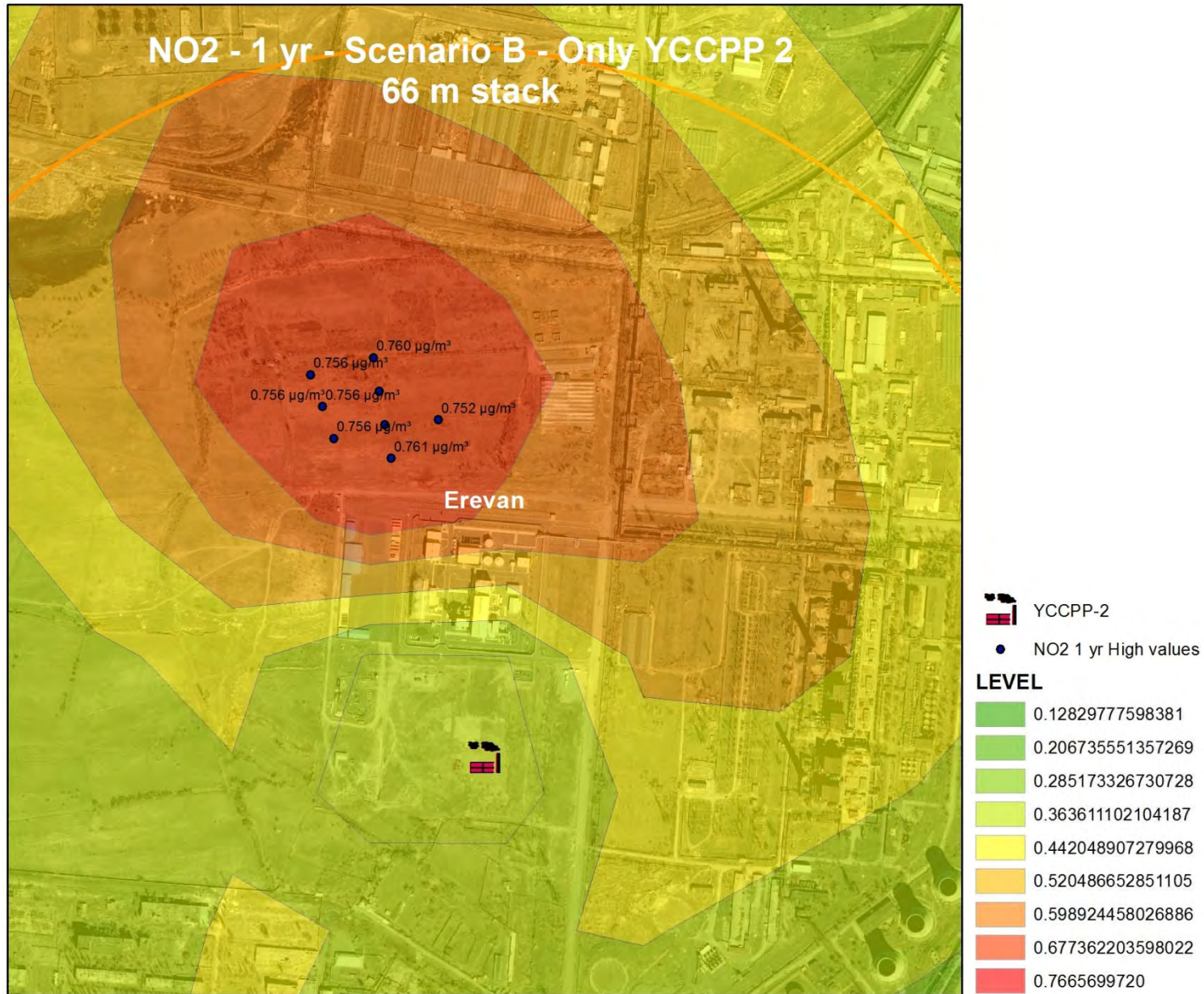


Figure 5-8: Maximum simulated 1 yr NO₂ GLC - Scenario B - YCCPP 2 only - closer view of the higher values

6. Summary of the results

The present ADC allows understanding what is the expected impact of the YCCPP-2 on the airshed of Yerevan.

In respect for international requirements, it is important to understand the quality of the airshed before the project is implemented (**baseline**). Only considering the baseline it is possible to understand the **cumulative impact** of the project. Baseline data have been collected in Summer 2017, Autumn 2017 and Winter 2017/2018 in the project area with this objective. They show that the airshed in the area is non-degraded.

Altogether **3 scenarios** were simulated:

- Baseline scenario, or **Scenario A**;
- Project scenario, or **Scenario B**;
- Cumulative scenario, or **Scenario C**.

Each of the scenarios was simulated for a stack height of **35 meters** (design), for a stack height of **43 meters** (alternative), and for a stack height of **66 meters** (alternative 2, or Good Engineering Practice (GEP) stack height). To keep up with best international practice, the YCCPP-2 will be built with a 66 m stack height.

The simulation of **CO** shows that all applicable international and national air quality standards are foreseen to be fulfilled in the area in all scenarios for all stack heights.

The maximum simulated GLCs of CO derived from the operation of YCCPP-2 only (Scenario B) represent less than 25% of all applicable air quality standards for all scenarios and for all stack heights investigated.

The maximum modeled **NO₂** GLCs are expected to be below the national and the international AQS throughout the entire assessment area for all scenarios and for all stack heights.

The maximum modeled NO₂ 1 hr GLC as a result of the operation of YCCPP-2 only (Scenario B) represent less than 25% of the applicable standards only when considering a stack height of 66 meters. The annual GLC of NO₂ is kept below 25% of the applicable standards for all stack heights.

7. Conclusion

The ADC presents the simulation of the individual impact and the cumulative impact of the YCCPP-2 on the surrounding airshed. The results show that the national and international air quality standards for CO and NO₂ are expected to be fulfilled in all cases.

The fulfillment of IFC's specific requirements for a future sustainable development in the area is only achieved if a stack height of 66 meters is built (GEP stack height). The Client has committed to implement this measure into the design.

8. References

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9. Annexes

9.1 Annex 1: PM₁₀ Baseline Studies



Project: Environmental and Social Impact Assessment for a Combined Cycle Power Plant - Yerevan 2

Project №: 8559P01

Noise and PM10 Baseline Study

Report

Rev01

**Prepared for
Fichtner GmbH & Co. KG**

**Prepared by
"ATMS Solutions" Ltd.**

August, 2017

Noise and PM10 Baseline Study Report

Rev01

Contents

1. Introduction.....3

2. Objective of the Study4

3. Measurement Methodology and Equipment.....4

3.1 Measuring Equipment and Software4

3.1.1 Noise Measurement.....4

3.1.2 PM10 Measurement.....5

4. Normative Framework5

4.1 Sanitary Norms for Noise5

4.2 Environmental Norms for Dust6

5. Description of Measurement Points.....6

6. Measurement Results and Evaluation 11

Main Conclusions..... 15

ANNEX 1. Map of measurement points..... 16

ANNEX 2. Verification documents of measuring devices 17

Noise and PM10 Baseline Study Report

Rev01

1. Introduction

Within the Main Contract between ARMPOWER SJSC (hereinafter - Client) and Fichtner GmbH & Co. KG (hereinafter - Employer) the latter has signed a subcontractor agreement with ATMS Solutions Ltd. (hereinafter - Contractor) to conduct the following tasks:

- Task I. Noise measurements
- Task II. PM10¹ measurements
- Reporting.

Noise and PM10 measurement points have been selected by the Employer and presented in [Annex 1](#). Quantities, durations and times (day-time / night-time) of noise and PM10 measurements were also defined by the Employer and presented below in [Table 1](#).

Table 1. Measurement pre-conditions

Measurement point	Measuring parameters	Time of measurement	Quantity, measurements	Duration	Total quantity, measurements
Noise measurements					20
Work-day					10
Noise 1	Noise, wind speed	Day-time/	1	1 hour	2
	Noise, wind speed	Night-time	1	1 hour	
Noise 2	Noise, wind speed	Day-time	1	1 hour	2
	Noise, wind speed	Night-time	1	1 hour	
Noise 3	Noise, wind speed	Day-time	1	1 hour	2
	Noise, wind speed	Night-time	1	1 hour	
Noise 4	Noise, wind speed	Day-time	1	1 hour	2
	Noise, wind speed	Night-time	1	1 hour	
Noise 5	Noise, wind speed	Day-time	1	1 hour	2
	Noise, wind speed	Night-time	1	1 hour	
Weekend					10
Noise 1	Noise, wind speed	Day-time	1	1 hour	2
	Noise, wind speed	Night-time	1	1 hour	
Noise 2	Noise, wind speed	Day-time	1	1 hour	2
	Noise, wind speed	Night-time	1	1 hour	
Noise 3	Noise, wind speed	Day-time	1	1 hour	2
	Noise, wind speed	Night-time	1	1 hour	
Noise 4	Noise, wind speed	Day-time	1	1 hour	2
	Noise, wind speed	Night-time	1	1 hour	
Noise 5	Noise, wind speed	Day-time	1	1 hour	2
	Noise, wind speed	Night-time	1	1 hour	
PM10 measurements					75
Air 1	PM10, temperature, RH ²	Day-time	5 x 5 ³	5 min ⁴	25
Air 2	PM10, temperature, RH	Day-time	5 x 5	5 min	25
Air 3	PM10, temperature, RH	Day-time	5 x 5	5 min	25

¹ Particle matters with 10 µm size

² Relative humidity

³ 5 measurements per day during the 5 days

⁴ 5 minutes for each measurement

Noise and PM10 Baseline Study Report

Rev01

2. Objective of the Study

The objective of the Study is to conduct instrumental measurements of noise levels and PM10 concentrations at the points around the Yerevan 2 Power Plant, which are expected to be impacted during the construction and operation stages. The measurement points have been selected by the Employer (see [Annex 1](#)). The study results should be reported to the Employer.

This Noise and PM10 Baseline Study Report (hereinafter - Study Report) provides an overview of the measurement process and equipment, description of the measurement (sensitive) points, noise and dust (PM10) national sanitary standards, a quantitative analysis, assessment of measurement results and main conclusions. The instrumental measurements were conducted between the 27.07.2017-05.08.2017 at five 5 noise and 3 air sensitive points.

3. Measurement Methodology and Equipment

3.1 Measuring Equipment and Software

3.1.1 Noise Measurement

Instrumental measurements of noise levels are performed using a Sound Level Meter (SLM) "WS1361". The SLM consists of a microphone, electronic circuits and a readout display. The microphone detects the small air pressure variations associated with sound and transforms them into electrical signals. Afterwards, these signals are processed by the electronic circuitry of the instrument. The readout displays the sound level in decibels. The duration of each noise measurement is 1 hour.

The SLM has SLOW and FAST response options. The response rate is the time period over which the instrument averages the sound level before displaying it on the readout. Usually measurements of background noise are taken in the SLOW response mode.

Data on the State verification, as well as technical characteristics of the Sound level meter are listed in Verification certificate that presented in [Annex 2](#). The verification date of the device is 16.05.2017. It is valid until 16.05.2018.

The SLM has the following technical characteristics:

- Measurement range: 30÷130 dB (sub-ranges: 30÷80, 40÷90, 50÷100, 60÷110, 70÷120, 80÷130, 30÷130),
- Frequency Range: 31.5÷8500 Hz,
- Accuracy: ±1.5 dB.

In order to ensure continuous measurements over a certain period of time and further analysis of the results, the SLM WS1361 is connected to a tablet. The special software installed in the tablet allows to record noise levels with one second frequency and provides complete information on the noise level (both in digital imaging and as a graph), including the minimum, maximum and average values of the sound level.

The wind speed during the noise measurements have been determined by the Microclimate parameters measuring device "Meteoscop". Data on the State verification, as well as technical characteristics of "Meteoscop" are listed in Verification certificate (see [Annex 2](#)) and summarized below:

- Measurement range of wind speed: 0.1~20 m/sec,
Accuracy: ±(0.05+0.05V), if wind speed is up to 1m/sec and ±(0.1+0.05V), if wind speed is between 1÷20m/sec,

Noise and PM10 Baseline Study Report

Rev01

- Measurement range of temperature: between -10 and +50°C, Accuracy: ± 0.2 ,
- Measurement range of relative humidity: between 3 and 97%, Accuracy: ± 3 ,
- The verification date of the device is 16.05.2017. It is valid until 16.05.2018.

3.1.2 PM10 Measurement

Dust concentration is measured by using of Dust particle meter DT-96. This device is equipped with 2.5um and 10um size channels to measure PM2.5 and PM10 simultaneously as well as air temperature and relative humidity. The duration of each PM10 measurement is 5 minutes. The obtained data is analyzed and compared with corresponding threshold limit value.

Technical parameters of the device are listed below:

- Concentration measurement: 0~2000 $\mu\text{g}/\text{m}^3$, resolution: 1 $\mu\text{g}/\text{m}^3$,
- Temperature range: 0~50°C, resolution: 1°C, accuracy: $\pm 0.1^\circ\text{C}$,
- Humidity Range: 0 to 100% RH, accuracy: $\pm 5\%$ RH, 0~20% RH, 80~100% RH; $\pm 3.5\%$ RH, 20~80% RH.

The verification of Dust particle meter is conducted by manufacturer on 08.08.2016 and valid till 08.08.2017 ([Annex 2](#)).

4. Normative Framework**4.1 Sanitary Norms for Noise**

Noise instrumental measurements, analysis and evaluation of results were carried out in accordance with the following regulations/standards:

- RoA Sanitary Norms №2-III-11.3 "Noise in the workplaces, in residential and public buildings and in residential construction areas" adopted by the order of RoA⁵ Minister of Health №138 on 06.03.2002,
- Guidelines for Community Noise, World Health Organization (WHO), 1999.

As criteria for determination of the conformity level of the actual noise in identified measurement points, the normative value of the equivalent (average) sound level is used, according to the RoA Sanitary Norms №2-III-11.3 "Noise in the workplaces, in residential and public buildings and housing in construction areas" as well as WHO's Guidelines for Community Noise (see [Table 2](#)).

Table 2. Threshold limit value (TLV) for noise

№	Premises and territories	Time	TLV (equivalent to sound level), dBA
1	Industrial and commercial areas ⁶	07:00-22:00 Day-time	70
		22:00-07:00 Night-time	70
2	Territories adjacent to residential buildings, clinics, ambulatories, rest houses, care homes, disabled persons homes, libraries,	06:00-22:00 Day-time	55

⁵ Republic of Armenia

⁶ Source: WHO's Guidelines for Community Noise

Noise and PM10 Baseline Study Report

Rev01

Nº Premises and territories	Time	TLV (equivalent to sound level), dBA
kinder gardens, schools and other educational facilities ⁷	22:00-06:00 Night-time	45

4.2 Environmental Norms for Dust

The PM10 measurements were conducted and evaluated in accordance with the following normative documentation acting in the Republic of Armenia:

- GOST 17.2.4.05-83. "Environmental protection. Atmosphere. Gravimetric method for determination of suspended dust particles",
- RoA Government Decree №160-N. "Norms of maximum permissible concentrations (MPC) of atmospheric air pollutants in residential areas".

The maximum permissible concentrations of PM10, including daily average values are defined by the RoA Government Decree №160-N and summarized below in [Table 3](#).

Table 3. Daily average and maximum permissible concentrations (MPC) for PM10

Nº	Name of substance	MPC (mg/ m³)	
		Max	Daily average
1	PM10	0.3	0.06

5. Description of Measurement Points

The given Study Report presents results of noise levels and PM10 concentration measurements for the points defined by the Employer (see [Annex 1](#)) and described below. Totally, 20 noise instrumental measurements were conducted at 5 points and 75 PM10 measurements were carried out at 3 points.

Noise 1, Air 2

Measurement points Noise 1 and Air 2 are placed approx. 1700m to the south-west from the CCPP Yerevan-2 site. These points are located near the northeast border of Ayntap community between the cemetery and private cultivated garden (see [Figures 1, 2](#)).

Noise 2

Measurement point Noise 2 is situated at the distance of approx. 1750m to the west from the CCPP Yerevan-2 site. The point Noise 2 is located on the eastern border of Noragavit settlement in front of the highway, connecting the capital Yerevan with the M2 roadway (see [Figure 3](#)).

Noise 3 and Noise 5

Measurement points Noise 3 and Noise 5 are located in Kharberd horticultural settlement. Both points are situated along the northern border of the settlement. Noise 5 is the closest point to the CCPP Yerevan-2 site, at the distance of approx. 1100m, while the distance between the point Noise 3 and Project site is 1500m (see [Figures 4, 5](#)).

Noise 4, Air 3

⁷ Source: Sanitary Norms № 2-III-11.3 "Noise in the workplaces, in residential and public buildings and in residential construction areas"

Noise and PM10 Baseline Study Report

Rev01

Measurement points Noise 4 and Air 3 are placed in industrial area near the northern border of the CCPP Yerevan-2 site (see [Figures 6, 7](#)).

Air 1

Measurement point Air 1 is situated in industrial area near the southeast border of current Yerevan-1 thermal power plant, between the fire brigade and abandoned production facility (see [Figure 8](#)).

Figure 1. Measurement process at point Noise 1**Figure 2. Measurement process at point Air 2**

Noise and PM10 Baseline Study Report

Rev01

Figure 3. Measurement process at point Noise 2



Figure 4. Measurement process at point Noise 3



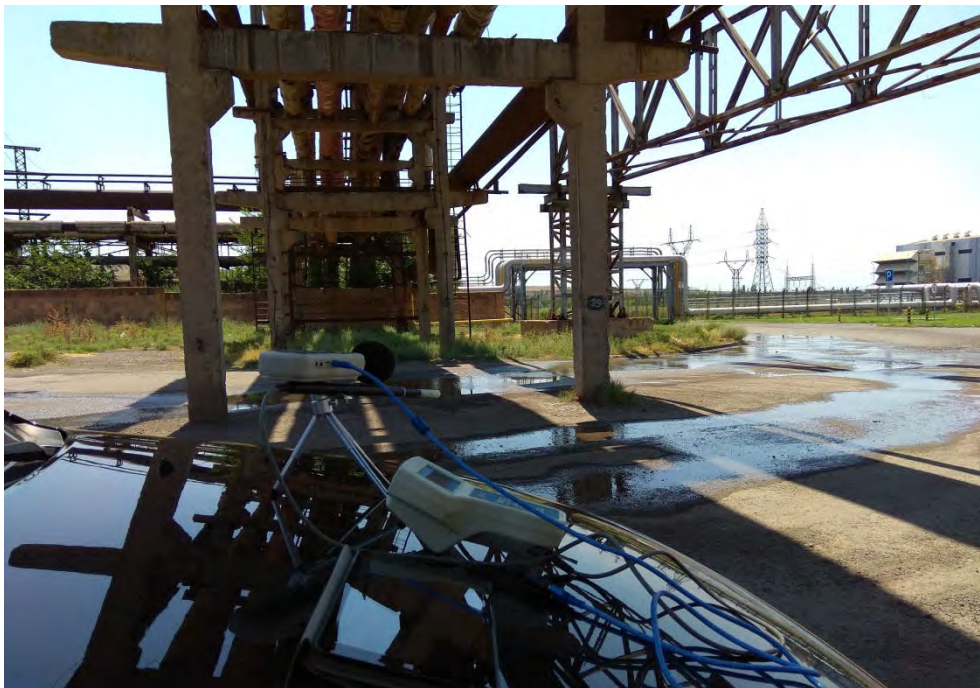
Noise and PM10 Baseline Study Report

Rev01

Figure 5. Measurement process at point Noise 5



Figure 6. Measurement process at point Noise 4



Noise and PM10 Baseline Study Report

Rev01

Figure 7. Measurement process at point Air 3



Figure 8. Measurement process at point Air 2



Noise and PM10 Baseline Study Report

Rev01

6. Measurement Results and Evaluation

Noise and PM10 measuring results are summarized in Table 4 (for noise) and Table 5 (for PM10) correspondingly. Diagrams, demonstrating equivalent noise levels at measurement points compared with the TLV are shown in Figures 9-11. Diagrams of PM10 actual concentrations in comparison with the MPCs (maximum and daily average) are presented in Figures 12-14.

Table 4. Results of noise measurement

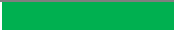














Point of measurement	Wind speed (m/s)	Time of measurement	Leq(A), dB(A)	TLV (equivalent to sound level), dB(A)	Compliance
Work-day					
Noise 1	< 1.7	Day-time	49.8	55	
	< 1.8	Night-time	47.1	45	
Noise 2	< 1.9	Day-time	72.6	55	
	< 2.3	Night-time	62.4	45	
Noise 3	< 1.8	Day-time	48.1	55	
	< 1.7	Night-time	40.0	45	
Noise 4	< 1.6	Day-time	53.6	70	
	< 1.9	Night-time	57.3	70	
Noise 5	< 1.7	Day-time	36.2	55	
	< 2.0	Night-time	39.4	45	
Weekend					
Noise 1	< 1.5	Day-time	43.4	55	
	< 2.1	Night-time	49.0	45	
Noise 2	< 1.8	Day-time	72.8	55	
	< 2.5	Night-time	59.2	45	
Noise 3	< 1.9	Day-time	43.9	55	
	< 2.0	Night-time	33.9	45	
Noise 4	< 1.8	Day-time	56.4	70	
	< 2.0	Night-time	57.2	70	
Noise 5	< 1.5	Day-time	35.6	55	
	< 1.8	Night-time	34.2	45	

Table 5. Results of PM10 measurement

Point of measurement	Temperature, °C	Relative humidity, %	PM10, mg/ m ³	MPC max, mg/ m ³	MPC daily average, mg/ m ³	Compliance
30.07.2017						
Air 1	38	20	0.014	0.3	0.06	
	38	21	0.011			
	38	20	0.01			
	39	19	0.01			
	38	19	0.011			
Air 2	39	22	0.02	0.3	0.06	
	39	20	0.041			
	39	20	0.021			
	39	21	0.021			
Air 3	38	20	0.019	0.3	0.06	
	38	22	0.022			
	38	21	0.017			
	39	21	0.013			
	39	20	0.013			
01.08.2017	38	19	0.016	0.3	0.06	
	37	22	0.013			
	37	21	0.01			
	38	21	0.011			
	38	19	0.012			
Air 1	38	21	0.014	0.3	0.06	
	38	21	0.014			

Noise and PM10 Baseline Study Report

Rev01

Point of measurement	Temperature, °C	Relative humidity, %	PM10, mg/ m ³	MPC max, mg/ m ³	MPC daily average, mg/ m ³	Compliance
Air 2	38	20	0.02	0.3	0.06	
	39	19	0.016			
	39	19	0.018			
	39	20	0.019			
	39	21	0.02			
Air 3	37	23	0.027	0.3	0.06	
	38	21	0.023			
	38	20	0.011			
	39	20	0.016			
	38	21	0.025			
02.08.2017						
Air 1	38	20	0.014	0.3	0.06	
	38	21	0.011			
	39	21	0.017			
	39	20	0.01			
	37	22	0.009			
Air 2	39	20	0.02	0.3	0.06	
	40	18	0.018			
	39	19	0.017			
	40	19	0.017			
	39	21	0.02			
Air 3	39	21	0.042	0.3	0.06	
	39	22	0.037			
	39	20	0.031			
	38	19	0.023			
	38	20	0.027			
03.08.2017						
Air 1	37	20	0.013	0.3	0.06	
	38	21	0.009			
	38	21	0.01			
	39	20	0.011			
	39	19	0.009			
Air 2	38	23	0.013	0.3	0.06	
	39	22	0.01			
	39	19	0.011			
	39	20	0.012			
	39	20	0.014			
Air 3	38	19	0.009	0.3	0.06	
	38	20	0.011			
	39	20	0.012			
	38	19	0.013			
	38	19	0.012			
05.08.2017						
Air 1	38	20	0.012	0.3	0.06	
	39	21	0.01			
	39	20	0.012			
	39	18	0.011			
	38	19	0.011			
Air 2	37	22	0.011	0.3	0.06	
	38	21	0.019			
	38	22	0.013			
	39	19	0.036			
	38	19	0.01			
Air 3	37	23	0.009	0.3	0.06	
	39	22	0.008			
	39	19	0.014			
	39	19	0.012			
	38	20	0.012			

Noise and PM10 Baseline Study Report

Rev01

Figure 9. Diagram of noise equivalent levels at measurement points located in/ near the residential areas compared with the TLV in day-time

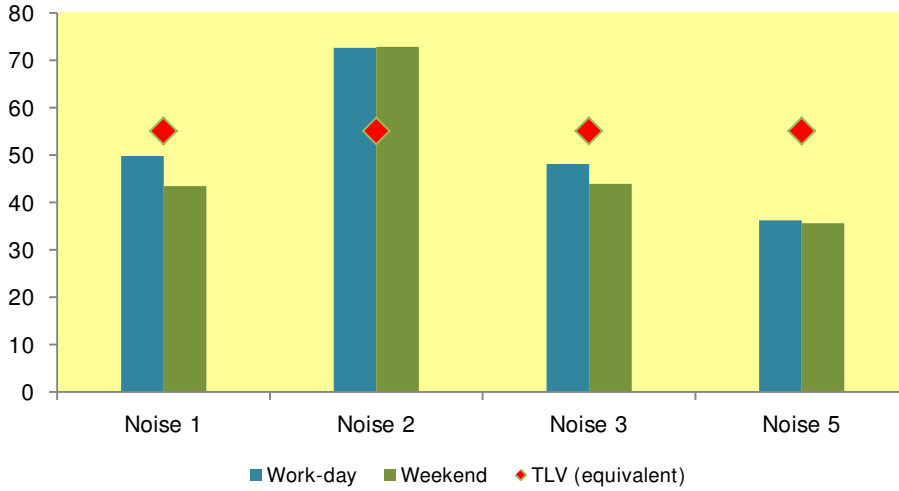


Figure 10. Diagram of noise equivalent levels at measurement points located in/ near the residential areas compared with the TLV in night-time

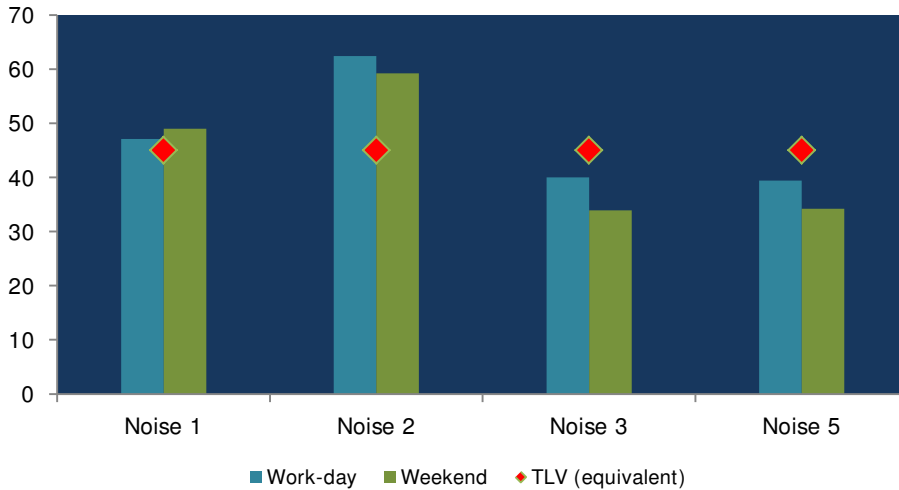
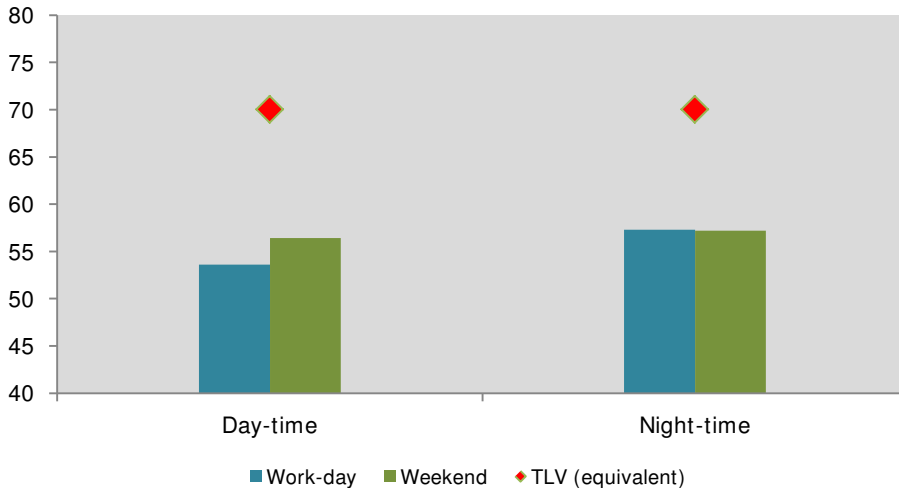


Figure 11. Diagram of noise equivalent level at measurement point Noise 4 (located in industrial area) compared with the TLV



Noise and PM10 Baseline Study Report

Rev01

Figure 12. Diagrams of PM10 actual concentrations at point Air 1 compared with the MPC (max and daily average)

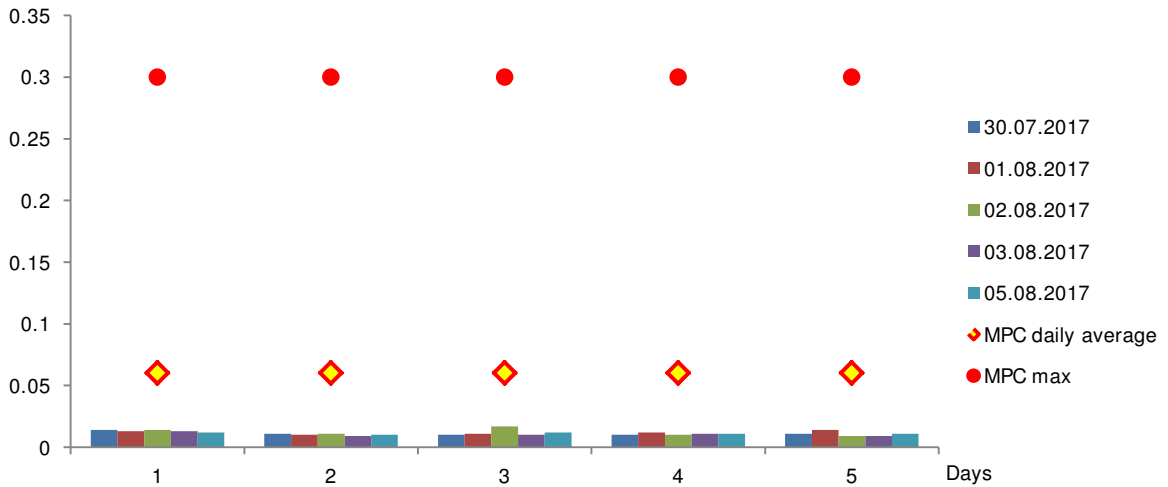


Figure 13. Diagrams of PM10 actual concentrations at point Air 2 compared with the MPC (max and daily average)

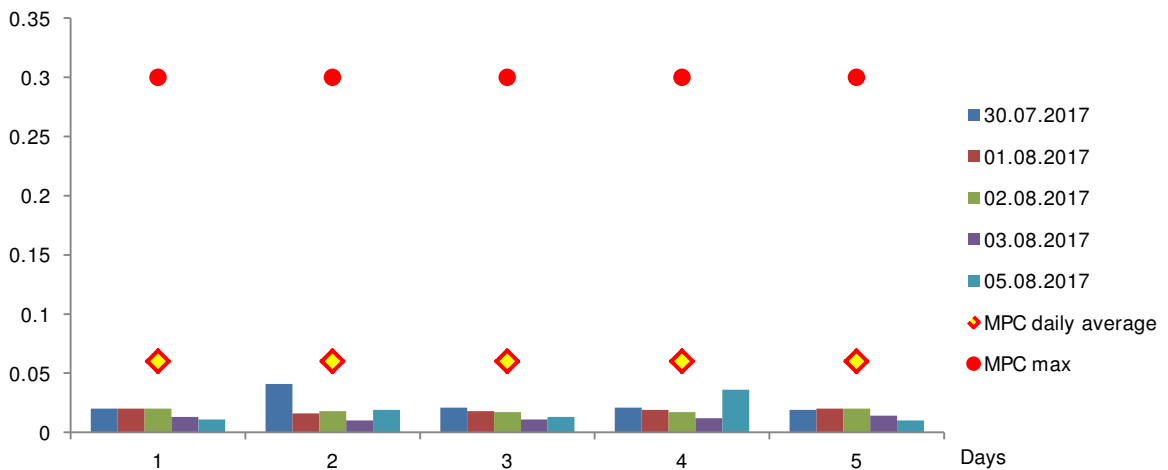
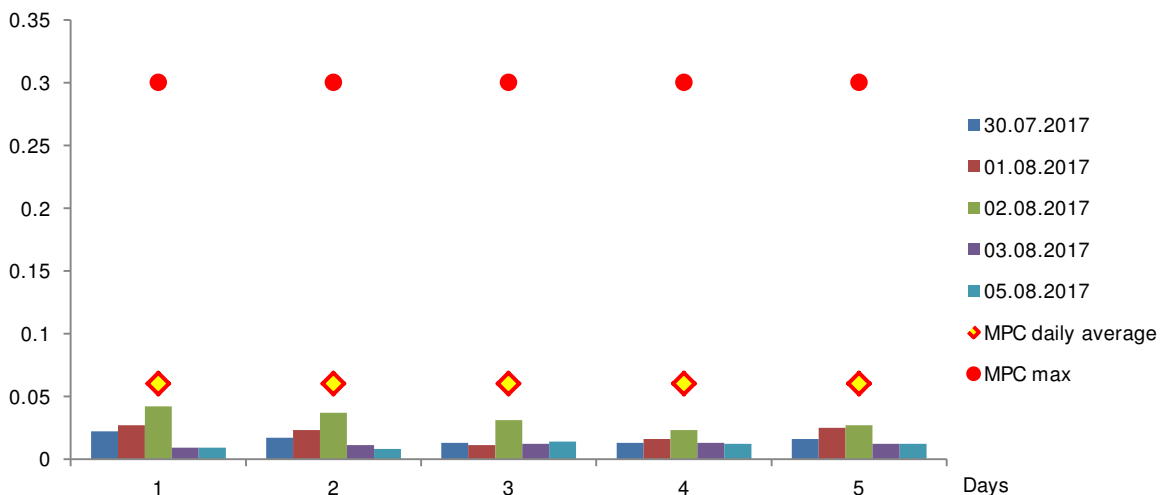


Figure 14. Diagrams of PM10 actual concentrations at point Air 3 compared with the MPC (max and daily average)



Noise and PM10 Baseline Study Report

Rev01

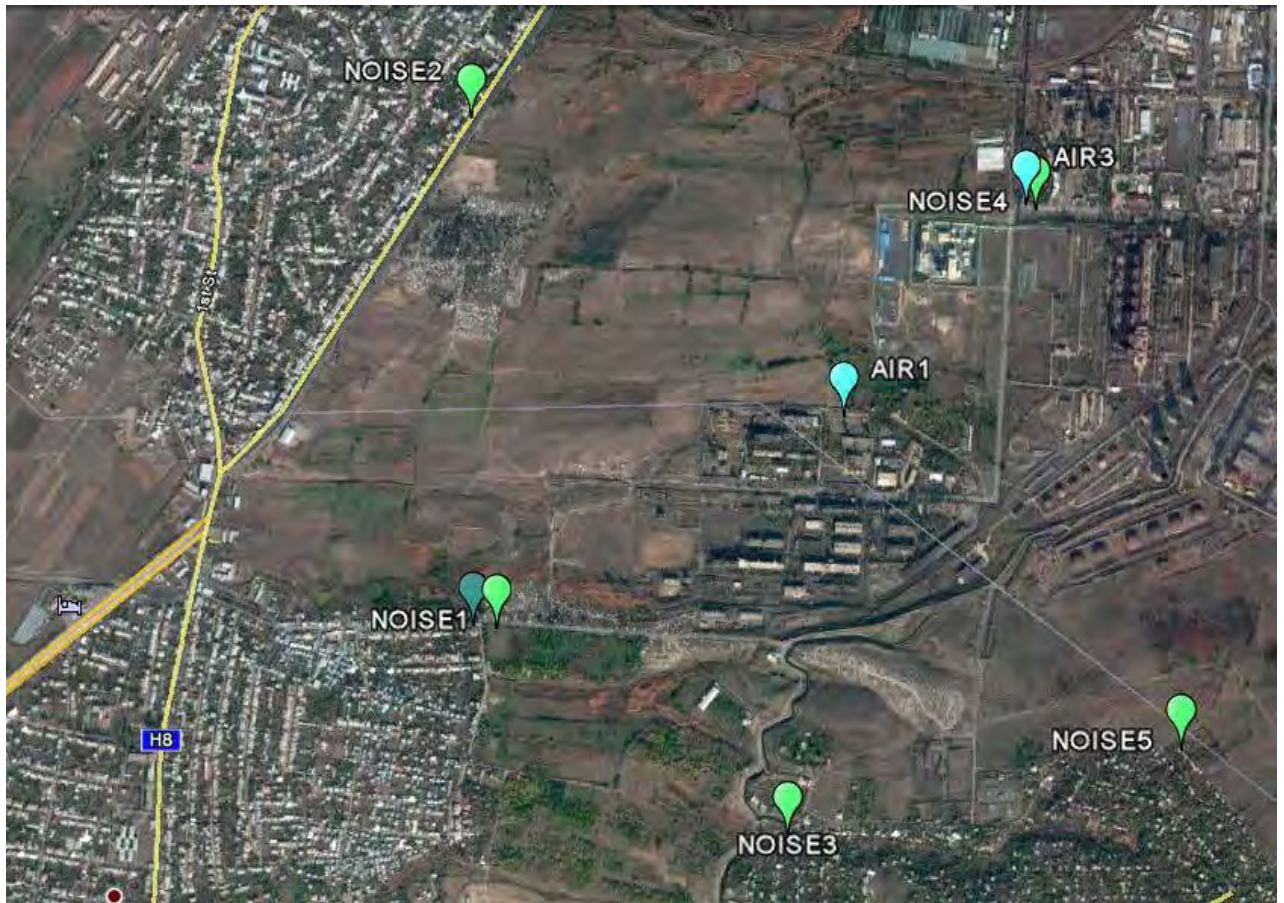
Main Conclusions

- 1) During the study totally 20 noise measurements were conducted at 5 selected points, which means that 4 measurements were carried out at each point, including work-day and weekend day measurements at day-time and night-time.
- 2) As TLVs for evaluation of noise actual levels at measurement points in/near the residential areas (points: Noise 1, Noise 2, Noise 3 and Noise 5) 55 dBA and 45 dBA as equivalent noise levels for day-time and night-time correspondingly have been applied. For the measurement point Noise 4 (located in industrial area) 70 dBA TLV is applied.
- 3) Day-time noise evaluation
Based on the noise measurement results conducted during work-days and weekend days, it can be concluded that noise equivalent levels in/near the residential areas were generally within the TLV (Noise 1, Noise 3 and Noise 5), except the point Noise 2 (located in front of the highway), where the noise level exceeded the 55 dBA normative value (see [Figure 9](#)). This can be explained by the movement of heavy vehicles and high traffic density along the highway (see [Figure 3](#)).
- 4) Night-time noise evaluation
Equivalent noise levels during work-days and weekend days at measurement points Noise 3 and Noise 5 are within the 45 dBA TLV. Noise levels at point Noise 1 during both work-days and weekend days were slightly exceeding the TLV (2.1 dBA and 4 dBA accordingly). This is due to the availability of background night noise from the facilities located in the vicinities, probably from the industrial area near the CCPP site. As a result of night-time measurements, the equivalent noise level at point Noise 2 (located in front of the highway) is above the 45 dBA TLV (see [Figure 10](#)). The reason is high traffic density along the highway even at night-time.
- 5) Noise equivalent levels in industrial area near the CCPP site during work-days and weekend days, measured at day-time and night-time, are below the 70 dBA TLV (see [Figure 11](#)).
- 6) 75 instrumental measurements were conducted in 3 sensitive points (Air 1, Air 2 and Air 3) during 5 days to determine the PM10 actual concentration. 5 measurements were conducted at each point per day, which means that totally 25 PM10 measurements were carried out at each point. The results of the study were compared with PM permissible concentrations (maximal is 0.3 mg/m³ and daily average is 0.06 mg/m³).
- 7) PM10 (dust particles of 10um size) actual concentrations at all sensitive points (Air 1, Air 2 and Air 3) in different daytime periods don't exceed the daily average and maximum permissible concentrations for residential areas set by the RoA Government Decree N^o160-N "Norms of maximum permissible concentrations of atmospheric air pollutants in residential areas" (see [Figures 12-14](#)).

Noise and PM10 Baseline Study Report

Rev01

ANNEX 1. Map of measurement points



Noise and PM10 Baseline Study Report

Rev01

ANNEX 2. Verification documents of measuring devices

ՀԱՅԱՍՏԱՆԻ ՀԱՆՐԱՊԵՏՈՒԹՅԱՆ ԷԿՈՆՈՄԻԿԱՅԻ ԼԱՍԱՆԱՐԿՈՒԹՅՈՒՆ

ՉՄՓՈՒԳՆՈՒԹՅԱՆ ԱԶԳԱՅԻՆ ԽՍՏՏՈՒՑ ՓԲԸ (ՉՄՓՈՒԳՆՈՒԹՅԱՆ ԱԶԳԱՅԻՆ ԿԱՐԿՈՒՄ)

ՎԿԱՅԱԿԱՆ № 017243
ՍՏՈՒԳԱԶՈՒՄԱՆ ՄԱՍԻՆ

Ստուգաչափման րվականը 2017թ. 01 «18»
Ուժի մեջ է մինչև 2018թ. 01 «18»

Հափման միջոցի նվազագույն և առաջին
ՅՐԵԿ 431110.02 C5

Գործարանային հմ. **89670**
Չափման տիրույթը $(-10 \div 50)^\circ\text{C}; (3 \div 52) \% \text{ Հ.Կ. } (20 \div 110) \text{ մմ}$
ճշտության դասը, կարգը (սխալանքը) $\pm 0.2^\circ\text{C}; \pm 3\%; \pm 0.13 \text{ մմ}$
Արտադրողը **Վ. Մուսկյան (1 Քեմեռ 3 Ճնչանոս.)**

Պատկանում է **Էլեկտրոֆիզիկա ԱՊԸ**

Ստուգաչափման արդյունքների հիման վրա չափման միջոցը ճանաչվել է պիտանի և թույլատրվում է կիրառման:

Ստուգաչափունը կատարվել է համաձայն **ՄՈ**

Ստուգաչափող **Վ. Մուսկյան**
Դրոշմի արտատվողը
Բաժնի (լաբորատորիայի) ղեկավար **Անդրանիկ Անդրանիկյան**

Քատառված է Էկոնոմիկայի նախարարի 14.02.2013թ. թիվ 104-Ն հրամանով
Գրանցված է 77 Արդարադատության նախարարության կողմից 21.03.2013թ. թիվ 10313102

ՀԱՅԱՍՏԱՆԻ ՀԱՆՐԱՊԵՏՈՒԹՅԱՆ ԷԿՈՆՈՄԻԿԱՅԻ ԼԱՍԱՆԱՐԿՈՒԹՅՈՒՆ

ՉՄՓՈՒԳՆՈՒԹՅԱՆ ԱԶԳԱՅԻՆ ԽՍՏՏՈՒՑ ՓԲԸ (ՉՄՓՈՒԳՆՈՒԹՅԱՆ ԱԶԳԱՅԻՆ ԿԱՐԿՈՒՄ)

ՎԿԱՅԱԿԱՆ № 015617
ՍՏՈՒԳԱԶՈՒՄԱՆ ՄԱՍԻՆ

Ստուգաչափման րվականը 2017թ. 05 «16»
Ուժի մեջ է մինչև 2018թ. 05 «16»

Հափման միջոցի նվազագույն և առաջին
ՄՅ 1361

Գործարանային հմ. **ա/կ**
Չափման տիրույթը $(30 \div 130) \text{ մմ}; (345 \div 84) \text{ մմ}$
ճշտության դասը, կարգը (սխալանքը) $\pm 1,5 \text{ մմ}$
Արտադրողը
Պատկանում է **ԱԶ ԵՊ ԶՆ Արդարադատության ԱՊԸ**

Ստուգաչափման արդյունքների հիման վրա չափման միջոցը ճանաչվել է պիտանի և թույլատրվում է կիրառման:

Ստուգաչափունը կատարվել է համաձայն **ՅՈՒՏ 8.257-84**

Ստուգաչափող **Վ. Մուսկյան**
Դրոշմի արտատվողը
Բաժնի (լաբորատորիայի) ղեկավար **Վ. Մուսկյան**

Քատառված է Էկոնոմիկայի նախարարի 14.02.2013թ. թիվ 104-Ն հրամանով
Գրանցված է 77 Արդարադատության նախարարության կողմից 21.03.2013թ. թիվ 10313102





Project: Environmental and Social Impact Assessment for a Combined Cycle Power Plant - Yerevan 2

Project №: 8559P01

PM10 Assessment Report

Rev01

Time Period: Autumn 2017

**Prepared for
RENCO ARMESTATE Ltd. and Fichtner GmbH & Co. KG**

**Prepared by
"ATMS Solutions" Ltd.**

November, 2017

PM10 Assessment Report (for autumn 2017)

Rev01

Contents

1. Introduction.....	3
2. Objective of the study	3
3. Measurement methodology and equipment.....	4
4. Normative framework.....	4
4.1 Environmental norms.....	4
4.2 Wind directions	5
5. Description of measurement points/sites	6
6. Weather conditions	11
7. Measurement results and evaluation	12
Main conclusions	17
ANNEX 1. Map of measurement points.....	18
ANNEX 2. Verification documents of measuring devices	19

PM10 Assessment Report (for autumn 2017)

Rev01

1. Introduction

Based on the service provision contract dated 27 of October 2017 between RENCO ARMESTATE Ltd. (hereinafter - Client) and ATMS Solutions Ltd. (hereinafter - Contractor) the latter has engaged to conduct PM10¹ measurements at the 5 points/sites during the 5 days and elaborate PM10 assessment report for the period autumn 2017.

PM10 measurement points/sites have been selected by the Client. The map with the indication of measurement points are presented in **Annex 1**. Quantities, durations and other parameters to be monitored in parallel with the PM measurements are given below in **Table 1**.

Table 1. Measurement specification

Measurement point	Measuring parameters	Time of measurement	Quantity, measurements	Duration, minutes ²	Total quantity, measurements
PM10 measurements					125
Air 1	PM10, temperature, RH ³ , wind speed	Day-time	5 x 5 ⁴	5	25
Air 2	PM10, temperature, RH, wind speed	Day-time	5 x 5	5	25
Air 3	PM10, temperature, RH, wind speed	Day-time	5 x 5	5	25
Air 4	PM10, temperature, RH, wind speed	Day-time	5 x 5	5	25
Air 5	PM10, temperature, RH, wind speed	Day-time	5 x 5	5	25

Besides, the Contractor also should provide the Client with the wind directions (rose of wind) for the region (should be extracted from the Republic of Armenia Construction Norms II-7.01-2011 "Construction Climatology").

2. Objective of the study

The objective of the Study is:

- To conduct instrumental measurements of PM10 concentrations and other relevant parameters (RH, temperature, wind speed) at the points around the Yerevan 2 Power Plant, which are expected to be impacted during the construction and operation stages,
- To assess the compliance of the PM actual concentrations to the national environmental norms,
- To elaborate PM assessment report.

This PM10 assessment report (hereinafter - Report) provides an overview of the measurement process and equipment, description of the measurement (sensitive) points, dust (PM10) national environmental norms, a quantitative analysis, assessment of measurement results and main conclusions. The instrumental measurements were conducted between the 28.10.2017 and 04.11.2017 at 5 sensitive points.

¹ Particle matters with 10 µm size

² 5 minutes for each measurement

³ Relative humidity

⁴ 5 measurements per day during the 5 days

PM10 Assessment Report (for autumn 2017)

Rev01

3. Measurement methodology and equipment

Dust concentration is measured by using of Dust particle meter DT-96. This device is equipped with 2.5um and 10um size channels to measure PM2.5 and PM10 simultaneously as well as air temperature and relative humidity. The duration of each PM10 measurement is 5 minutes. The obtained data is analyzed and compared with corresponding threshold limit value.

Technical parameters of the device are listed below:

- Concentration measurement: 0~2000 ug/m³, resolution: 1 ug/m³,
- Temperature range: 0~50°C, resolution: 1°C, accuracy: ±0.1°C,
- Humidity Range: 0 to 100% RH, accuracy: ±5% RH, 0~20% RH, 80~100% RH; ±3.5% RH, 20~80% RH.

The wind speed during the noise measurements have been determined by the Microclimate parameters measuring device "Meteoscop". Technical characteristics of "Meteoscop" are summarized below:

- Measurement range of wind speed: 0.1~20 m/sec,
Accuracy: ±(0.05+0.05V), if wind speed is up to 1m/sec and ±(0.1+0.05V), if wind speed is between 1÷20m/sec,
- Measurement range of temperature: between -10 and +50°C,
Accuracy: ±0.2,
- Measurement range of relative humidity: between 3 and 97%,
Accuracy: ±3,
- The verification date of the device is 16.05.2017. It is valid until 16.05.2018.

Data on the State verification, as well as technical characteristics of the device is presented in Verification certificate (see [Annex 2](#)).

4. Normative framework**4.1 Environmental norms**

The PM10 measurements were conducted and evaluated in accordance with the following normative documentation acting in the Republic of Armenia:

- GOST 17.2.4.05-83. "Environmental protection. Atmosphere. Gravimetric method for determination of suspended dust particles",
- RoA Government Decree N^o160-N. "Norms of maximum permissible concentrations (MPC) of atmospheric air pollutants in residential areas".

The maximum permissible concentrations of PM10, including daily average values are defined by the RoA Government Decree N^o160-N and summarized below in [Table 2](#).

Table 2. Daily average and maximum permissible concentrations (MPC) for PM10

№	Name of substance	MPC (mg/ m ³)	
		Max	Daily average
1	PM10	0.3	0.06

PM10 Assessment Report (for autumn 2017)

Rev01

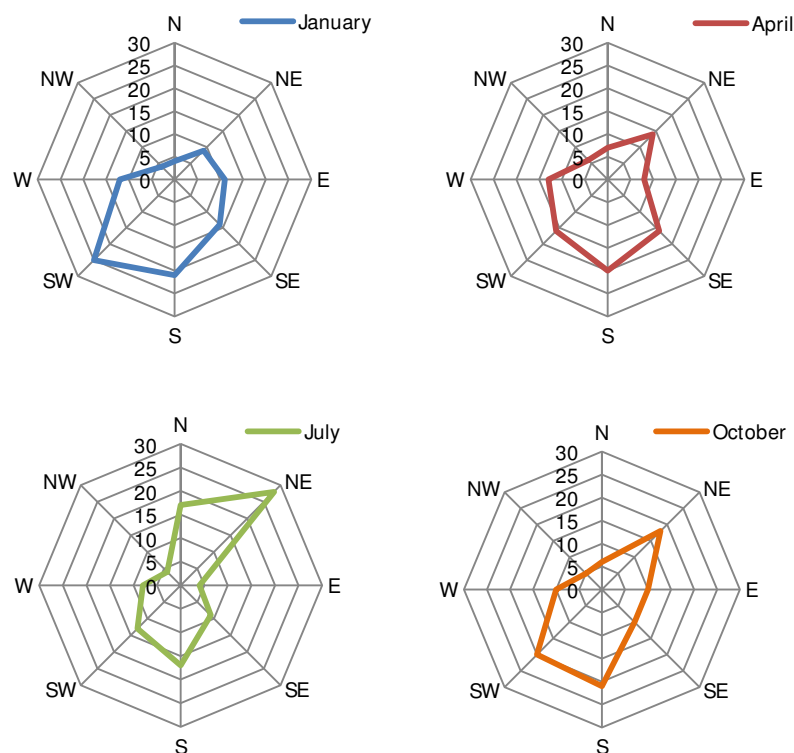
4.2 Wind directions

The climatic conditions of Armenia, including wind directions and speeds were monitored using meteorological stations located in most of the settlements in Armenia. The monitoring results of the last 30 years were summarized in Republic of Armenia Construction Norms II-7.01-2011 "Construction Climatology". The data on wind directions and average speeds from the Erebuni meteorological station (PM10 measurement points were located in Erebuni administrative district of Yerevan) are given below in Table 3, while rose of wind is presented in Figure 1.

Table 3. Daily average and maximum permissible concentrations (MPC) for PM10

Settlement / meteorological station	Average atmospheric pressure (hPa)	Months	Frequency, % by directions								Average monthly speed, m/sec	Average annual speed, m/sec	Days of strong wind (≥15m/sec)
			Average speed, m/sec										
			Northern	North-Eastern	Eastern	South-Eastern	Southern	South-Western	Western	North-Western			
Yerevan / Erebuni	912,1	January	4	9	11	14	21	25	12	4	0,7	1,5	29
			2,2	2,2	2,2	2,9	2,7	2,3	2,6	2,7			
		April	7	14	8	16	20	16	13	6	1,9		
			3,1	3,2	2,8	4,0	3,1	3,0	3,8	3,6			
		July	17	28	4	9	17	13	8	4	2,8		
			5,2	5,7	2,8	2,7	2,4	2,7	2,9	4,3			
		October	6	18	10	10	21	20	10	5	1,0		
			2,9	2,5	2,1	2,5	2,3	2,4	2,9	3,5			

Figure 1. Rose of wind



PM10 Assessment Report (for autumn 2017)

Rev01

5. Description of measurement points/ sites

The given Report presents results of PM10 concentration measurements for the points defined by the Client (see [Annex 1](#)) and described below. Totally, 125 PM10 instrumental measurements were conducted at 5 points.

Air 1

X= 456810.00 m E, Y= 4440184.00 m N

Measurement point Air 1 is situated in industrial area near the south-east border of current Yerevan-1 thermal power plant, between the fire brigade and abandoned production facility (see [Figure 2](#)).

Air 2

X= 455723.00 m E, Y= 4439628.00 m N

Measurement point Air 2 is placed approx. 1700 m to the south-west from the CCPP Yerevan-2 site. This point is located near the northeast border of Ayntap community between the cemetery and private cultivated garden (see [Figure 3](#)).

Air 3

X= 457405.00 m E, Y= 4440835.00 m N

Measurement point Air 3 is placed in industrial area near the northern border of the CCPP Yerevan-2 site (see [Figure 4](#)).

Air 4

X= 458540.00 m E, Y= 4439142.00 m N

Measurement point Air 4 is located at the distance of approx. 1500 m to the south-east from the CCPP Yerevan-2 site, in front of the administrative building of "Food safety risk assessment research center" SNCO⁵ (see [Figure 5](#)).

Air 5

X= 462777.00 m E, Y= 4443372.00 m N

Measurement point Air 5 is located at the distance of approx. 5800 m to the north-east from the CCPP Yerevan-2 site, Jrashen residential block within the boundary of Erebuni administrative district (see [Figure 6](#)).

⁵ State Non-Commercial Organization

PM10 Assessment Report (for autumn 2017)

Rev01

Figure 2. Measurement process at point Air 1



PM10 Assessment Report (for autumn 2017)

Rev01

Figure 3. Measurement process at point Air 2



PM10 Assessment Report (for autumn 2017)

Rev01

Figure 4. Measurement process at point Air 3



PM10 Assessment Report (for autumn 2017)

Rev01

Figure 5. Measurement process at point Air 4



PM10 Assessment Report (for autumn 2017)

Rev01

Figure 6. Measurement process at point Air 5



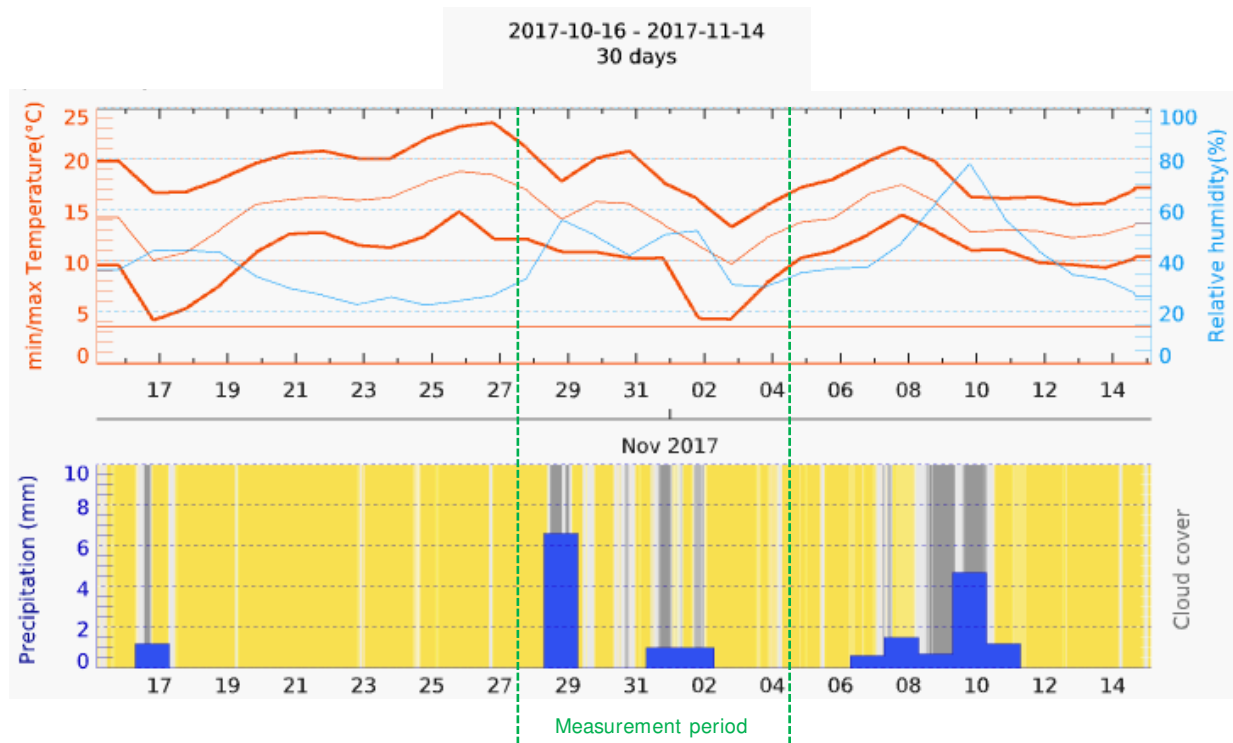
6. Weather conditions

The weather conditions during the measurement period (28.10.17-04.11.17) were presented in [Figure 7](#) (source: meteoblue.com):

PM10 Assessment Report (for autumn 2017)

Rev01

Figure 7. Whether conditions during the measurement period



7. Measurement results and evaluation

Measurement results of PM10 concentration and other relevant parameters are summarized in Table 4 (for PM10). Diagrams of PM10 actual concentrations in comparison with the MPCs (maximum and daily average) are presented in Figures 8-12.

Table 4. Results of PM10 measurement

Point of measurement	Temperature, °C	Relative humidity, %	PM10, mg/ m ³	Wind speed, m/ sec	MPC max, mg/ m ³	MPC daily average, mg/ m ³	Compliance
28.10.2017							
Air 1	16	47	0.02	<2.2	0.3	0.06	Compliant
	16	48	0.041	<2.7			
	18	48	0.021	<2.8			
	17	46	0.021	<2.8			
Air 2	16	45	0.019	<2.5	0.3	0.06	Compliant
	16	50	0.022	<2.3			
	17	51	0.029	<2.2			
	18	48	0.035	<2.5			
Air 3	18	48	0.038	<2.4	0.3	0.06	Compliant
	16	48	0.034	<2.4			
	15	50	0.038	<3.2			
	16	47	0.046	<3.1			
Air 4	17	48	0.053	<4.1	0.3	0.06	Compliant
	17	46	0.047	<3.8			
	16	46	0.045	<3.4			
	14	47	0.023	<3.4			
Air 4	15	47	0.03	<3.4	0.3	0.06	Compliant
	15	48	0.032	<4.2			
	16	46	0.033	<4.1			
	15	49	0.028	<4.0			

PM10 Assessment Report (for autumn 2017)

Rev01

Point of measurement	Temperature, °C	Relative humidity, %	PM10, mg/ m ³	Wind speed, m/ sec	MPC max, mg/ m ³	MPC daily average, mg/ m ³	Compliance
Air 5	13	49	0.028	<3.0	0.3	0.06	
	14	46	0.037	<3.2			
	16	45	0.049	<3.5			
	16	46	0.046	<3.4			
	15	48	0.036	<3.2			
31.10.2017							
Air 1	14	46	0.012	<0.8	0.3	0.06	
	16	45	0.012	<0.6			
	17	44	0.014	<0.9			
	17	40	0.015	<1.0			
	15	42	0.014	<0.5			
Air 2	13	48	0.016	<1.2	0.3	0.06	
	15	46	0.014	<1.1			
	16	43	0.018	<1.1			
	16	44	0.025	<1.0			
	15	44	0.02	<1.2			
Air 3	14	43	0.022	<1.2	0.3	0.06	
	16	42	0.028	<1.0			
	17	40	0.033	<1.2			
	18	40	0.042	<0.8			
	17	41	0.035	<0.9			
Air 4	14	45	0.015	<1.9	0.3	0.06	
	15	43	0.016	<2.4			
	17	42	0.016	<2.7			
	17	40	0.018	<2.5			
	16	41	0.014	<2.1			
Air 5	14	44	0.014	<1.1	0.3	0.06	
	16	42	0.017	<1.2			
	16	41	0.018	<1.4			
	17	40	0.019	<1.2			
	16	40	0.012	<1.1			
02.11.2017							
Air 1	8	47	0.01	<1.2	0.3	0.06	
	10	43	0.014	<1.1			
	12	44	0.014	<1.5			
	13	42	0.017	<1.6			
	12	43	0.012	<1.1			
Air 2	9	43	0.008	<0.7	0.3	0.06	
	11	41	0.01	<0.7			
	13	40	0.015	<0.8			
	13	41	0.017	<0.9			
	13	40	0.016	<0.9			
Air 3	9	43	0.02	<0.9	0.3	0.06	
	10	41	0.028	<0.8			
	12	42	0.027	<1.3			
	13	40	0.021	<1.2			
	13	42	0.015	<1.0			
Air 4	8	42	0.012	<0.7	0.3	0.06	
	10	42	0.012	<0.6			
	11	40	0.014	<1.0			
	13	41	0.012	<1.0			
	12	41	0.013	<0.8			
Air 5	8	43	0.013	<0.8	0.3	0.06	
	9	43	0.014	<0.8			
	11	40	0.016	<0.9			
	13	41	0.016	<0.6			
	12	42	0.014	<0.7			

PM10 Assessment Report (for autumn 2017)

Rev01

Point of measurement	Temperature, °C	Relative humidity, %	PM10, mg/ m ³	Wind speed, m/ sec	MPC max, mg/ m ³	MPC daily average, mg/ m ³	Compliance
03.11.2017							
Air 1	9	41	0.012	< 0.8	0.3	0.06	
	11	40	0.015	< 0.7			
	13	37	0.016	< 1.0			
	14	34	0.017	< 1.1			
	14	36	0.024	< 1.1			
Air 2	8	42	0.018	< 0.9	0.3	0.06	
	11	40	0.023	< 0.7			
	14	40	0.028	< 0.6			
	15	37	0.024	< 0.8			
	14	39	0.02	< 0.8			
Air 3	10	39	0.017	< 0.9	0.3	0.06	
	11	37	0.027	< 0.7			
	14	35	0.022	< 1.1			
	14	34	0.015	< 1.3			
	13	37	0.028	< 1.1			
Air 4	9	37	0.011	< 0.7	0.3	0.06	
	10	36	0.013	< 0.6			
	13	33	0.015	< 1.1			
	14	32	0.02	< 1.2			
	14	34	0.018	< 1.0			
Air 5	9	36	0.015	< 0.8	0.3	0.06	
	11	33	0.019	< 0.8			
	13	32	0.025	< 0.7			
	15	31	0.024	< 0.9			
	14	33	0.018	< 1.1			
04.11.2017							
Air 1	10	37	0.015	< 0.7	0.3	0.06	
	12	35	0.019	< 0.7			
	15	34	0.025	< 1.1			
	15	32	0.021	< 0.9			
	16	33	0.022	< 1.2			
Air 2	11	41	0.017	< 0.8	0.3	0.06	
	14	39	0.031	< 0.7			
	15	39	0.021	< 0.9			
	16	38	0.025	< 0.8			
	16	37	0.009	< 1.1			
Air 3	11	38	0.021	< 1.0	0.3	0.06	
	13	36	0.016	< 1.1			
	15	36	0.025	< 1.4			
	16	34	0.021	< 1.3			
	16	33	0.022	< 1.3			
Air 4	10	40	0.017	< 1.2	0.3	0.06	
	12	38	0.019	< 1.1			
	14	36	0.022	< 1.2			
	16	36	0.017	< 1.4			
	16	37	0.019	< 1.3			
Air 5	10	38	0.032	< 0.7	0.3	0.06	
	13	36	0.025	< 0.9			
	15	36	0.026	< 0.8			
	16	35	0.028	< 1.0			
	15	34	0.023	< 1.2			

PM10 Assessment Report (for autumn 2017)

Rev01

Figure 8. Diagrams of PM10 actual concentrations at point Air 1 compared with the MPC (max and daily average)

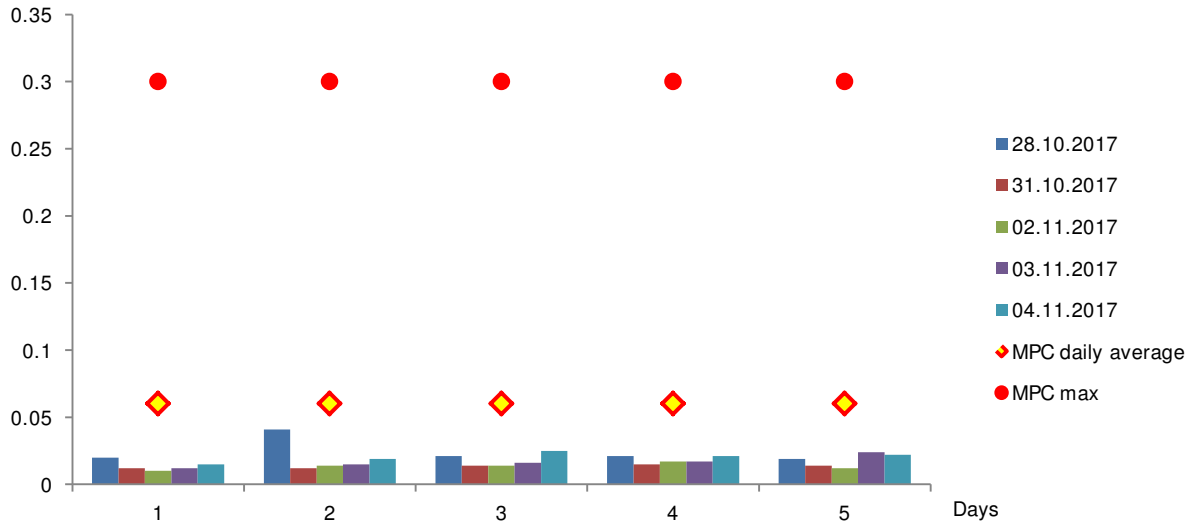
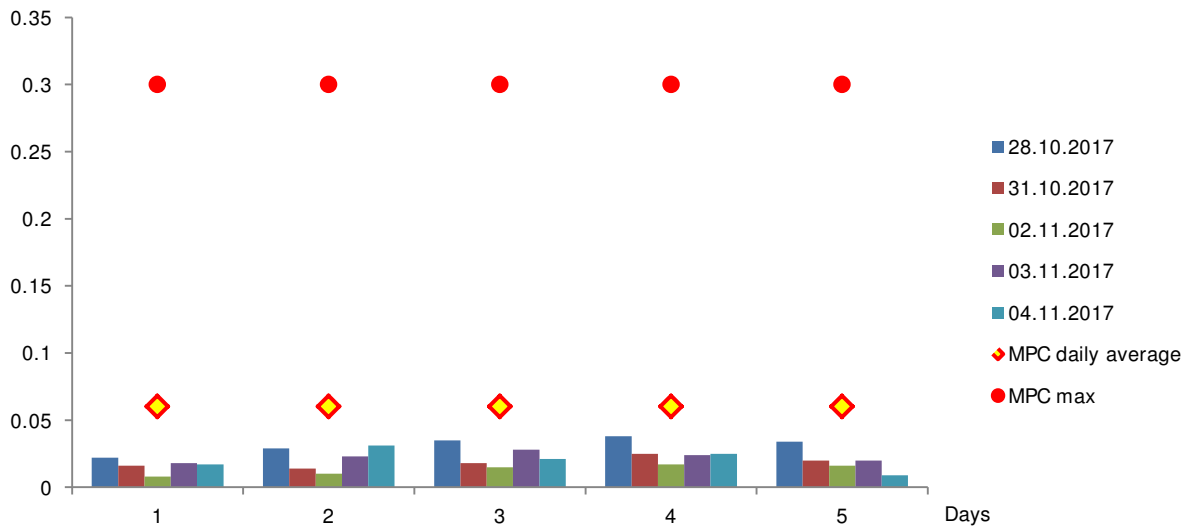


Figure 9. Diagrams of PM10 actual concentrations at point Air 2 compared with the MPC (max and daily average)



PM10 Assessment Report (for autumn 2017)

Rev01

Figure 10. Diagrams of PM10 actual concentrations at point Air 3 compared with the MPC (max and daily average)

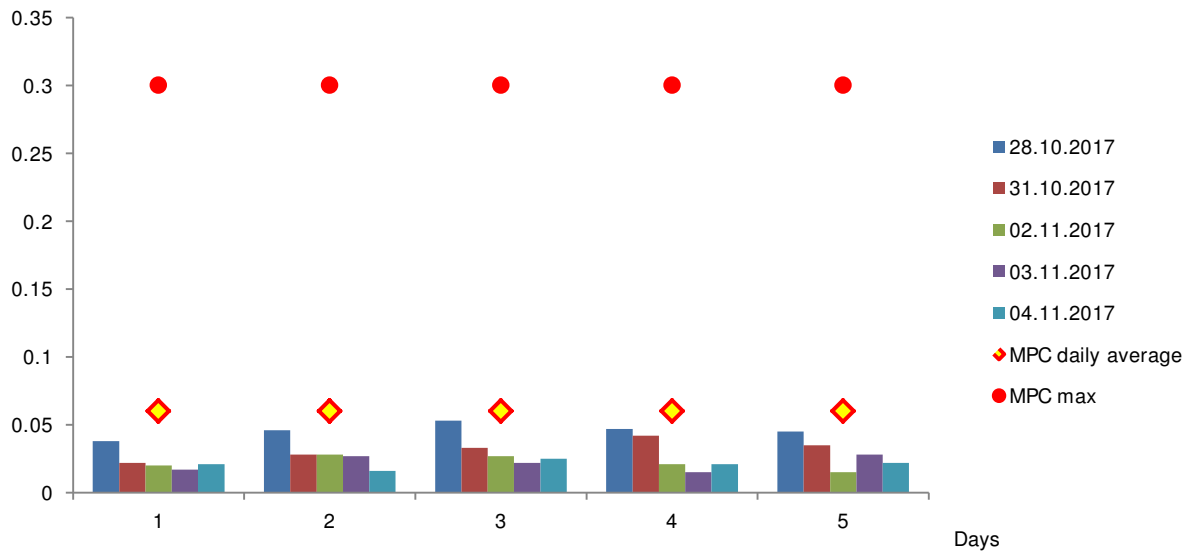
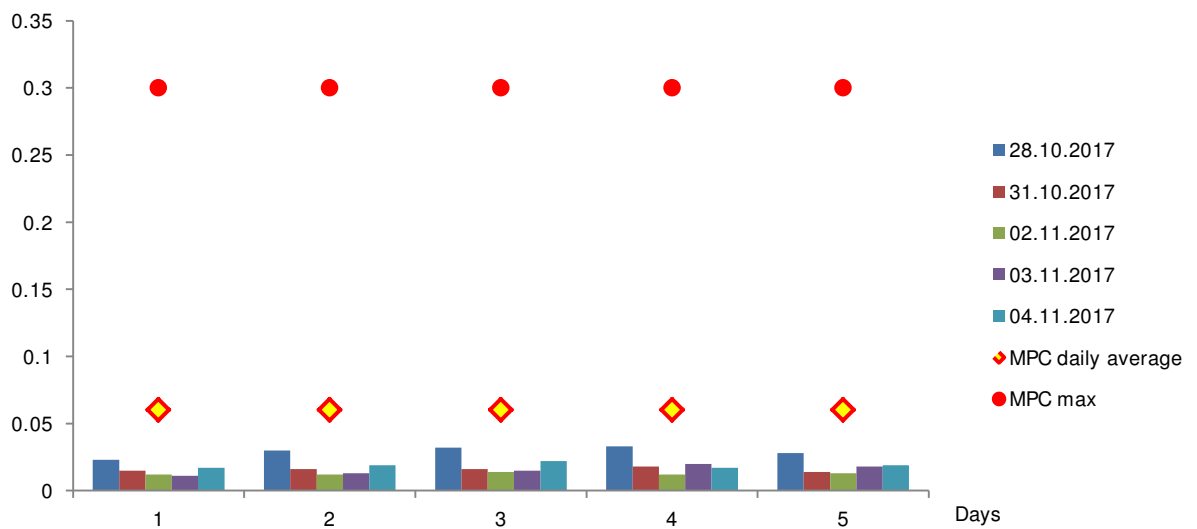


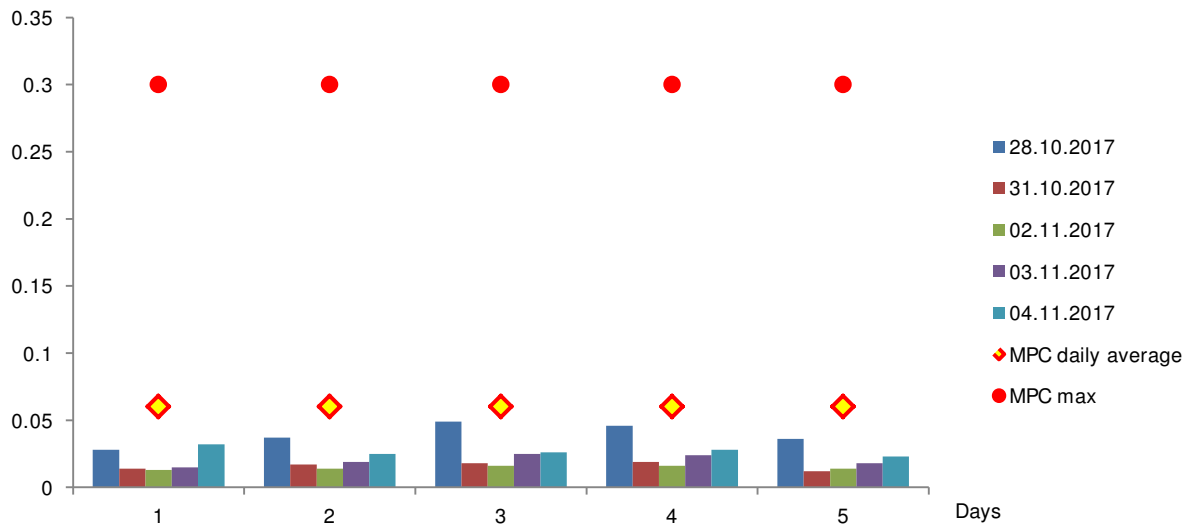
Figure 11. Diagrams of PM10 actual concentrations at point Air 4 compared with the MPC (max and daily average)



PM10 Assessment Report (for autumn 2017)

Rev01

Figure 12. Diagrams of PM10 actual concentrations at point Air 5 compared with the MPC (max and daily average)



Main conclusions

- 1) 125 instrumental measurements were conducted in 5 sensitive points (Air 1, Air 2, Air 3, Air 4 and Air 5) during 5 days to determine the PM10 actual concentration. 5 measurements were conducted at each point per day, which means that totally 25 PM10 measurements were carried out at each point. The results of the study were compared with PM permissible concentrations (maximal is 0.3 mg/m³ and daily average is 0.06 mg/m³).
- 2) PM10 (dust particles of 10um size) actual concentrations at all sensitive points (Air 1, Air 2, Air 3, Air 4 and Air 5) in different daytime periods don't exceed the daily average and maximum permissible concentrations for residential areas set by the RA Government Decree N^o160-N "Norms of maximum permissible concentrations of atmospheric air pollutants in residential areas" (see [Figures 8-12](#)).

PM10 Assessment Report (for autumn 2017)

Rev01

ANNEX 1. Map of measurement points



PM10 Assessment Report (for autumn 2017)

Rev01

ANNEX 2. Verification documents of measuring devices

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ԶՄՓԱԳԻՏՈՒԹՅԱՆ ԱԶԳԱՅԻՆ
ԻՆՍՏԻՏՈՒՏ ՓԲԸ
(ԶՄՓԱԳԻՏՈՒԹՅԱՆ ԱԶԳԱՅԻՆ
ՄԱՐՄԻՆ)

ՎԿԱՅԱԿԱՆ № 017243
ՍՏՈՒԳԱԶՈՓՄԱՆ ՄԱՍԻՆ

Ստուգաչափման թվականը 2017թ. 01 «18»
Ուժի մեջ է մինչև 2018թ. 01 «18»

Մ. Կոչարյան
Հախման միջոցի մականունը և տեսակը
ՃՅԵԿ. 431110.02 ՇԾ

Գործարանային հմ. **89690**
Չափման տիրույթը **(-10 ÷ 50)°C ; (3 ÷ 92) % Հ.Կ. (30 ÷ 110) քմ/ս**
ճշտության դասը, կարգը (սխալանքը) **±0,2°C ; ±3% ; ±0,13 քմ/ս**
Արտադրողը **Վ. Մանուկյան (1 Քեմեռ - ՅՈՒՆԻՎԵՐՍԻՏԵՏ)**

Պատկանում է **Վ. Կոչարյան, Արմ. Կոչարյան**
իրավաբանական (ֆիզիկական անձի) անվանումը (անունը)

Ստուգաչափման արդյունքների հիման վրա չափման միջոցը ճանաչվել է
պիտանի և թույլատրվում է կիրառման:
Ստուգաչափումը կատարվել է համաձայն **ՄՊ**
ստուգաչափման մեթոդիկայի անվանումը, նշագիրը

Ստուգաչափող **Վ. Կոչարյան**
Դրոշմի արտատիպը

Բաժնի (լաբորատորիայի)
ղեկավար **Վ. Կոչարյան**

Պատասխան է եկնոմիկայի նախարարի 14.02.2013թ. թիվ 104-Ն հրամանով
Գրանցված է 73 Արդարադատության նախարարության կողմից 21.03.2013թ. թիվ 10313102



Project: Environmental and Social Impact Assessment for a Combined Cycle Power Plant - Yerevan 2

Project №: 8559P01

PM10 Assessment Report

Rev01

Time Period: Winter 2017-2018

**Prepared for
RENCO ARMESTATE Ltd. and Fichtner GmbH & Co. KG**

**Prepared by
"ATMS Solutions" Ltd.**

February, 2018

PM10 Assessment Report (for winter 2017-2018)

Rev01

Contents

1. Introduction.....3

2. Objective of the study3

3. Measurement methodology and equipment.....4

4. Normative framework.....4

4.1 Environmental norms.....4

4.2 Wind directions4

5. Description of measurement points/sites6

6. Weather conditions7

7. Measurement results and evaluation8

Main conclusions22

ANNEX 1. Map of measurement points.....23

ANNEX 2. Pictures of measurements process at monitoring points.....24

ANNEX 3. Verification documents of measuring devices39

PM10 Assessment Report (for winter 2017-2018)

Rev01

1. Introduction

Based on the service provision contract dated 20 of December 2017 between RENCO ARMESTATE Ltd. (hereinafter - Client) and ATMS Solutions Ltd. (hereinafter - Contractor) the latter has engaged to conduct PM10¹ measurements at the 5 points/sites during the 30 days and elaborate PM10 assessment report for the winter period of 2017-2018.

PM10 measurement points/sites have been selected by the Client. The map with the indication of measurement points are presented in **Annex 1**. Quantities, durations and other parameters to be monitored in parallel with the PM measurements are given below in **Table 1**.

Table 1. Measurement specification

Measurement point	Measuring parameters	Time of measurement	Quantity, measurements	Duration, minutes ²	Total quantity, measurements
PM10 measurements					750
Air 1	PM10, temperature, RH ³ , wind speed	Day-time	5 x 30 ⁴	5	150
Air 2	PM10, temperature, RH, wind speed	Day-time	5 x 30	5	150
Air 3	PM10, temperature, RH, wind speed	Day-time	5 x 30	5	150
Air 4	PM10, temperature, RH, wind speed	Day-time	5 x 30	5	150
Air 5	PM10, temperature, RH, wind speed	Day-time	5 x 30	5	150

Besides, the Contractor also should provide the Client with the wind directions (rose of wind) for the region (should be extracted from the Republic of Armenia Construction Norms II-7.01-2011 "Construction Climatology").

2. Objective of the study

The objective of the Study is:

- To conduct instrumental measurements of PM10 concentrations and other relevant parameters (RH, temperature, wind speed) at the points around the Yerevan 2 Power Plant, which are expected to be impacted during the construction and operation stages,
- To assess the compliance of the PM actual concentrations to the national environmental norms,
- To elaborate PM assessment report.

This PM10 assessment report (hereinafter - Report) provides an overview of the measurement process and equipment, description of the measurement (sensitive) points, dust (PM10) national environmental norms, a quantitative analysis, assessment of measurement results and main conclusions. The instrumental measurements were conducted between the 17.12.2017 and 03.02.2018 at 5 sensitive points.

¹ Particle matters with 10 µm size

² 5 minutes for each measurement

³ Relative humidity

⁴ 5 measurements per day during the 30 days

PM10 Assessment Report (for winter 2017-2018)

Rev01

3. Measurement methodology and equipment

Dust concentration is measured by using of Dust particle meter DT-96. This device is equipped with 2.5um and 10um size channels to measure PM2.5 and PM10 simultaneously as well as air temperature and relative humidity. The duration of each PM10 measurement is 5 minutes. The obtained data is analyzed and compared with corresponding threshold limit value.

Technical parameters of the device are listed below:

- Concentration measurement: 0~2000 ug/m³, resolution: 1 ug/m³,
- Temperature range: 0~50°C, resolution: 1°C, accuracy: ±0.1°C,
- Humidity Range: 0 to 100% RH, accuracy: ±5% RH, 0~20% RH, 80~100% RH; ±3.5% RH, 20~80% RH.

The wind speed during the noise measurements have been determined by the Microclimate parameters measuring device "Meteoscop". Technical characteristics of "Meteoscop" are summarized below:

- Measurement range of wind speed: 0.1~20 m/sec,
Accuracy: ±(0.05+0.05V), if wind speed is up to 1m/sec and ±(0.1+0.05V), if wind speed is between 1÷20m/sec,
- Measurement range of temperature: between -10 and +50°C,
Accuracy: ±0.2,
- Measurement range of relative humidity: between 3 and 97%,
Accuracy: ±3.

Data on the State verification, as well as technical characteristics of the device is presented in Verification certificate (see [Annex 3](#)).

4. Normative framework**4.1 Environmental norms**

The PM10 measurements were conducted and evaluated in accordance with the following normative documentation acting in the Republic of Armenia:

- GOST 17.2.4.05-83. "Environmental protection. Atmosphere. Gravimetric method for determination of suspended dust particles",
- RoA Government Decree N^o160-N. "Norms of maximum permissible concentrations (MPC) of atmospheric air pollutants in residential areas".

The maximum permissible concentrations of PM10, including daily average values are defined by the RoA Government Decree N^o160-N and summarized below in [Table 2](#).

Table 2. Daily average and maximum permissible concentrations (MPC) for PM10

№	Name of substance	MPC (mg/ m ³)	
		Max	Daily average
1	PM10	0.3	0.06

4.2 Wind directions

The climatic conditions of Armenia, including wind directions and speeds were monitored using meteorological stations located in most of the settlements in Armenia. The monitoring results of the last

PM10 Assessment Report (for winter 2017-2018)

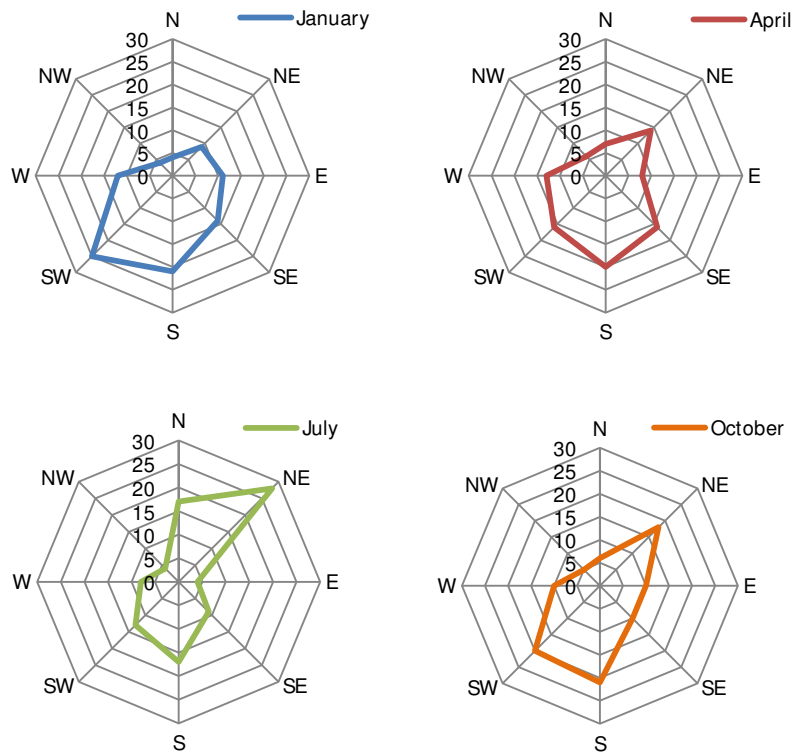
Rev01

30 years were summarized in Republic of Armenia Construction Norms II-7.01-2011 "Construction Climatology". The data on wind directions and average speeds from the Erebuni meteorological station (PM10 measurement points were located in Erebuni administrative district of Yerevan) are given below in Table 3, while rose of wind is presented in Figure 1.

Table 3. Daily average and maximum permissible concentrations (MPC) for PM10

Settlement / meteorological station	Average atmospheric pressure (hPa)	Months	Frequency, % by directions								Average monthly speed, m/sec	Average annual speed, m/sec	Days of strong wind (≥15m/sec)
			Average speed, m/sec										
			Northern	North-Eastern	Eastern	South-Eastern	Southern	South-Western	Western	North-Western			
Yerevan / Erebuni	912,1	January	4	9	11	14	21	25	12	4	0,7	1,5	29
			2,2	2,2	2,2	2,9	2,7	2,3	2,6	2,7			
		April	7	14	8	16	20	16	13	6	1,9		
			3,1	3,2	2,8	4,0	3,1	3,0	3,8	3,6			
		July	17	28	4	9	17	13	8	4	2,8		
			5,2	5,7	2,8	2,7	2,4	2,7	2,9	4,3			
		October	6	18	10	10	21	20	10	5	1,0		
			2,9	2,5	2,1	2,5	2,3	2,4	2,9	3,5			

Figure 1. Rose of wind



PM10 Assessment Report (for winter 2017-2018)

Rev01

5. Description of measurement points/ sites

The given Report presents results of PM10 concentration measurements for the points defined by the Client (see [Annex 1](#)) and described below. Totally, 750 PM10 instrumental measurements were conducted at 5 points.

Air 1

X= 456810.00 m E, Y= 4440184.00 m N

Measurement point Air 1 is situated in industrial area near the south-east border of current Yerevan-1 thermal power plant, between the fire brigade and abandoned production facility (see [Annex 2](#)).

Air 2

X= 455723.00 m E, Y= 4439628.00 m N

Measurement point Air 2 is placed approx. 1700 m to the south-west from the CCPP Yerevan-2 site. This point is located near the northeast border of Ayntap community between the cemetery and private cultivated garden (see [Annex 2](#)).

Air 3

X= 457405.00 m E, Y= 4440835.00 m N

Measurement point Air 3 is placed in industrial area near the northern border of the CCPP Yerevan-2 site (see [Annex 2](#)).

Air 4

X= 458540.00 m E, Y= 4439142.00 m N

Measurement point Air 4 is located at the distance of approx. 1500 m to the south-east from the CCPP Yerevan-2 site, in front of the administrative building of "Food safety risk assessment research center" SNCO⁵ (see [Annex 2](#)).

Air 5

X= 462777.00 m E, Y= 4443372.00 m N

Measurement point Air 5 is located at the distance of approx. 5800 m to the north-east from the CCPP Yerevan-2 site, Jrashen residential block within the boundary of Erebuni administrative district (see [Annex 2](#)).

⁵ State Non-Commercial Organization

PM10 Assessment Report (for winter 2017-2018)

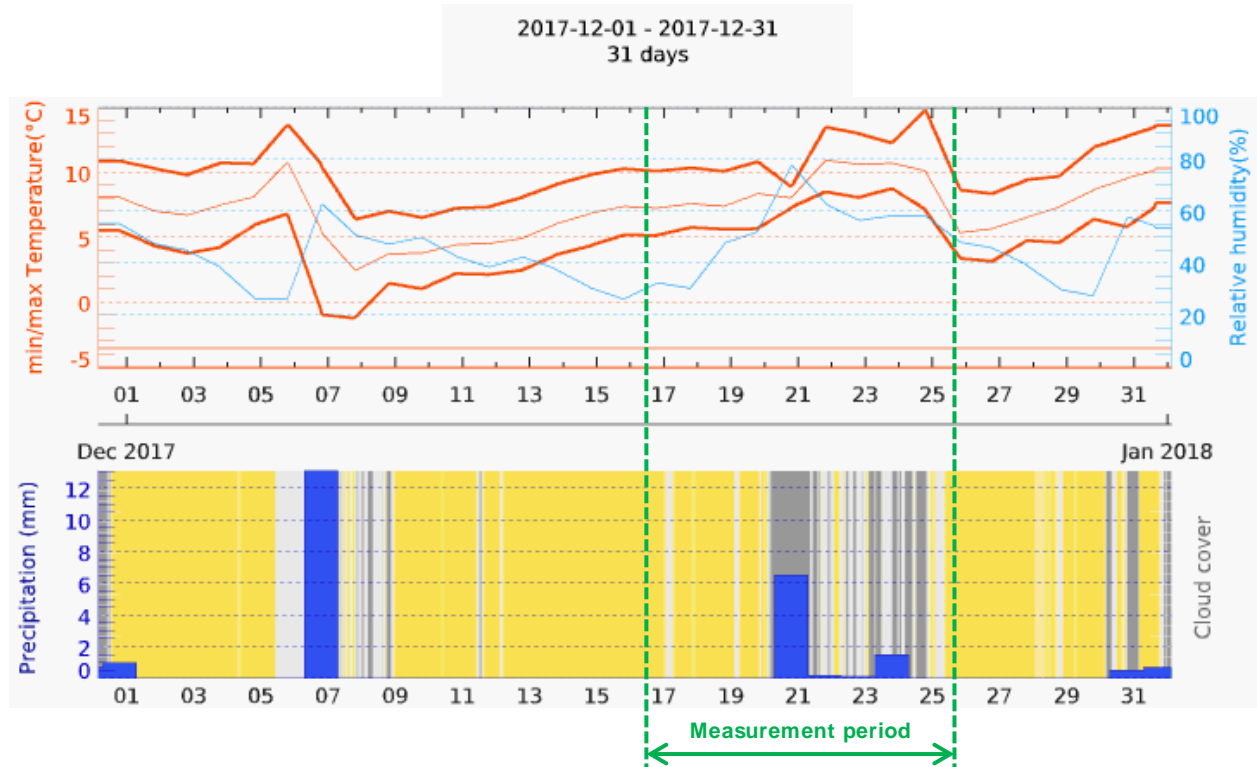
Rev01

6. Weather conditions

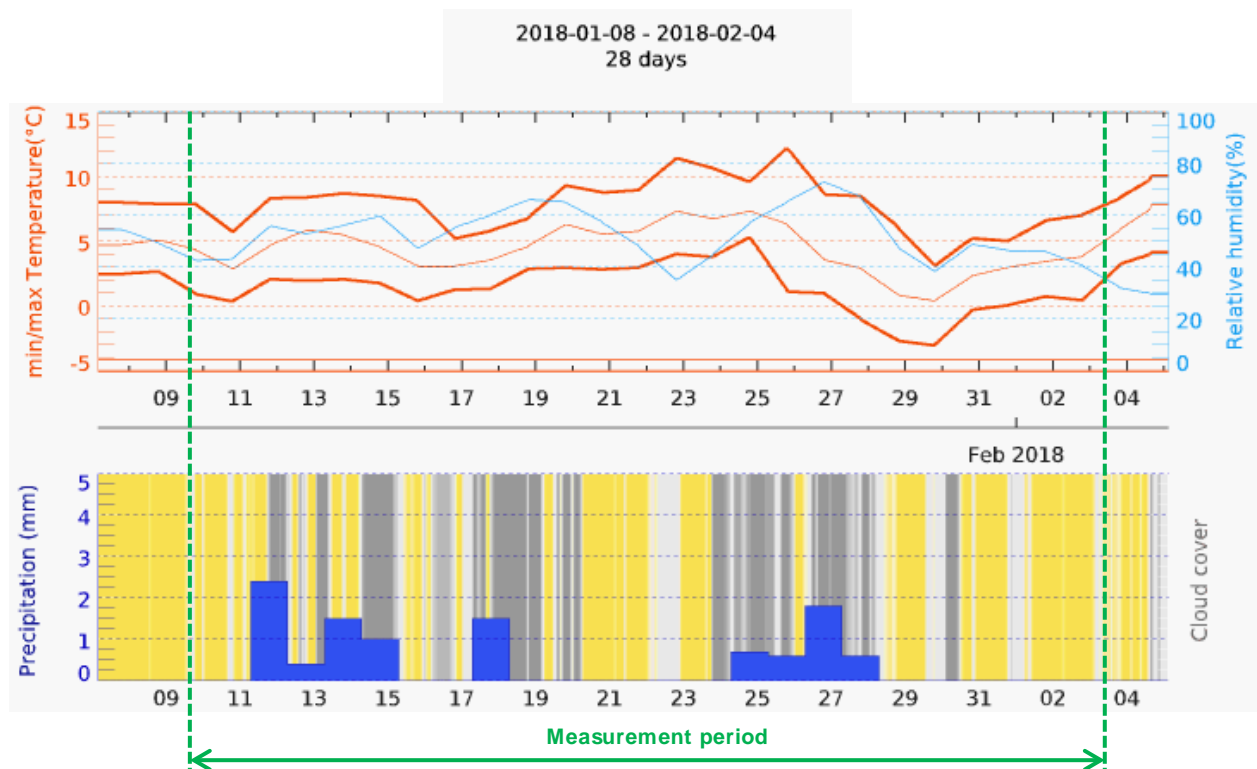
The weather conditions during the measurement period (17.12.17 - 03.02.18) were presented in Figure 2 (source: meteoblue.com):

Figure 2. Whether conditions during the measurement period

a) December 2017



b) January-February 2018



PM10 Assessment Report (for winter 2017-2018)

Rev01

7. Measurement results and evaluation

Measurement results of PM10 concentration and other relevant parameters are summarized in [Table 4](#) (for PM10).

Table 4. Results of PM10 measurement

Point of measurement	Temperature, °C	Relative humidity, %	PM10, mg/ m ³	Wind speed, m/ sec	MPC max, mg/ m ³	MPC daily average, mg/ m ³	Compliance
17.12.2017							
Air 1	5	49	0.017	< 1.0	0.3	0.06	
	5	48	0.018	< 1.3			
	6	47	0.020	< 1.1			
	6	45	0.020	< 1.0			
	6	47	0.020	< 0.9			
Air 2	4	50	0.015	< 0.6	0.3	0.06	
	5	52	0.016	< 0.8			
	5	50	0.015	< 0.9			
	6	49	0.019	< 0.8			
	6	48	0.018	< 0.9			
Air 3	4	43	0.017	< 1.7	0.3	0.06	
	5	44	0.018	< 2.0			
	5	42	0.020	< 2.1			
	6	42	0.018	< 1.6			
	6	41	0.022	< 2.0			
Air 4	4	45	0.019	< 1.2	0.3	0.06	
	4	44	0.022	< 1.4			
	5	44	0.020	< 1.4			
	5	48	0.025	< 1.2			
	6	50	0.020	< 1.4			
Air 5	3	55	0.025	< 0.9	0.3	0.06	
	4	57	0.020	< 1.1			
	5	60	0.026	< 0.9			
	6	60	0.021	< 1.2			
	5	57	0.018	< 0.8			
19.12.2017							
Air 1	3	46	0.026	< 0.9	0.3	0.06	
	4	44	0.025	< 0.9			
	4	43	0.029	< 0.6			
	4	43	0.028	< 1.1			
	5	44	0.028	< 1.0			
Air 2	3	52	0.043	< 1.3	0.3	0.06	
	4	48	0.048	< 0.8			
	4	52	0.052	< 0.6			
	5	50	0.055	< 0.9			
	4	52	0.050	< 1.1			
Air 3	3	42	0.027	< 1.0	0.3	0.06	
	4	42	0.030	< 0.8			
	4	40	0.033	< 0.7			
	5	41	0.030	< 0.7			
	4	40	0.034	< 1.2			
Air 4	3	44	0.027	< 0.6	0.3	0.06	
	3	42	0.025	< 0.8			
	4	45	0.025	< 0.9			
	4	45	0.030	< 1.2			
	4	42	0.031	< 1.0			
Air 5	2	50	0.048	< 0.7			
	3	52	0.050	< 1.0			

PM10 Assessment Report (for winter 2017-2018)

Rev01

Point of measurement	Temperature, °C	Relative humidity, %	PM10, mg/ m ³	Wind speed, m/ sec	MPC max, mg/ m ³	MPC daily average, mg/ m ³	Compliance
	4	57	0.046	< 1.1	0.3	0.06	
	4	57	0.057	< 0.8			
	4	53	0.052	< 0.9			
21.12.2017							
Air 1	2	71	0.032	< 0.8	0.3	0.06	
	3	69	0.037	< 0.7			
	3	67	0.043	< 1.0			
	4	66	0.047	< 1.2			
	4	67	0.042	< 1.2			
Air 2	3	67	0.021	< 1.0	0.3	0.06	
	4	63	0.023	< 0.7			
	4	60	0.020	< 0.7			
	5	61	0.021	< 0.8			
	5	63	0.024	< 1.0			
Air 3	2	62	0.044	< 1.3	0.3	0.06	
	4	60	0.057	< 1.3			
	4	61	0.046	< 1.6			
	4	63	0.057	< 1.5			
	3	60	0.047	< 1.6			
Air 4	2	70	0.038	< 0.9	0.3	0.06	
	2	68	0.042	< 0.8			
	3	67	0.047	< 0.8			
	4	65	0.048	< 0.8			
	3	64	0.044	< 1.1			
Air 5	2	70	0.042	< 0.6	0.3	0.06	
	3	68	0.051	< 1.2			
	3	64	0.041	< 1.0			
	4	61	0.042	< 0.7			
	4	63	0.037	< 0.7			
22.12.2017							
Air 1	0	71	0.031	< 0.9	0.3	0.06	
	1	70	0.033	< 1.0			
	0	70	0.030	< 1.0			
	1	68	0.028	< 0.8			
	1	70	0.030	< 1.0			
Air 2	1	68	0.019	< 1.1	0.3	0.06	
	1	67	0.021	< 0.8			
	2	67	0.018	< 0.6			
	2	68	0.017	< 0.8			
	1	65	0.022	< 0.9			
Air 3	1	69	0.043	< 0.8	0.3	0.06	
	1	71	0.047	< 0.8			
	1	70	0.048	< 0.6			
	2	69	0.047	< 1.0			
	1	68	0.047	< 1.1			
Air 4	0	70	0.025	< 0.7	0.3	0.06	
	0	72	0.024	< 0.9			
	1	70	0.031	< 0.9			
	2	68	0.028	< 0.7			
	1	68	0.023	< 1.0			
Air 5	1	69	0.043	< 0.8	0.3	0.06	
	1	71	0.047	< 0.8			
	1	70	0.048	< 0.6			
	2	69	0.047	< 1.0			
	1	68	0.047	< 1.1			
25.12.2017							
Air 1	6	48	0.005	< 1.8			

PM10 Assessment Report (for winter 2017-2018)

Rev01

Point of measurement	Temperature, °C	Relative humidity, %	PM10, mg/ m ³	Wind speed, m/ sec	MPC max, mg/ m ³	MPC daily average, mg/ m ³	Compliance
	7	46	0.005	< 1.7	0.3	0.06	
	8	45	0.009	< 1.8			
	7	42	0.010	< 2.2			
	7	44	0.007	< 2.3			
Air 2	6	40	0.008	< 0.9	0.3	0.06	
	8	40	0.009	< 1.2			
	8	42	0.006	< 0.8			
	7	40	0.010	< 1.4			
	7	38	0.010	< 1.2			
Air 3	5	45	0.006	< 2.2	0.3	0.06	
	6	46	0.005	< 2.0			
	7	44	0.008	< 1.7			
	7	44	0.009	< 2.8			
	7	43	0.011	< 2.7			
Air 4	5	55	0.005	< 3.1	0.3	0.06	
	7	53	0.008	< 3.5			
	7	50	0.006	< 2.8			
	8	51	0.006	< 3.0			
	6	51	0.007	< 1.8			
Air 5	6	44	0.027	< 0.7	0.3	0.06	
	7	43	0.047	< 1.2			
	8	42	0.043	< 1.0			
	6	45	0.042	< 0.9			
	5	43	0.038	< 1.0			
10.01.2018							
Air 1	6	35	0.009	< 1.0	0.3	0.06	
	8	33	0.018	< 0.9			
	11	32	0.011	< 0.8			
	12	33	0.010	< 1.2			
	10	33	0.008	< 1.1			
Air 2	7	34	0.020	< 1.1	0.3	0.06	
	8	32	0.033	< 0.9			
	12	32	0.042	< 1.4			
	12	33	0.030	< 0.8			
	11	30	0.040	< 0.8			
Air 3	7	31	0.006	< 1.8	0.3	0.06	
	9	30	0.008	< 1.2			
	11	31	0.009	< 1.7			
	12	31	0.008	< 1.0			
	12	29	0.010	< 1.1			
Air 4	7	33	0.011	< 0.9	0.3	0.06	
	10	32	0.013	< 0.6			
	11	33	0.011	< 0.5			
	12	30	0.007	< 0.7			
	11	30	0.010	< 0.6			
Air 5	7	34	0.010	< 0.7	0.3	0.06	
	10	32	0.008	< 1.1			
	11	32	0.022	< 0.6			
	12	32	0.015	< 1.0			
	12	30	0.012	< 1.3			
11.01.2018							
Air 1	6	38	0.047	< 1.7	0.3	0.06	
	9	37	0.056	< 2.0			
	9	35	0.050	< 1.8			
	10	36	0.041	< 0.9			
	10	34	0.046	< 1.0			
Air 2	6	40	0.052	< 1.2			

PM10 Assessment Report (for winter 2017-2018)

Rev01

Point of measurement	Temperature, °C	Relative humidity, %	PM10, mg/ m ³	Wind speed, m/ sec	MPC max, mg/ m ³	MPC daily average, mg/ m ³	Compliance
	9	38	0.057	< 1.1	0.3	0.06	
	10	39	0.050	< 1.0			
	10	38	0.044	< 0.8			
	9	38	0.026	< 1.3			
Air 3	5	42	0.037	< 0.7	0.3	0.06	
	9	40	0.033	< 1.4			
	9	40	0.026	< 1.2			
	10	41	0.028	< 0.4			
	9	40	0.023	< 1.0			
Air 4	5	35	0.040	< 1.1	0.3	0.06	
	8	34	0.047	< 0.9			
	9	32	0.041	< 0.5			
	10	32	0.034	< 1.0			
	10	32	0.035	< 1.0			
Air 5	5	41	0.036	< 1.2	0.3	0.06	
	8	42	0.039	< 1.0			
	9	40	0.032	< 1.0			
	10	40	0.054	< 0.8			
	9	41	0.035	< 0.7			
12.01.2018							
Air 1	6	64	0.058	< 1.4	0.3	0.06	
	8	62	0.051	< 2.1			
	9	58	0.047	< 1.5			
	9	60	0.050	< 1.5			
	9	57	0.044	< 2.0			
Air 2	6	65	0.053	< 0.8	0.3	0.06	
	9	60	0.058	< 1.0			
	9	61	0.054	< 1.2			
	10	57	0.051	< 0.9			
	9	55	0.048	< 0.9			
Air 3	6	60	0.045	< 0.8	0.3	0.06	
	8	58	0.052	< 0.4			
	9	52	0.053	< 0.8			
	9	54	0.047	< 0.9			
	9	53	0.039	< 1.1			
Air 4	5	55	0.020	< 0.9	0.3	0.06	
	7	54	0.019	< 0.5			
	9	50	0.020	< 1.1			
	9	52	0.015	< 1.0			
	8	50	0.023	< 1.1			
Air 5	5	54	0.014	< 2.1	0.3	0.06	
	7	50	0.018	< 2.0			
	9	51	0.020	< 1.8			
	10	48	0.024	< 1.7			
	9	48	0.013	< 1.4			
13.01.2018							
Air 1	6	49	0.033	< 1.5	0.3	0.06	
	9	48	0.035	< 2.0			
	10	46	0.037	< 1.8			
	10	46	0.039	< 1.8			
	9	47	0.033	< 1.7			
Air 2	6	39	0.032	< 0.7	0.3	0.06	
	9	40	0.048	< 1.0			
	9	38	0.033	< 0.8			
	10	36	0.022	< 1.1			
	9	36	0.034	< 1.1			
Air 3	6	63	0.032	< 1.5			

PM10 Assessment Report (for winter 2017-2018)

Rev01

Point of measurement	Temperature, °C	Relative humidity, %	PM10, mg/ m ³	Wind speed, m/ sec	MPC max, mg/ m ³	MPC daily average, mg/ m ³	Compliance
	8	60	0.036	< 1.3	0.3	0.06	
	10	58	0.031	< 1.3			
	9	58	0.034	< 1.0			
	9	56	0.034	< 1.4			
Air 4	5	57	0.019	< 2.5	0.3	0.06	
	8	57	0.033	< 3.1			
	9	53	0.009	< 3.0			
	10	52	0.011	< 2.8			
	9	52	0.038	< 1.8			
Air 5	5	62	0.023	< 1.4	0.3	0.06	
	8	59	0.019	< 2.1			
	9	60	0.028	< 2.0			
	10	54	0.028	< 1.7			
	10	55	0.031	< 1.8			
14.01.2018							
Air 1	4	58	0.051	< 1.0	0.3	0.06	
	6	57	0.054	< 1.1			
	7	55	0.044	< 1.4			
	7	54	0.046	< 0.9			
	6	52	0.047	< 1.2			
Air 2	4	56	0.053	< 1.3	0.3	0.06	
	6	55	0.056	< 1.2			
	7	54	0.048	< 0.9			
	8	52	0.045	< 1.2			
	7	52	0.048	< 1.0			
Air 3	4	62	0.039	< 1.2	0.3	0.06	
	6	61	0.037	< 0.9			
	7	59	0.045	< 0.8			
	8	54	0.043	< 1.2			
	8	53	0.037	< 1.3			
Air 4	3	62	0.034	< 0.6	0.3	0.06	
	5	62	0.033	< 0.7			
	6	57	0.034	< 1.1			
	8	56	0.030	< 1.4			
	7	54	0.032	< 1.1			
Air 5	3	66	0.028	< 1.0	0.3	0.06	
	6	65	0.032	< 1.0			
	7	64	0.036	< 1.3			
	8	61	0.028	< 1.8			
	7	59	0.034	< 1.4			
15.01.2018							
Air 1	2	70	0.010	< 1.4	0.3	0.06	
	3	67	0.012	< 2.0			
	4	65	0.009	< 1.7			
	5	65	0.009	< 1.9			
	4	67	0.012	< 1.4			
Air 2	2	68	0.025	< 1.9	0.3	0.06	
	4	66	0.010	< 5.5			
	5	65	0.008	< 3.4			
	5	64	0.013	< 2.8			
Air 3	4	62	0.017	< 2.9	0.3	0.06	
	2	73	0.010	< 1.6			
	3	72	0.013	< 1.5			
	5	70	0.016	< 1.3			
	5	70	0.012	< 1.2			
Air 4	5	68	0.013	< 0.9	0.3	0.06	
Air 4	3	72	0.011	< 0.8			

PM10 Assessment Report (for winter 2017-2018)

Rev01

Point of measurement	Temperature, °C	Relative humidity, %	PM10, mg/ m ³	Wind speed, m/ sec	MPC max, mg/ m ³	MPC daily average, mg/ m ³	Compliance
	5	72	0.009	< 1.2	0.3	0.06	
	5	70	0.013	< 0.9			
	5	68	0.028	< 1.5			
	4	69	0.022	< 1.1			
	3	73	0.036	< 0.6			
Air 5	4	70	0.044	< 0.3	0.3	0.06	
	5	70	0.042	< 1.1			
	6	67	0.028	< 1.0			
	5	65	0.034	< 0.8			
	16.01.2018						
Air 1	3	57	0.013	< 1.1	0.3	0.06	
	5	54	0.018	< 0.9			
	6	53	0.016	< 1.0			
	6	53	0.012	< 1.2			
	5	52	0.020	< 1.2			
Air 2	3	61	0.019	< 0.8	0.3	0.06	
	4	60	0.032	< 1.0			
	5	58	0.025	< 1.3			
	6	56	0.025	< 1.1			
	6	55	0.014	< 1.1			
Air 3	3	64	0.032	< 0.9	0.3	0.06	
	5	61	0.043	< 0.7			
	5	60	0.026	< 1.1			
	6	57	0.016	< 0.9			
	6	58	0.015	< 0.8			
Air 4	2	62	0.015	< 0.9	0.3	0.06	
	3	60	0.014	< 0.5			
	5	59	0.017	< 0.8			
	6	57	0.018	< 1.1			
	5	56	0.009	< 1.0			
Air 5	2	58	0.050	< 0.8	0.3	0.06	
	4	57	0.052	< 0.6			
	5	56	0.053	< 1.2			
	5	54	0.052	< 1.0			
	5	53	0.055	< 1.3			
17.01.2018							
Air 1	3	61	0.011	< 1.0	0.3	0.06	
	5	58	0.017	< 1.2			
	6	57	0.015	< 1.2			
	6	56	0.017	< 1.3			
	7	53	0.014	< 1.1			
Air 2	4	64	0.022	< 1.9	0.3	0.06	
	5	62	0.017	< 2.0			
	6	60	0.037	< 2.2			
	7	60	0.023	< 2.0			
	7	57	0.019	< 1.4			
Air 3	3	65	0.013	< 1.2	0.3	0.06	
	4	63	0.017	< 1.4			
	6	59	0.019	< 1.4			
	6	58	0.022	< 1.1			
	7	57	0.021	< 0.8			
Air 4	2	66	0.013	< 0.9	0.3	0.06	
	4	64	0.018	< 1.1			
	5	62	0.017	< 1.1			
	6	61	0.016	< 1.0			
	6	60	0.019	< 1.3			
Air 5	2	59	0.010	< 0.8			

PM10 Assessment Report (for winter 2017-2018)

Rev01

Point of measurement	Temperature, °C	Relative humidity, %	PM10, mg/ m ³	Wind speed, m/ sec	MPC max, mg/ m ³	MPC daily average, mg/ m ³	Compliance
	5	57	0.008	<0.7			
	5	56	0.011	<1.3	0.3	0.06	
	6	54	0.010	<1.1			
	6	53	0.011	<0.9			
18.01.2018							
Air 1	4	64	0.047	<0.9	0.3	0.06	
	6	62	0.044	<0.4			
	7	61	0.051	<1.1			
	8	60	0.053	<1.0			
	8	58	0.037	<1.1			
Air 2	4	65	0.045	<0.8	0.3	0.06	
	6	64	0.042	<0.3			
	7	62	0.048	<0.7			
	9	60	0.038	<0.6			
	8	59	0.042	<1.0			
Air 3	4	70	0.038	<1.7	0.3	0.06	
	5	67	0.042	<1.8			
	8	63	0.034	<1.4			
	8	62	0.043	<1.2			
	8	60	0.031	<1.3			
Air 4	3	70	0.029	<1.0	0.3	0.06	
	5	67	0.033	<1.5			
	7	65	0.030	<1.2			
	8	64	0.044	<1.0			
	7	61	0.040	<1.2			
Air 5	3	66	0.043	<0.7	0.3	0.06	
	6	65	0.046	<0.6			
	7	63	0.054	<1.2			
	8	61	0.052	<1.1			
	8	58	0.050	<0.8			
19.01.2018							
Air 1	5	50	0.019	<1.7	0.3	0.06	
	7	47	0.021	<3.3			
	9	45	0.020	<2.7			
	10	44	0.016	<2.0			
	10	43	0.018	<3.1			
Air 2	5	51	0.014	<2.8	0.3	0.06	
	8	47	0.018	<5.0			
	10	46	0.025	<3.7			
	11	44	0.028	<1.6			
	10	44	0.011	<2.4			
Air 3	5	48	0.015	<2.4	0.3	0.06	
	7	44	0.040	<5.5			
	9	44	0.033	<4.2			
	10	43	0.017	<3.2			
	10	42	0.012	<3.3			
Air 4	4	50	0.015	<1.8	0.3	0.06	
	7	48	0.019	<3.5			
	9	47	0.017	<2.2			
	10	45	0.016	<2.0			
	10	44	0.015	<1.7			
Air 5	4	54	0.011	<1.7	0.3	0.06	
	6	51	0.010	<2.5			
	10	50	0.016	<1.3			
	10	49	0.019	<1.2			
	9	47	0.010	<1.8			
20.01.2018							

PM10 Assessment Report (for winter 2017-2018)

Rev01

Point of measurement	Temperature, °C	Relative humidity, %	PM10, mg/ m ³	Wind speed, m/ sec	MPC max, mg/ m ³	MPC daily average, mg/ m ³	Compliance
Air 1	4	57	0.012	< 1.8	0.3	0.06	
	7	54	0.016	< 2.9			
	9	52	0.012	< 2.4			
	11	51	0.008	< 2.1			
	10	50	0.012	< 1.1			
Air 2	4	54	0.015	< 2.1	0.3	0.06	
	8	51	0.037	< 3.0			
	10	50	0.033	< 3.1			
	11	48	0.010	< 1.8			
	10	48	0.014	< 1.4			
Air 3	4	57	0.016	< 2.0	0.3	0.06	
	7	55	0.035	< 2.1			
	10	52	0.011	< 1.2			
	11	52	0.017	< 1.2			
	10	50	0.018	< 1.3			
Air 4	3	53	0.011	< 1.2	0.3	0.06	
	7	50	0.015	< 2.0			
	10	48	0.017	< 2.0			
	11	47	0.010	< 1.8			
	10	46	0.016	< 1.7			
Air 5	4	55	0.022	< 1.3	0.3	0.06	
	6	52	0.028	< 1.9			
	10	50	0.029	< 1.8			
	10	49	0.037	< 1.7			
	9	49	0.019	< 1.7			
21.01.2018							
Air 1	5	52	0.047	< 1.5	0.3	0.06	
	8	50	0.046	< 2.0			
	10	49	0.037	< 2.1			
	11	48	0.043	< 1.7			
	10	48	0.025	< 1.6			
Air 2	6	50	0.024	< 0.9	0.3	0.06	
	9	47	0.052	< 2.1			
	11	46	0.031	< 1.8			
	11	45	0.058	< 1.7			
	10	45	0.048	< 1.7			
Air 3	5	58	0.028	< 1.8	0.3	0.06	
	9	55	0.029	< 2.1			
	10	53	0.019	< 1.7			
	11	52	0.034	< 1.1			
	11	51	0.025	< 1.4			
Air 4	5	56	0.043	< 1.1	0.3	0.06	
	8	53	0.015	< 0.8			
	10	52	0.027	< 1.0			
	11	50	0.032	< 1.2			
	10	48	0.023	< 1.4			
Air 5	4	51	0.038	< 1.4	0.3	0.06	
	8	48	0.033	< 2.0			
	10	46	0.035	< 1.6			
	11	45	0.030	< 1.4			
	10	44	0.040	< 1.6			
22.01.2018							
Air 1	5	58	0.032	< 1.1	0.3	0.06	
	9	55	0.031	< 2.0			
	11	52	0.042	< 1.8			
	11	51	0.040	< 1.6			
	10	50	0.049	< 1.6			

PM10 Assessment Report (for winter 2017-2018)

Rev01

Point of measurement	Temperature, °C	Relative humidity, %	PM10, mg/ m ³	Wind speed, m/ sec	MPC max, mg/ m ³	MPC daily average, mg/ m ³	Compliance
Air 2	6	55	0.035	< 1.4	0.3	0.06	
	9	53	0.030	< 1.2			
	10	50	0.045	< 0.9			
	11	48	0.051	< 1.1			
	10	47	0.048	< 1.0			
Air 3	5	52	0.042	< 1.7	0.3	0.06	
	9	50	0.048	< 1.8			
	11	48	0.039	< 1.4			
	10	47	0.051	< 1.3			
	10	45	0.045	< 1.0			
Air 4	5	57	0.020	< 1.1	0.3	0.06	
	8	54	0.033	< 0.8			
	10	53	0.028	< 0.9			
	10	51	0.041	< 1.3			
	9	50	0.031	< 1.0			
Air 5	5	51	0.015	< 1.0	0.3	0.06	
	8	49	0.017	< 1.3			
	10	48	0.021	< 1.5			
	9	48	0.020	< 1.5			
	9	48	0.019	< 0.9			
23.01.2018							
Air 1	6	46	0.039	< 1.4	0.3	0.06	
	9	44	0.045	< 1.6			
	11	43	0.040	< 1.7			
	12	41	0.042	< 1.0			
	11	42	0.037	< 1.1			
Air 2	6	49	0.046	< 1.2	0.3	0.06	
	9	46	0.041	< 1.7			
	12	44	0.038	< 1.6			
	12	45	0.040	< 1.2			
	11	45	0.051	< 1.1			
Air 3	6	44	0.058	< 1.0	0.3	0.06	
	9	42	0.048	< 1.4			
	12	40	0.051	< 0.9			
	12	39	0.045	< 1.3			
	11	40	0.041	< 1.1			
Air 4	5	43	0.052	< 0.9	0.3	0.06	
	9	40	0.045	< 0.4			
	10	39	0.058	< 0.9			
	11	39	0.051	< 1.1			
	11	37	0.054	< 1.4			
Air 5	5	45	0.042	< 1.6	0.3	0.06	
	8	43	0.043	< 1.8			
	10	42	0.050	< 1.3			
	11	41	0.038	< 1.5			
	11	40	0.036	< 1.1			
24.01.2018							
Air 1	6	52	0.038	< 2.0	0.3	0.06	
	9	50	0.036	< 1.9			
	12	47	0.035	< 1.6			
	13	45	0.045	< 1.4			
	12	45	0.047	< 1.7			
Air 2	6	55	0.042	< 1.2	0.3	0.06	
	10	52	0.044	< 1.6			
	12	50	0.053	< 1.6			
	12	49	0.047	< 1.7			
	12	48	0.050	< 1.3			

PM10 Assessment Report (for winter 2017-2018)

Rev01

Point of measurement	Temperature, °C	Relative humidity, %	PM10, mg/ m ³	Wind speed, m/ sec	MPC max, mg/ m ³	MPC daily average, mg/ m ³	Compliance
Air 3	6	51	0.045	< 1.0	0.3	0.06	
	10	47	0.041	< 1.1			
	12	46	0.049	< 1.1			
	13	44	0.044	< 1.4			
	12	44	0.042	< 0.9			
Air 4	5	49	0.049	< 1.5	0.3	0.06	
	8	46	0.054	< 1.1			
	11	44	0.058	< 1.4			
	12	43	0.047	< 1.0			
	12	43	0.050	< 1.4			
Air 5	5	53	0.048	< 1.4	0.3	0.06	
	8	50	0.046	< 1.3			
	11	48	0.051	< 1.6			
	13	47	0.050	< 1.4			
	12	46	0.044	< 1.0			
25.01.2018							
Air 1	4	59	0.025	< 1.5	0.3	0.06	
	6	56	0.027	< 2.4			
	8	54	0.024	< 1.7			
	9	55	0.019	< 1.5			
	9	54	0.027	< 1.1			
Air 2	4	58	0.022	< 1.3	0.3	0.06	
	7	56	0.026	< 1.5			
	9	55	0.036	< 1.5			
	9	54	0.031	< 1.8			
Air 3	9	53	0.040	< 1.2	0.3	0.06	
	4	59	0.034	< 2.0			
	7	57	0.028	< 2.2			
	8	54	0.024	< 1.8			
	9	52	0.030	< 1.5			
Air 4	9	52	0.052	< 1.6	0.3	0.06	
	4	53	0.034	< 1.1			
	5	52	0.038	< 1.0			
	7	50	0.030	< 1.2			
	9	50	0.028	< 1.3			
Air 5	9	51	0.034	< 1.0	0.3	0.06	
	4	59	0.048	< 1.0			
	6	57	0.045	< 1.2			
	7	54	0.051	< 1.4			
	10	52	0.042	< 1.3			
Air 1	9	52	0.043	< 0.8	0.3	0.06	
	3	68	0.019	< 2.8			
	5	68	0.018	< 6.4			
	6	67	0.018	< 1.6			
	7	65	0.016	< 3.4			
Air 2	6	65	0.021	< 2.7	0.3	0.06	
	3	65	0.018	< 2.2			
	6	63	0.017	< 6.3			
	7	65	0.010	< 2.6			
	7	64	0.011	< 3.7			
Air 3	6	62	0.010	< 2.3	0.3	0.06	
	3	67	0.045	< 1.8			
	5	65	0.056	< 3.0			
	7	64	0.042	< 1.7			
	7	64	0.052	< 1.5			
Air 3	6	62	0.044	< 1.9	0.3	0.06	
	6	62	0.044	< 1.9			

PM10 Assessment Report (for winter 2017-2018)

Rev01

Point of measurement	Temperature, °C	Relative humidity, %	PM10, mg/ m ³	Wind speed, m/ sec	MPC max, mg/ m ³	MPC daily average, mg/ m ³	Compliance
Air 4	3	72	0.047	< 1.5	0.3	0.06	
	4	70	0.014	< 2.2			
	6	70	0.017	< 2.4			
	7	68	0.039	< 1.1			
	6	65	0.048	< 2.4			
Air 5	3	70	0.018	< 1.0	0.3	0.06	
	5	68	0.023	< 0.8			
	6	67	0.021	< 1.0			
	7	65	0.023	< 1.3			
	7	65	0.017	< 1.1			
27.01.2018							
Air 1	2	75	0.007	< 1.0	0.3	0.06	
	4	72	0.010	< 1.4			
	5	72	0.008	< 1.3			
	6	70	0.005	< 1.2			
	6	71	0.007	< 1.7			
Air 2	2	76	0.005	< 1.3	0.3	0.06	
	5	74	0.005	< 1.0			
	5	72	0.014	< 1.6			
	6	72	0.017	< 1.7			
	6	72	0.020	< 1.3			
Air 3	2	75	0.008	< 1.1	0.3	0.06	
	4	73	0.009	< 1.0			
	5	70	0.011	< 1.4			
	6	72	0.008	< 1.2			
	5	71	0.012	< 1.3			
Air 4	1	69	0.014	< 1.0	0.3	0.06	
	3	68	0.009	< 0.7			
	5	65	0.013	< 1.4			
	6	64	0.014	< 1.2			
	5	64	0.015	< 1.4			
Air 5	1	71	0.016	< 1.3	0.3	0.06	
	4	68	0.023	< 0.7			
	6	67	0.012	< 1.2			
	6	65	0.015	< 1.3			
	5	64	0.011	< 0.9			
28.01.2018							
Air 1	1	48	0.014	< 1.8	0.3	0.06	
	3	48	0.013	< 2.6			
	6	46	0.014	< 1.7			
	7	45	0.018	< 2.4			
	5	46	0.008	< 2.0			
Air 2	1	44	0.012	< 1.2	0.3	0.06	
	4	45	0.010	< 1.9			
	6	43	0.011	< 1.6			
	7	42	0.010	< 2.1			
	7	43	0.021	< 1.8			
Air 3	1	50	0.014	< 1.4	0.3	0.06	
	4	50	0.013	< 1.7			
	6	48	0.014	< 1.7			
	7	48	0.018	< 1.6			
	6	47	0.008	< 1.8			
Air 4	0	50	0.014	< 1.8	0.3	0.06	
	3	47	0.013	< 1.8			
	5	45	0.014	< 1.4			
	6	45	0.013	< 2.1			
	5	44	0.013	< 2.0			

PM10 Assessment Report (for winter 2017-2018)

Rev01

Point of measurement	Temperature, °C	Relative humidity, %	PM10, mg/ m ³	Wind speed, m/ sec	MPC max, mg/ m ³	MPC daily average, mg/ m ³	Compliance
Air 5	1	54	0.036	<0.8	0.3	0.06	
	3	52	0.041	<0.9			
	6	53	0.036	<1.4			
	6	50	0.031	<1.2			
	5	50	0.023	<1.0			
29.01.2018							
Air 1	0	36	0.013	<0.8	0.3	0.06	
	2	36	0.009	<1.3			
	4	35	0.008	<1.7			
	6	35	0.011	<1.6			
	6	34	0.010	<1.7			
Air 2	1	38	0.015	<1.8	0.3	0.06	
	3	36	0.028	<2.2			
	5	35	0.010	<1.7			
	6	34	0.008	<1.2			
	6	33	0.007	<1.2			
Air 3	1	35	0.011	<1.7	0.3	0.06	
	3	35	0.045	<1.6			
	4	33	0.035	<1.7			
	6	32	0.042	<1.1			
	6	32	0.037	<1.2			
Air 4	0	34	0.026	<1.1	0.3	0.06	
	2	33	0.021	<0.6			
	5	34	0.014	<1.1			
	6	32	0.014	<1.2			
	5	34	0.021	<1.5			
Air 5	0	40	0.016	<1.0	0.3	0.06	
	2	39	0.032	<1.3			
	4	39	0.033	<1.5			
	6	37	0.028	<1.5			
	6	38	0.044	<0.7			
30.01.2018							
Air 1	0	36	0.042	<1.6	0.3	0.06	
	2	36	0.039	<2.1			
	6	36	0.034	<1.4			
	7	34	0.031	<1.4			
	7	31	0.045	<1.1			
Air 2	1	34	0.046	<1.0	0.3	0.06	
	3	33	0.032	<1.1			
	7	32	0.030	<0.7			
	7	30	0.038	<1.2			
	7	32	0.037	<1.4			
Air 3	0	40	0.031	<1.4	0.3	0.06	
	3	39	0.027	<1.6			
	6	37	0.061	<1.8			
	7	38	0.044	<1.3			
	7	36	0.056	<1.1			
Air 4	0	42	0.033	<0.8	0.3	0.06	
	3	40	0.034	<0.9			
	7	40	0.017	<1.4			
	6	40	0.053	<1.4			
	6	38	0.051	<1.3			
Air 5	0	38	0.018	<0.9	0.3	0.06	
	2	37	0.018	<0.7			
	6	36	0.029	<1.3			
	6	37	0.041	<1.4			
	6	36	0.017	<1.5			

PM10 Assessment Report (for winter 2017-2018)

Rev01

Point of measurement	Temperature, °C	Relative humidity, %	PM10, mg/ m ³	Wind speed, m/ sec	MPC max, mg/ m ³	MPC daily average, mg/ m ³	Compliance
31.01.2018							
Air 1	2	39	0.019	< 1.2	0.3	0.06	
	4	38	0.014	< 1.4			
	7	39	0.033	< 1.1			
	8	34	0.013	< 1.3			
	7	35	0.016	< 1.0			
Air 2	2	40	0.041	< 1.7	0.3	0.06	
	4	38	0.051	< 1.8			
	8	38	0.038	< 1.4			
	9	37	0.032	< 1.3			
	8	38	0.028	< 0.8			
Air 3	2	42	0.013	< 1.1	0.3	0.06	
	5	40	0.017	< 1.7			
	8	41	0.015	< 1.8			
	8	38	0.016	< 1.6			
	7	37	0.026	< 1.4			
Air 4	1	41	0.015	< 1.0	0.3	0.06	
	4	40	0.016	< 1.1			
	8	38	0.015	< 1.2			
	8	37	0.015	< 1.5			
	7	36	0.015	< 1.4			
Air 5	1	44	0.047	< 1.8	0.3	0.06	
	4	42	0.045	< 2.2			
	7	42	0.044	< 2.3			
	8	40	0.034	< 1.7			
	8	41	0.031	< 1.4			
01.02.2018							
Air 1	3	35	0.011	< 1.8	0.3	0.06	
	7	34	0.010	< 2.8			
	10	34	0.008	< 2.1			
	11	30	0.007	< 2.3			
	10	31	0.005	< 1.4			
Air 2	4	32	0.006	< 1.9	0.3	0.06	
	8	30	0.008	< 2.2			
	10	30	0.006	< 1.5			
	11	28	0.005	< 1.6			
	11	28	0.007	< 1.8			
Air 3	4	33	0.006	< 1.8	0.3	0.06	
	8	30	0.009	< 1.7			
	11	29	0.005	< 1.8			
	11	28	0.006	< 1.2			
	10	27	0.005	< 1.3			
Air 4	3	36	0.007	< 1.4	0.3	0.06	
	8	31	0.006	< 1.1			
	10	30	0.005	< 1.3			
	11	31	0.008	< 1.0			
	11	30	0.008	< 1.2			
Air 5	3	37	0.010	< 1.4	0.3	0.06	
	7	34	0.011	< 2.1			
	11	30	0.009	< 1.3			
	11	31	0.008	< 1.7			
	10	32	0.006	< 2.0			
02.02.2018							
Air 1	4	34	0.045	< 1.8	0.3	0.06	
	7	31	0.017	< 3.2			
	11	30	0.016	< 1.7			
	12	31	0.042	< 2.9			

PM10 Assessment Report (for winter 2017-2018)

Rev01

Point of measurement	Temperature, °C	Relative humidity, %	PM10, mg/ m ³	Wind speed, m/ sec	MPC max, mg/ m ³	MPC daily average, mg/ m ³	Compliance				
Air 2	11	30	0.016	<2.0	0.3	0.06					
	3	36	0.046	<1.2							
	8	35	0.014	<1.8							
	12	33	0.049	<1.9							
	12	32	0.051	<1.4							
Air 3	10	31	0.034	<1.5	0.3	0.06					
	3	32	0.049	<1.4							
	7	30	0.052	<1.6							
	11	29	0.056	<1.4							
	11	28	0.055	<1.7							
Air 4	10	28	0.050	<1.0	0.3	0.06					
	3	34	0.016	<1.0							
	7	30	0.012	<1.1							
	10	29	0.024	<1.3							
	12	28	0.015	<0.9							
Air 5	11	28	0.030	<1.1	0.3	0.06					
	3	37	0.046	<1.6							
	6	35	0.046	<2.7							
	10	32	0.038	<2.1							
	11	31	0.049	<2.4							
Air 1	11	30	0.047	<2.1	0.3	0.06					
	03.02.2018										
	3	33	0.028	<1.6				0.3	0.06		
	5	31	0.022	<2.0							
	7	30	0.027	<1.6							
8	29	0.020	<1.9								
8	29	0.029	<1.0								
Air 2	3	35	0.033	<1.1	0.3	0.06					
	6	34	0.019	<1.2							
	8	32	0.054	<1.4							
	9	30	0.037	<0.9							
	8	30	0.032	<1.2							
Air 3	2	36	0.026	<1.8	0.3	0.06					
	6	35	0.021	<2.1							
	7	32	0.032	<1.7							
	8	33	0.035	<1.4							
	7	31	0.047	<1.1							
Air 4	2	38	0.028	<1.5	0.3	0.06					
	5	35	0.031	<1.4							
	6	36	0.037	<1.2							
	8	32	0.039	<1.7							
	8	32	0.040	<1.0							
Air 5	2	39	0.036	<1.5	0.3	0.06					
	5	36	0.032	<1.4							
	7	36	0.041	<1.1							
	8	34	0.035	<1.4							
	8	33	0.029	<2.0							

PM10 Assessment Report (for winter 2017-2018)

Rev01

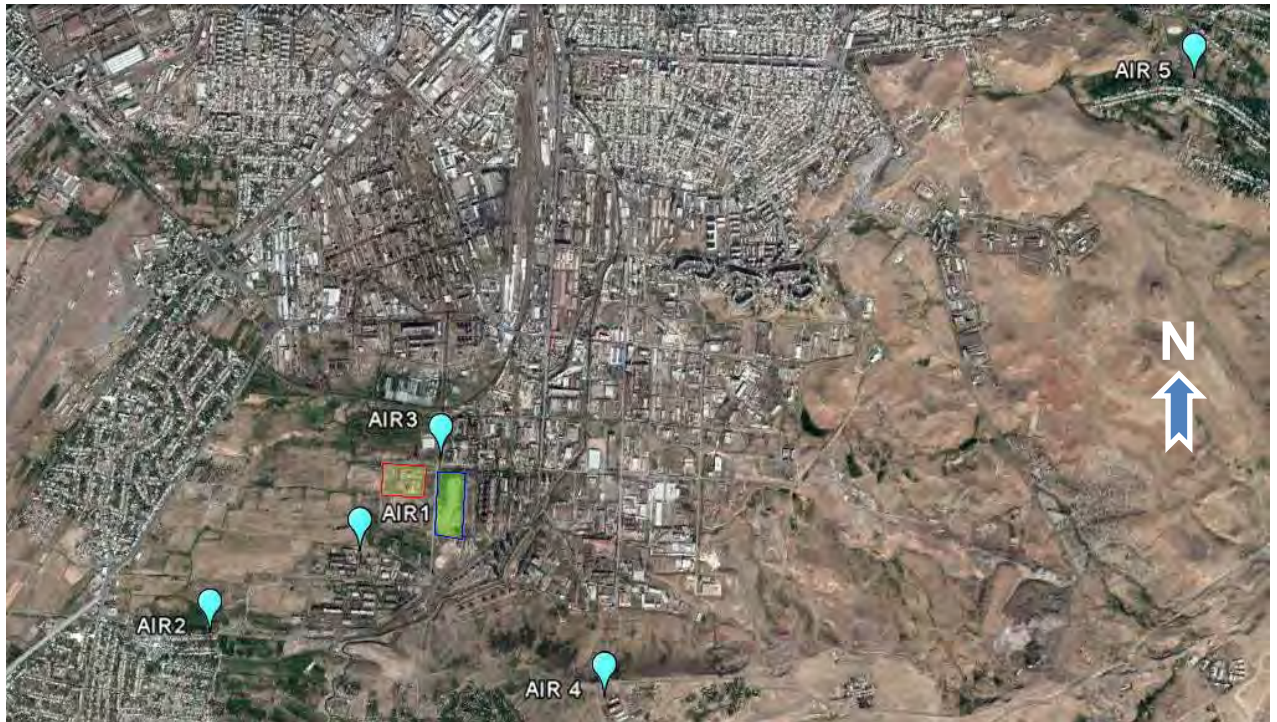
Main conclusions

- 1) 750 instrumental measurements were conducted in 5 sensitive points (Air 1, Air 2, Air 3, Air 4 and Air 5) during 30 days to determine the PM10 actual concentration. 5 measurements were conducted at each point per day, which means that totally 150 PM10 measurements were carried out at each point. The results of the study were compared with PM permissible concentrations (maximal is 0.3 mg/m^3 and daily average is 0.06 mg/m^3).
- 2) PM10 (dust particles of 10um size) actual concentrations at all sensitive points (Air 1, Air 2, Air 3, Air 4 and Air 5) in different daytime periods during the 30 days measurements don't exceed the daily average and maximum permissible concentrations for residential areas set by the RA Government Decree N^o160-N "Norms of maximum permissible concentrations of atmospheric air pollutants in residential areas".

PM10 Assessment Report (for winter 2017-2018)

Rev01

ANNEX 1. Map of measurement points



PM10 Assessment Report (for winter 2017-2018)

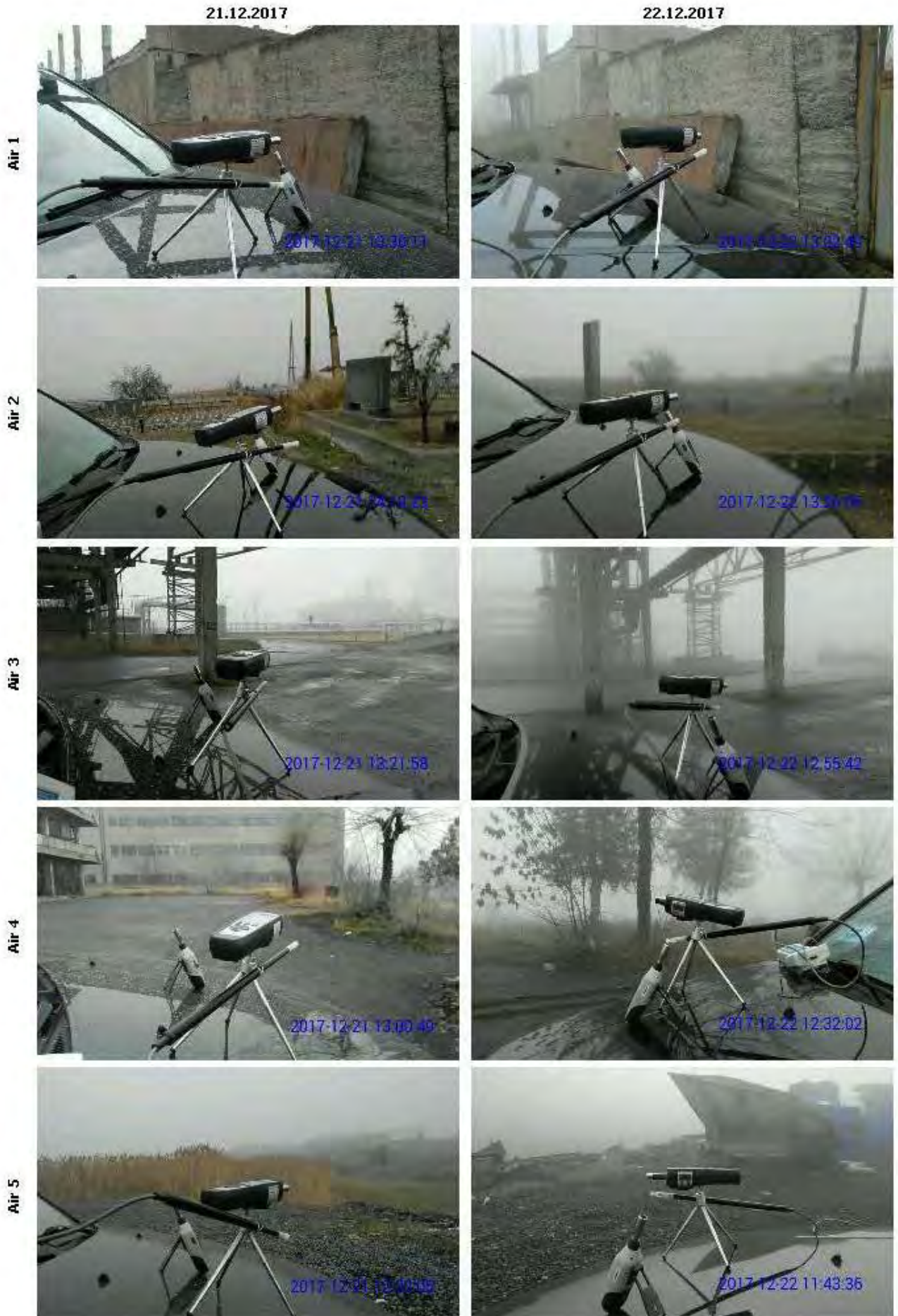
Rev01

ANNEX 2. Pictures of measurements process at monitoring points



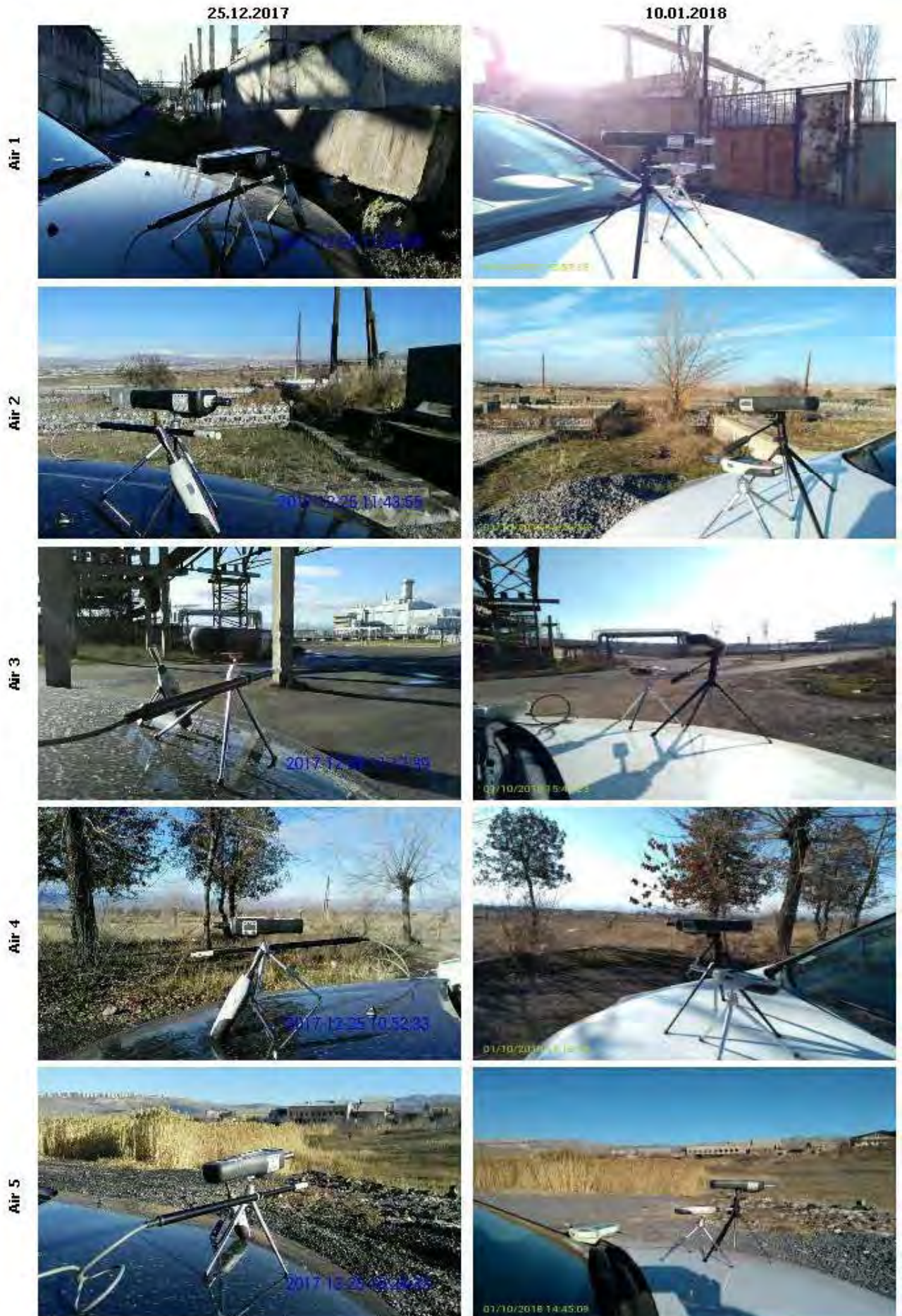
PM10 Assessment Report (for winter 2017-2018)

Rev01



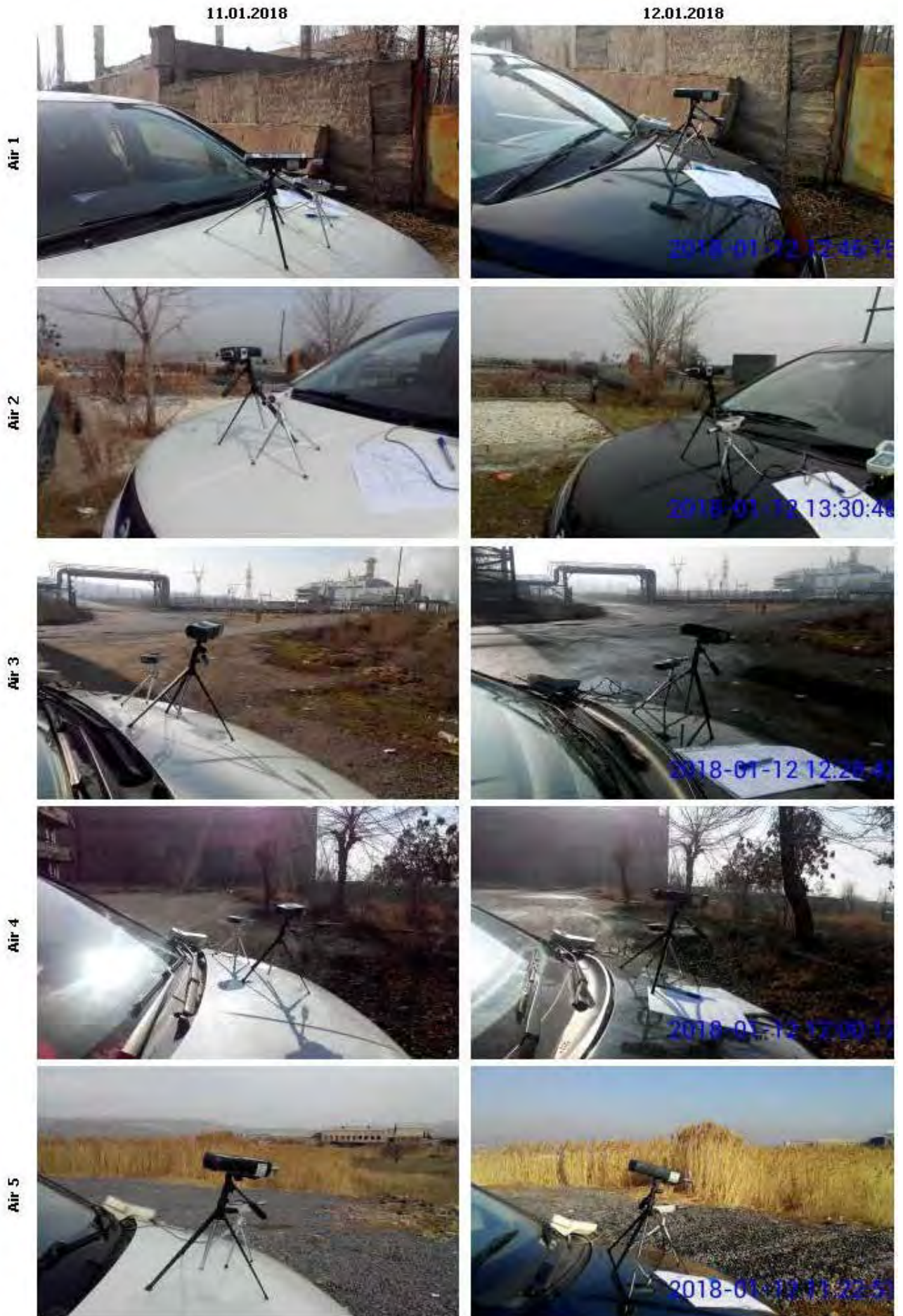
PM10 Assessment Report (for winter 2017-2018)

Rev01



PM10 Assessment Report (for winter 2017-2018)

Rev01



PM10 Assessment Report (for winter 2017-2018)

Rev01



PM10 Assessment Report (for winter 2017-2018)

Rev01



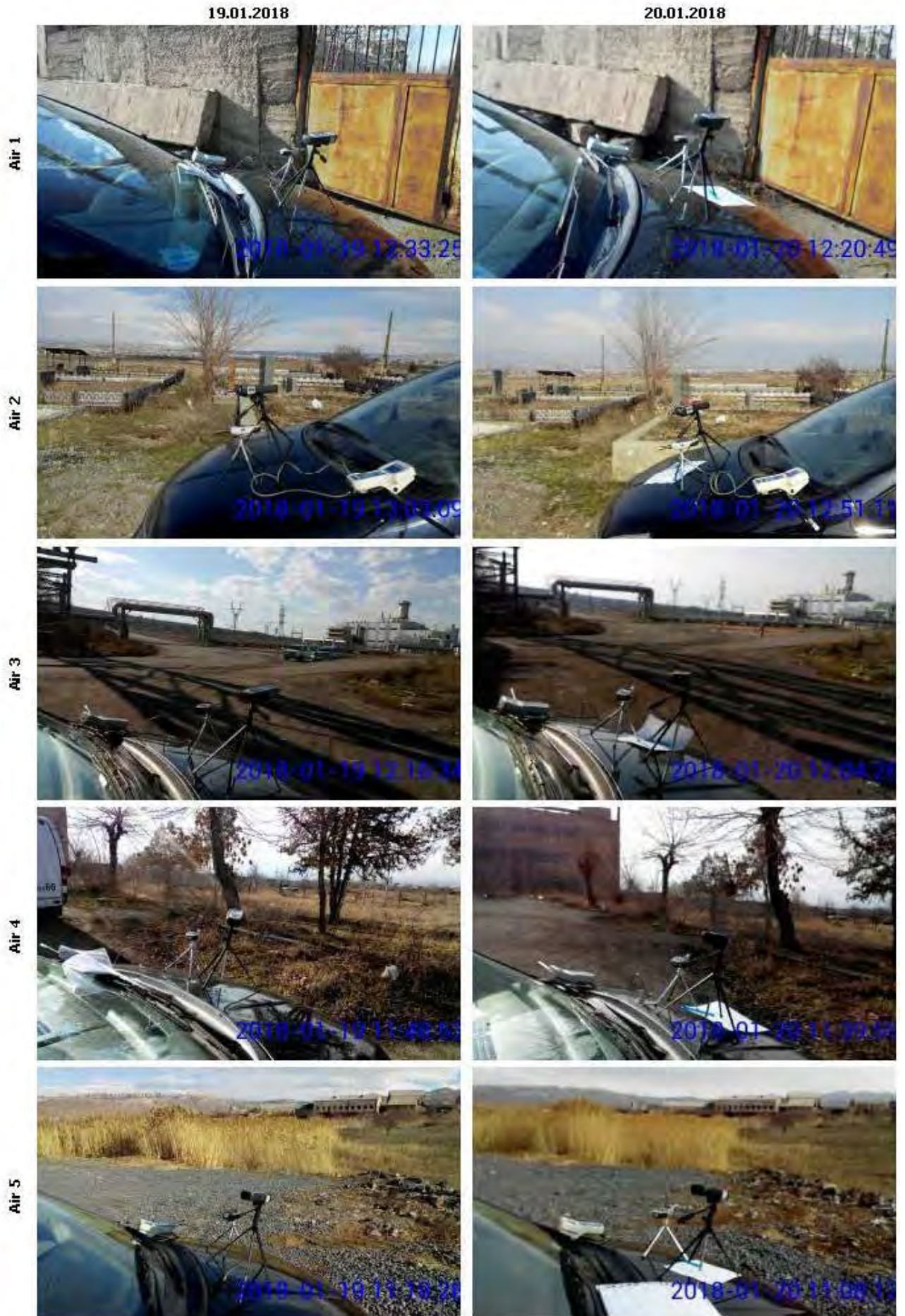
PM10 Assessment Report (for winter 2017-2018)

Rev01



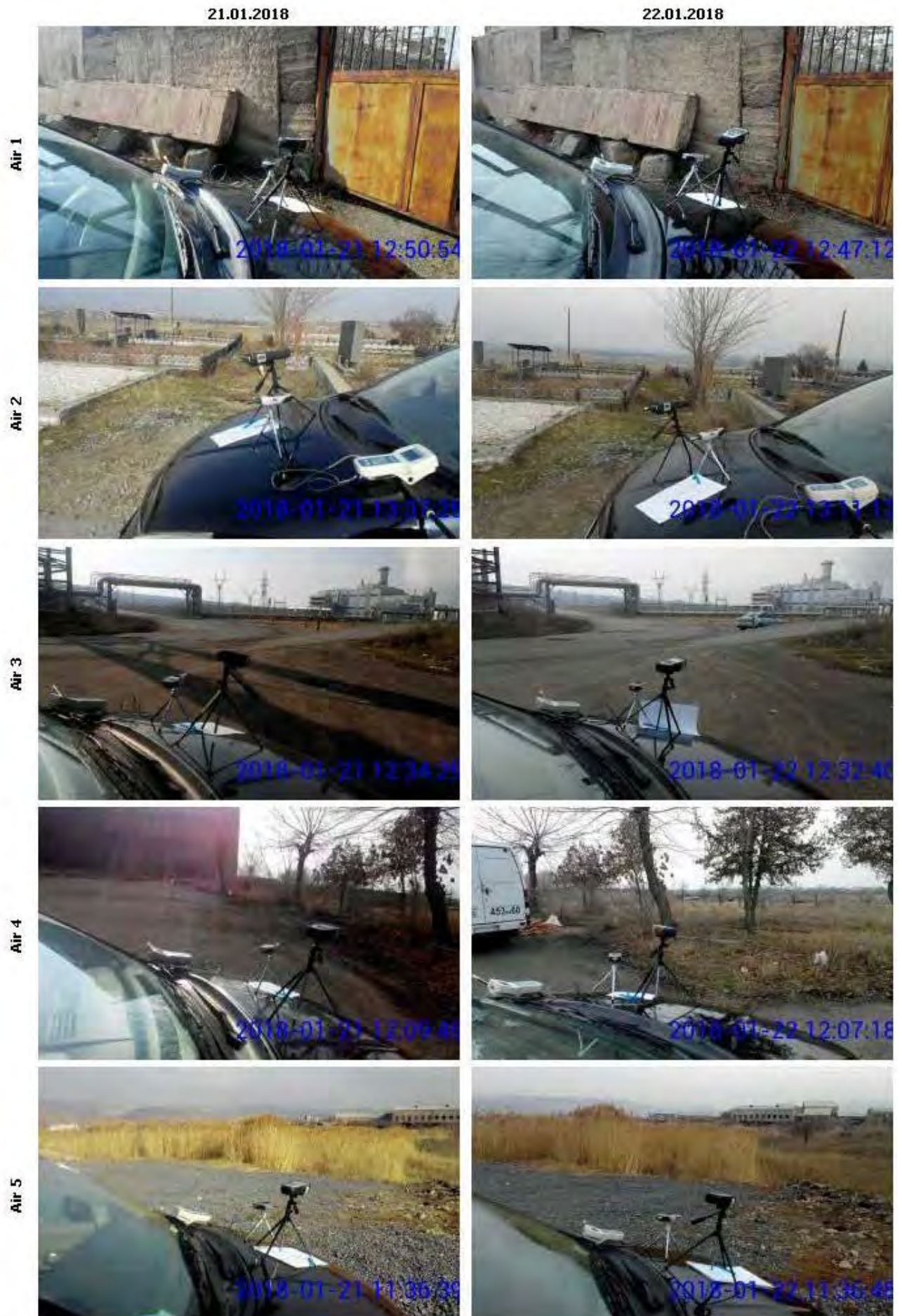
PM10 Assessment Report (for winter 2017-2018)

Rev01



PM10 Assessment Report (for winter 2017-2018)

Rev01



PM10 Assessment Report (for winter 2017-2018)

Rev01



PM10 Assessment Report (for winter 2017-2018)

Rev01



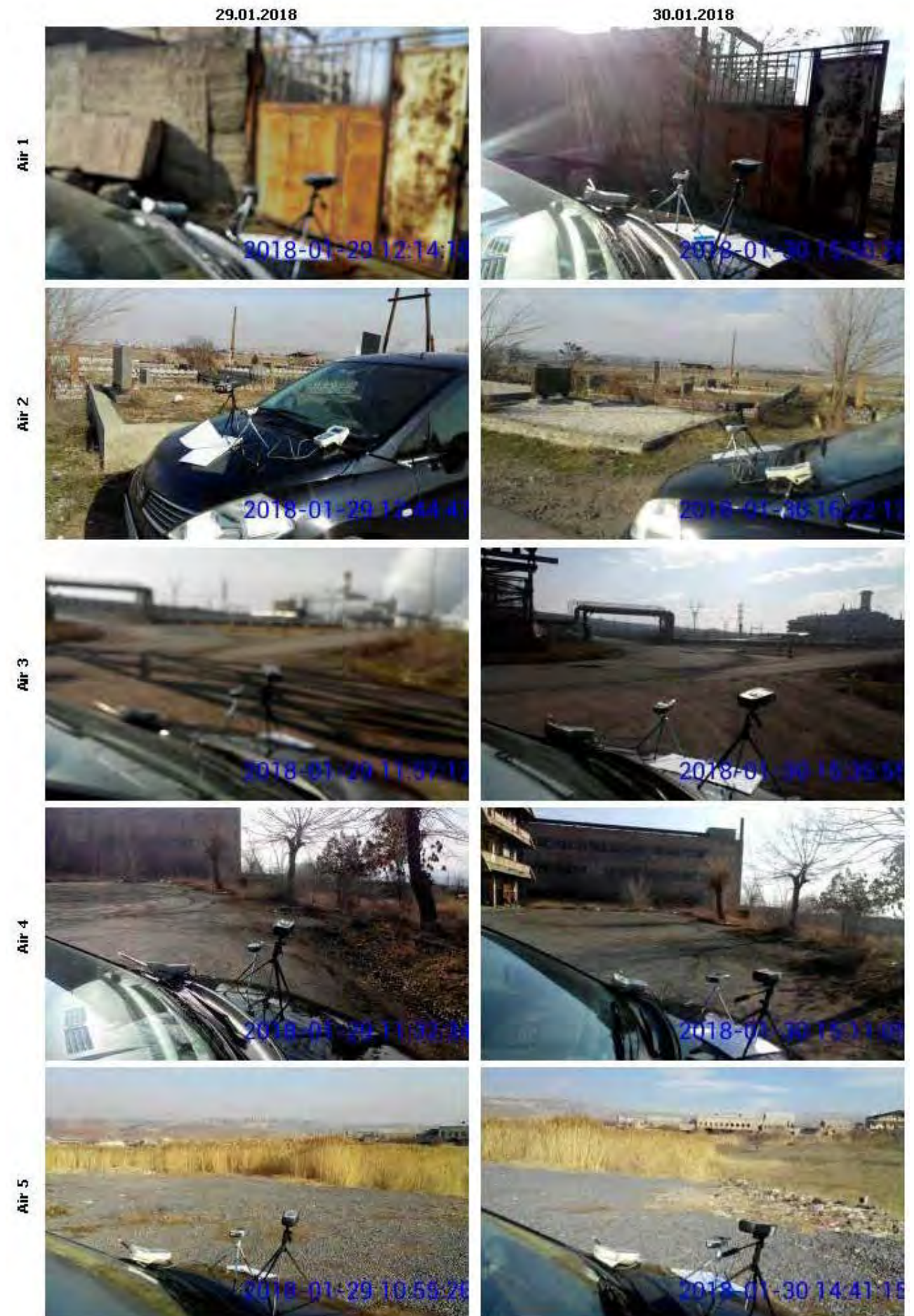
PM10 Assessment Report (for winter 2017-2018)

Rev01



PM10 Assessment Report (for winter 2017-2018)

Rev01



PM10 Assessment Report (for winter 2017-2018)

Rev01



PM10 Assessment Report (for winter 2017-2018)

Rev01



PM10 Assessment Report (for winter 2017-2018)

Rev01

ANNEX 3. Verification documents of measuring devices

ՀԱՅԱՍՏԱՆԻ ՀԱՆՐԱՊԵՏՈՒԹՅԱՆ
ԷԿՈՆՈՄԻԿԱՅԻ
ՆԱԽԱՐԱՐՈՒԹՅՈՒՆ



ՉՓԱԳԻՏՈՒԹՅԱՆ ԱԶԳԱՅԻՆ
ԻՆՍՏԻՏՈՒՏ ՓԲԸ
(ՉՓԱԳԻՏՈՒԹՅԱՆ ԱԶԳԱՅԻՆ
ՄԱՐՄԻՆ)

ՎԿԱՅԱԿԱՆ № 017243
ՍՏՈՒԳԱԶՈՓՄԱՆ ՄԱՍԻՆ

Ստուգաչափման թվականը 2018թ. 01 «18»
Ուժի մեջ է մինչև 2018թ. 01 «18»

Մ. Կոչարյան
Հախման միջոցի մականունը և տեսակը
ՃԾԵԿ. 431110.02 ՇԾ

Գործարանային հմ. **89690**
Չափման տիրույթը **(-10 ÷ 50)°C ; (3 ÷ 92) % Հ.Կ. (30 ÷ 110) քմ/ս**
ճշտության դասը, կարգը (սխալանքը) **±0,2°C ; ±3% ; ±0,13 քմ/ս**
Արտադրողը **Վ. Մանուկյան (1 Քեմեկ - ՅՈՒՆԻՍԿԵՊ)**

Պատկանում է **Վ. Կոչարյան, Արմ. Կոչարյան**
իրավարանական (ֆիզիկական անձի) անվանումը (անունը)

Ստուգաչափման արդյունքների հիման վրա չափման միջոցը ճանաչվել է
պիտանի և թույլատրվում է կիրառման:
Ստուգաչափումը կատարվել է համաձայն **ՄՊ**
ստուգաչափման մեթոդիկայի անվանումը, նշագիրը

Ստուգաչափող **Վ. Կոչարյան**
Դրոշմի արտատիպը

Բաժնի (լաբորատորիայի)
ղեկավար **Վ. Կոչարյան**

Պատասխանատվություն է կրող միակից նախարարի 14.02.2013թ. թիվ 104-Ն, հրամանով
Գրանցված է 33 Արդարադատության նախարարության կողմից 21.03.2013թ. թիվ 10313102

9.2 Annex 2: NO₂ and SO₂ Baseline Studies

REPORT

On Air Monitoring

In July-August 2017, air sampling from 5 points was carried out by the task presented by FICHTNER specialists.

Sampling was performed by natural diffusion method, through passive samplers.

The duration of all sampling was 7 days, the exact time of installation and removal was fixed for days, hours and minutes.

The samplers after removal were transported to the Laboratory of Environmental Monitoring and Information Center of the Ministry of Nature Protection, where the content of SO₂ and NO₂ were determined by the chemical analysis method.

Measurement results are given below.

Table 1. Point coordinates

Point	Latitude	Longitude
Air 1	40° 6'39.08"N	44°29'35.57"E
Air 2	40° 6'20.92"N	44°28'49.68"E
Air 3	40° 7'0.26"N	44°30'0.58"E
Air 4	40° 6'6.11"N	44°30'51.85"E
Air 5	40° 8'25.39"N	44°33'41.81"E

Table 2. Results of the analysis according to points

Name of pollutants	Allowed pollutant concentrations: ¹ , mg/m ³		Air 1	Air 2	Air 3	Air 4	Air 5
	Average daily	Maximum short term					
NO ₂	0.04	0.2	0.016	0.0119	0.0213	0.0201	0.0092
SO ₂	0.05	0.5	0.0194	0.0221	0.0284	0.0328	0.0317

¹ Maximum Permissible Concentration of Air Polluting Substances in Settlements and Maximum Permissible Norms of Hazardous Substances in Emissions from Vehicles Operated in the Republic of Armenia (Decree of the Government of Armenia No. 160-N dated 2 February 2006)

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REPORT N2 (Autumn)

On Air Monitoring

Yerevan, November 15, 2017

In November 2017, air sampling from 5 points was carried out by the task presented by FICHTNER specialists.

Sampling was performed by natural diffusion method, through passive samplers.

The duration of all sampling was 10 days because the rainy weather, the exact time of installation and removal was fixed for days, hours and minutes.

The samplers after removal were transported to the Laboratory of Environmental Monitoring and Information Center of the Ministry of Nature Protection, where the content of SO₂ and NO₂ were determined by the chemical analysis method.

Measurement results are given below.

Table 1. Point coordinates

Point	Latitude	Longitude
Air 1	40° 6'39.08"N	44°29'35.57"E
Air 2	40° 6'20.92"N	44°28'49.68"E
Air 3	40° 7'0.26"N	44°30'0.58"E
Air 4	40° 6'5.35"N	44°30'49.03"E
Air 5	40° 8'25.39"N	44°33'41.81"E

Table 2. Results of the analysis according to points

Name of pollutants	Allowed pollutant concentrations: ¹ , mg/m ³		Air 1	Air 2	Air 3	Air 4	Air 5	Average
	Average daily	Maximum short term						
NO ₂	0.04	0.2	0.0043	0.0047	0.0045	0.0047	0.0047	0.0046
SO ₂	0.05	0.5	0.0187	0.0267	0.0197	0.0262	0.0335	0.0250

Director

V.Tevosyan

¹ Maximum Permissible Concentration of Air Polluting Substances in Settlements and Maximum Permissible Norms of Hazardous Substances in Emissions from Vehicles Operated in the Republic of Armenia (Decree of the Government of Armenia No. 160-N dated 2 February 2006)

Պատվիրատուի անուն՝ «Քոնսեկոարդ» ՍՊԸ
 Նմուշառման ամսաթիվ՝ 02-13.11.2017թ.
 Արդյունքների տրման ամսաթիվ՝ 14.11.2017թ.

ՀԱՍՏԱՏՈՒՄ ԵՄ
 «Շրջակա միջավայրի մոնիթորինգի և
 տեղեկատվության կենտրոն» ՊՈԱԿ-ի
 մասնաճյուղի տեղակալ



Գ. Շահնազարյան

[Signature]
 « 14 » « 11 » 2017թ.

ՋէԿ-ի մերձակա տարածքի մթնոլորտային օդի որակի երկրորդ ուսումնասիրության արդյունքները

Նմուշառման դիտակետի համար	Ուսումնասիրվող դիտակետում միջին կոնցենտրացիա, մգ/մ ³	
	ՍԹԿ _{միջ.օր} = 0,05	ՍԹԿ _{միջ.օր} = 0,04
	Ծծմբի երկօքսիդ	Ազոտի երկօքսիդ
PS1	0.0187	0.0043
PS2	0.0267	0.0047
PS3	0.0197	0.0045
PS4	0.0262	0.0047
PS5	0.0335	0.0047
Ուսումնասիրվող տարածքում միջին կոնցենտրացիա, մգ/մ ³	0.0250	0.0046

ՍԹԿ-սահմանային թույլատրելի կոնցենտրացիա

Օդի որակի ուսումնասիրության լաբորատորիայի վարիչ / *[Signature]* Ա. Գաբրիելյան

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REPORT N3 (winter)

On Air Monitoring

Yerevan, February 1, 2018

In December 2017 – January 2018, air sampling from 5 points was carried out by the task presented by FICHTNER specialists. Such measurements have been done for 3 times.

Sampling was performed by natural diffusion method, through passive samplers.

The duration of each sampling was 10 days, the exact time of installation and removal was fixed for days, hours and minutes.

The samplers after removal were transported to the Laboratory of Environmental Monitoring and Information Center of the Ministry of Nature Protection, where the content of SO₂ and NO₂ were determined by the chemical analysis method.

Measurement results are given below.

Table 1. Point coordinates

Point	Latitude	Longitude
Air 1	40° 6'39.08"N	44°29'35.57"E
Air 2	40° 6'20.92"N	44°28'49.68"E
Air 3	40° 7'0.26"N	44°30'0.58"E
Air 4	40° 6'5.35"N	44°30'49.03"E
Air 5	40° 8'25.39"N	44°33'41.81"E

Table 2. Results of the analysis according to points: December 29, 2017 – January 8, 2018

Name of pollutants	Allowed pollutant concentrations ¹ , mg/m ³		Air 1	Air 2	Air 3	Air 4	Air 5	Average
	Average daily	Maximum short term						
NO ₂	0.04	0.2	0.0171	0.0229	0.0265	0.0191	0.0259	0.0223
SO ₂	0.05	0.5	0.0387	0.0238	0.0211	0.0118	0.0120	0.0215

¹ Maximum Permissible Concentration of Air Polluting Substances in Settlements and Maximum Permissible Norms of Hazardous Substances in Emissions from Vehicles Operated in the Republic of Armenia (Decree of the Government of Armenia No. 160-N dated 2 February 2006)

Table 3. Results of the analysis according to points: January 9, 2018 - January 19, 2018

Name of pollutants	Allowed pollutant concentrations, mg/m ³		Air 1	Air 2	Air 3	Air 4	Air 5	Average
	Average daily	Maximum short term						
NO ₂	0.04	0.2	0.0184	0.0082	0.0152	0.0195	0.0153	0.0153
SO ₂	0.05	0.5	0.0116	0.0101	0.0283	0.0062	0.0284	0.0169

Table 4. Results of the analysis according to points: January 19, 2018 - January 29, 2018

Name of pollutants	Allowed pollutant concentrations, mg/m ³		Air 1	Air 2	Air 3	Air 4	Air 5	Average
	Average daily	Maximum short term						
NO ₂	0.04	0.2	0.0120	0.0170	0.0188	0.0115	0.0170	0.0156
SO ₂	0.05	0.5	0.0259	0.0189	0.0202	0.0334	0.0375	0.0272

Table 5. Average figures for 3 measurements of winter campaign

Name of pollutants	Allowed pollutant concentrations, mg/m ³		Average
	Average daily	Maximum short term	
NO ₂	0.04	0.2	0.01773
SO ₂	0.05	0.5	0.02187

Director

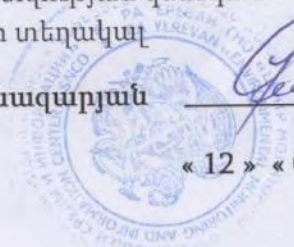
V.Tevosyan

Պատվիրատուի անուն՝ «Քոնսեկոարդ» ՍՊԸ
 Նմուշառման ամսաթիվ՝ 29.12.2017-08.01.2018թ.
 Արդյունքների տրման ամսաթիվ՝ 12.01.2018թ.

ՀԱՍՏԱՏՈՒՄ ԵՄ
 «Շրջակա միջավայրի մոնիթորինգի և
 տեղեկատվության կենտրոն» ՊՈԱԿ-ի
 սնօրենի տեղակալ

Գ. Շահնազարյան

« 12 » « 01 » 2018թ.



Երևան ՋԷԿ-ի մերձակա բնակելի հատվածում մթնոլորտային օդի որակի ձևեռային N 1
 ուսումնասիրության արդյունքները

Նմուշառման դիտակետի համար	Ուսումնասիրվող դիտակետում միջին օրական կոնցենտրացիա, մգ/մ ³	
	ՄԹԿ _{միջ.օր} = 0,05	ՄԹԿ _{միջ.օր} = 0,04
	Ծմբի երկօրսիդ	Ազոտի երկօրսիդ
PS1	0,0387	0,0171
PS2	0,0238	0,0229
PS3	0,0211	0,0265
PS4	0,0118	0,0191
PS5	0,0120	0,0259
Ուսումնասիրվող տարածքում միջին կոնցենտրացիա, մգ/մ ³	0,0215	0,0223

ՄԹԿ-սահմանային թույլատրելի կոնցենտրացիա

Օդի որակի ուսումնասիրության լաբորատորիայի վարիչ

Ա. Գաբրիելյան

Պատվիրատուի անուն՝ «Քոնսեկոարդ» ՍՊԸ
 Նմուշառման ամսաթիվ՝ 09.01-19.01.2018թթ.
 Արդյունքների տրման ամսաթիվ՝ 30.01.2018թ.

ՀԱՍՏԱՏՈՒՄ ԵՄ
 «Շրջակա միջավայրի մոնիթորինգի և
 տեղեկատվության կենտրոն» ՊՈԱԿ-ի
 տնօրենի տեղակալ

Գ. Շահնազարյան

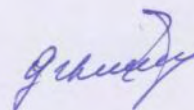
« 30 » « 01 » 2018թ.

Երևան ՋԷԿ-ի մերձակա բնակելի հատվածում մթնոլորտային օդի որակի
 ձևեռային N 2 ուսումնասիրության արդյունքները

Նմուշառման դիտակետի համար	Ուսումնասիրվող դիտակետում միջին օրական կոնցենտրացիա, մգ/մ ³	
	ՍԹԿ _{միջ.օր} = 0,05	ՍԹԿ _{միջ.օր} = 0,04
	Օծմբի երկօքսիդ	Ազոտի երկօքսիդ
PS1	0.0116	0.0184
PS2	0.0101	0.0082
PS3	0.0283	0.0152
PS4	0.0062	0.0195
PS5	0.0284	0.0153
Ուսումնասիրվող տարածքում միջին կոնցենտրացիա, մգ/մ ³	0.0169	0.0153

ՍԹԿ-սահմանային թույլատրելի կոնցենտրացիա

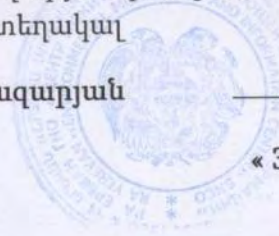
Օդի մոնիթորինգի լաբորատորիայի վարիչ

 Ա. Գաբրիելյան

Պատվիրատուի անուն՝ «Քոնսեկոարդ» ՍՊԸ
 Նմուշառման ամսաթիվ՝ 19.01-29.01.2018թթ.
 Արդյունքների տրման ամսաթիվ՝ 30.01.2018թ.

ՀԱՍՏԱՏՈՒՄ ԵՄ
 «Շրջակա միջավայրի մոնիթորինգի և
 տեղեկատվության կենտրոն» ՊՈԱԿ-ի
 տնօրենի տեղակալ

Գ. Շահնազարյան



[Handwritten signature]

« 30 » « 01 » 2018թ.

Երևան ՋԷԿ-ի մերձակա բնակելի հատվածում մթնոլորտային օդի որակի
 ձևեռային N 3 ուսումնասիրության արդյունքները

Նմուշառման դիտակետի համար	Ուսումնասիրվող դիտակետում միջին օրական կոնցենտրացիա, մգ/մ ³	
	ՄԹԿ _{միջ.օր} = 0,05	ՄԹԿ _{միջ.օր} = 0,04
	Ծծմբի երկօքսիդ	Ազոտի երկօքսիդ
PS1	0.0259	0.0120
PS2	0.0189	0.0170
PS3	0.0202	0.0188
PS4	0.0334	0.0115
PS5	0.0375	0.0170
Ուսումնասիրվող տարածքում միջին կոնցենտրացիա, մգ/մ ³	0.0272	0.0156

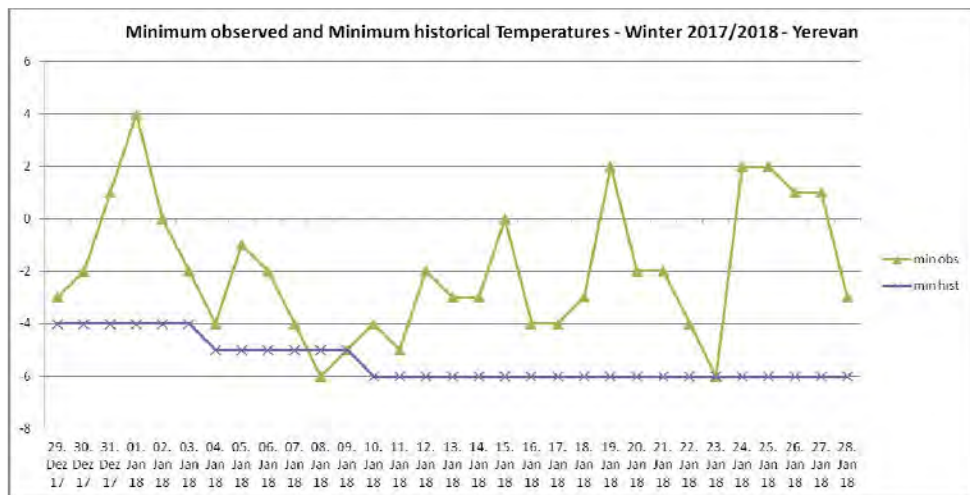
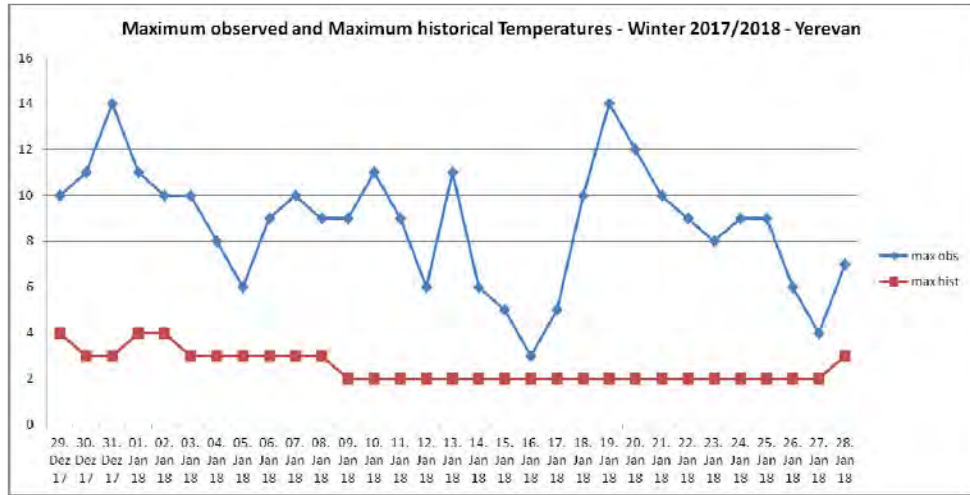
ՄԹԿ-սահմանային թույլատրելի կոնցենտրացիա

Օդի մոնիթորինգի լաբորատորիայի վարիչ

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Ա. Գաբրիելյան

9.3 Annex 3: Temperature statistics in Yerevan - Winter 2017 vs. historical data (raw data source: accuweather.com)



Yerevan 2 CC Power Plant Armpower CJSC

Stakeholder Engagement Plan



Source: Fichtner (July 2017)

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Table of Contents

1. Introduction	1-1
1.1 Brief Project description	1-1
2. Public Consultation Regulations and Requirements	2-1
2.1 National framework	2-1
2.2 International framework	2-1
2.2.1 Stakeholders	2-2
2.2.2 Information Disclosure	2-3
2.2.3 Public Consultation	2-4
2.2.4 Grievance Mechanism	2-6
3. Summary of previous stakeholder engagement activities	3-1
4. Project Stakeholders	4-1
5. Information disclosure and consultation methods	5-1
5.1 Engagement during the ESIA preparation	5-1
5.1.1 Notification of the project to the local authorities	5-1
5.1.2 Disclosure of the Draft Final ESIA and respective Non Technical Executive Summary	5-2
5.2 Engagement during construction	5-5
5.3 Engagement during operation	5-5
5.4 Documentation	5-6
6. Grievance Mechanism	6-1
6.1 General public grievance mechanism	6-1
6.2 Workers grievance mechanism	6-3
7. Timetable	7-1
8. Roles and responsibilities	8-1
8.1 Developer - ArmPower/RENCO	8-1
8.2 EPC Contractor - RENCO SPA	8-1
8.3 Project Operator - ArmPower/RENCO	8-2
8.4 Supporting roles - local authorities and NGOs	8-2
9. Final remarks	9-1
10. References	10-1

11. Annexes	11-1
11.1 Annex 1 - Invitations for the previous public consultation sessions	11-1
11.2 Annex 2 - Form for comments	11-1
11.3 Annex 3 - Stakeholder Log	11-2
11.4 Annex 4 - Public Grievances Form	11-3

List of Figures

Figure 5-1:	Project site and its vicinity	5-3
-------------	-------------------------------------	-----

List of Tables

Table 2-1:	Different techniques for undertaking Public Consultation (ADB, 2012)	2-5
Table 4-1:	Stakeholder Analysis List	4-2
Table 7-1:	Stakeholder Engagement and ESIA Schedule	7-1
Table 7-2:	Stakeholder Engagement Schedule during construction and operation....	7-2

1. Introduction

The present Final **Stakeholder Engagement Plan** (SEP) is prepared within the context of the Final Environmental and Social Impact Assessment (ESIA) of the Yerevan CCPP - 2 project.

The SEP describes the strategy and program to be implemented for engaging with the stakeholders of the Project in a culturally and timely appropriate manner. The goal is to ensure the timely provision of relevant and understandable information and to create a process that provides opportunities for stakeholders to express their opinions, aspirations and suggestions about environmental measures, eventual land acquisition and social impacts of the project, and that allows the Project Developer to consider and respond to them.

It is important to note that the Project has been in the past subject to a process of public consultation and that an Environmental Permit has been granted. The public engagement activities defined in the present SEP have as an objective to engage the public once more in a process that assures as well compliance with the requirements of the IFIs (International Financing Institutions) ADB (Asian Development Bank) and IFC (International Financing Corporation).

1.1 Brief Project description

The Ministry of Energy (MOE) of the Republic of Armenia plans to improve the total output capacity of its electric energy production, complementing the power units of the existing Yerevan Combined Cycle Thermal Power Plant (YCCPP-1) with a modern and efficient power plant. For this reason a new gas fired Combined Cycle Power Plant of 254 MWe (YCCPP-2) is planned to be built at the site next to the existing YCCPP-1, in an already industrialized region in the south of Yerevan.

The foreseen site location allows co-utilizing the existing auxiliary systems of YCCPP-1 such as water intake and discharge structures, fuel gas regulators, adjacent substation and devices. Possible alternative locations for the proposed new YCCPP-2 had been considered prior to opting for the foreseen site. On account to minimize the additional costs for newly developing such a site and modifying the transmission network to accommodate the new power plant, the foreseen site was selected together with MOE as a final option.

The Project has already been given national approval, which is documented in the following Conclusion: *RA Minister of Nature Protection (11.01.2017): State Expert Examination Conclusion on Expert Examination of Influence on the Environment BP 02. Report of evaluation of influence on environment of the new power station in Yerevan with combined cycle of steam and gas.*

The new CCPP will include a Gas Turbine (GT), a Steam Turbine (ST), and a Heat Recovery Steam Generator (HRSG) and all auxiliary equipment and systems that, at local condition with an ambient temperature of 15°C, will produce 254 MW. Interconnections to gas, water and electrical grid are already in place (the new CCPP will use interconnections of existing YCCPP-1).

RENCO SPA will be the EPC Contractor for this Project, which will be operated by ArmPower CJSC, a subsidiary company of RENCO SPA.

2. Public Consultation Regulations and Requirements

This Section provides a brief description of the national regulation of Armenia concerning the public participation in the process of ESIA. Also the IFIs' requirements in these matters are summarized.

The Project has been in the past subject to a process of public consultation and obtained the necessary environmental license. For this reason, the present SEP and the corresponding procedures are/will be undertaken with the main focus of respecting the standards of the IFIs.

2.1 National framework

The notification of stakeholders in the Republic of Armenia and the implementation of public hearings are regulated by the Law on Environmental Impact Assessment and Examination (Article 26).

The public hearings organization is carried out according to the procedure defined by the Decree N 1325-N dated 19.11.2014. Depending on the impact of the planned activity, 2 or 4 hearings are conducted. The first and third hearings are organized by the affected community and the customer, the second and fourth hearings by the affected community and the Expertise Center of the Ministry of Nature Protection with the participation of the client.

2.2 International framework

The SEP follows the IFIs requirements for public engagement, namely the ones depicted in the following documents:

- **ADB, 2009:** *Safeguard Policy Statement*, ADB, Philippines, 2009
- **ADB, 2012:** *Strengthening participation for development results - an Asian Development Bank guide to Participation*, ADB, Philippines, 2012
- **IFC, 1998:** *Doing Better Business through Effective Public Consultation and Disclosure - A Good Practice Manual*, IFC, Washington, D.C., October 1998
- **IFC, 2007:** *Stakeholder Engagement: a good practice handbook for companies doing business in emerging markets*, IFC, Washington, D.C., May 2007
- **IFC, 2012:** *Performance Standard 1 - Assessment and Management of Environmental and Social Risks and Impacts*, IFC, Washington, D.C., January 2012

The requirements of importance for the Project are summarized in the following sections.

2.2.1 Stakeholders

Stakeholders are those who will be or are likely to be directly or indirectly affected, positively or negatively, by a project (commonly referred to as project-affected people or project-affected communities), as well as those who might have an interest in, or may influence, the project (the “interested parties”).

Generally, stakeholders can be distributed in the following three groups (adapted from ADB, 2012 and IFC, 1998):

a) Civil society:

- General public: directly or indirectly affected population groups and subgroups (e.g., youth, girls, and women’s groups), and ethnic minority groups:
 - People owning land or assets impacted by the project, both on- and off-site.
 - People using agricultural land or natural resources, such as forests or rivers.
 - Squatters already on-site.
 - Immigrants attracted to the project and its potential labor benefits prior to implementation.
 - People’s organizations and institutions affected by the project, such as village development associations, recreational groups, women’s groups, farming and fishing cooperatives, and religious groups.
 - Locally disadvantaged and voiceless groups, such as the poor and women.
 - Indigenous or tribal peoples with special ties to land, or who have specific land, resource, and cultural rights that may be protected by national or international law.
 - People from surrounding villages who may be potential sources of labor.
- Civil society organizations: national and international NGOs, community-based organizations, foundations, labor unions, and independent research institutes.
- Informal representatives: scientific community, school teachers, religious leaders.

b) Government:

- Central Government: civil servants in ministries, cabinets, etc.
- Representative assemblies: elected government bodies (e.g., parliament, national and local assemblies, and elected community leaders)
- Bilateral and multilateral government institutions: international financial institutions, bilateral government donors, etc.

c) Private Sector:

- Private companies (including suppliers, customers, and contractors), umbrella groups representing groups in the private sector, and chambers of commerce.
- The media.

According to IFC PS 1 (2012), the stakeholders of the Project, including Affected Communities, shall be identified and a tailored SEP shall be prepared.

2.2.2 Information Disclosure

Disclosure is a formal-sounding term for making information accessible to stakeholders. Information is critical to the effective participation of affected citizens near the project. An informed public will better understand the trade-offs between project benefits and disadvantages; be able to contribute meaningfully to project design; and have greater trust in its new corporate neighbors. Communicating such information in a manner that is understandable to the stakeholders is an important first (and ongoing) step in the process of stakeholder engagement (IFC 2007; IFC 1998). Good practice principles in what concerns information disclosure are:

- **Early disclosure:** in order for the engagement process to be efficient, the disclosure of information about the project shall be undertaken early in the planning schedule, that is, before the decision-making has been finally undertaken and any impacts have been delivered. Only this way it is possible to include the stakeholders' visions and opinions on the decisions concerning the project.
- **Disclose objective information:** as far as possible, inform the stakeholders about numbers and facts (even if preliminary), so to avoid the creation of false expectations or unnecessary alarm.
- **Design disclosure to support consultation:** crucially, leave sufficient time between the provision of information about the benefits and disadvantages of the project (or changes to project operations and their implications) and the start of consultations.
- **Provide meaningful information:** transmit the information in a matter that is culturally adequate to the targeted public. Consider the local language, the access to information media, the literacy levels, etc.
- **Ensure the accessibility of information - adapt the disclosure techniques to the targeted public.**

2.2.3 Public Consultation

Consultation is a process of deliberation, discussion and dialogue. It is more than just disclosing information, although clear, transparent and timely information is the basis for any consultation process. The objective of the consultation is also to seek feedback, advice and opinion of the stakeholders in order to shape the project, to the extent possible, to their needs and concerns. In this sense, the vulnerable groups shall be given a particular chance of having their voice heard.

The IFIs require that the client undertakes a process of meaningful consultation in a manner that provides the interested and affected parties with opportunities to express their views on project risks, impacts, and mitigation measures, and allows the client to consider and respond to them. Meaningful consultation is the one that (based on IFC, 2012):

- is based on the disclosure of relevant and adequate information including, where appropriate and relevant, draft documents and plans, prior to decisions being taken when options are still open;
- is undertaken early in the environmental and social appraisal process;
- focus on the social and environmental risks and adverse impacts, and the proposed measures and actions to address these;
- is carried out on an ongoing basis as the nature of issues, impacts and opportunities evolves;
- is undertaken in a manner that is inclusive and culturally appropriate, i.e., tailored to the language preferences of the affected parties, their decision-making process, and the needs of any disadvantaged or vulnerable groups;
- is free of external manipulation, interference, coercion or intimidation;
- reports back in a timely way to those consulted.

There is a vast amount of reference literature and tool kits detailing the variety of participatory techniques and methodologies that can be employed as part of the stakeholder engagement process. However, as is the case with most aspects of the process, the choice of methods will depend on the aim of the consultation, the nature of those being consulted (language, literacy, location, exposure to issues), and the timescale/resources available. Using more than one method yields better responses - in quality and quantity. Different methods can also produce different results (IFC, 2007; ADB, 2012).

Table 3-1 presents some of the techniques that are commonly used for undertaking Public Consultation during an ESIA process.

Table 2-1: Different techniques for undertaking Public Consultation (ADB, 2012)

Technique	Description
Online and Written Consultation	This typically involves using a specific consultation web page to introduce the policy, strategy, or project and the aim of the consultation. The consultation structure varies. A draft document, broad topics, or open-ended questions can be used to guide comments or a survey style with closed questions. Public comments allow discussion between stakeholders. Social media can be used. Online consultation enables open public consultation, but it only reaches those who are literate and with internet access, and therefore not the most disadvantaged. Written feedback posted or e-mailed is also common.
Public Meeting	Meetings are an open accessible method of consulting with the public. They take place at any level (community, regional, national, etc.). Ensure they are fully accessible and give adequate notice to interested bodies. Also the meeting size affects participation. Groups of fewer than 20 people ensure everyone can speak. Breakout sessions and participatory methodologies (e.g., ranking, diagrams) can help capture all viewpoints.
Workshop	Workshops involve gathering a group to gain their feedback in a structured format. The face-to-face format allows for brainstorming and testing ideas. Preferable to a single workshop, a series produces greater output. Try different workshop types (e.g., open space, write shop, participatory methods). Facilitation is important, and a skilled neutral individual can help ensure group rules are clear, views are taken seriously, and no participant dominates.
Focus Group Discussion (FGD)	Semi-structured qualitative discussions with a small homogenous group (generally 5–12 participants plus 1–2 skilled facilitators). Open discussion explores people’s attitudes, concerns, and preferences toward a specific issue, with the range of viewpoints collated at the end. The mix of people depends on the purpose but numbers are typically restricted to 15 or fewer. Community members not used to formal meetings may feel more comfortable expressing themselves in a FGD (e.g., women, ethnic minorities, or disadvantaged groups; the disabled; or poor individuals and households).
In-Depth Interview	Qualitative phone or face-to-face interviews with individuals (e.g., community members, key informants, or civil society leaders) can get a sense of stakeholders’ perspectives. They can be structured (formal, and closely following a written interview guide), semi-structured (partially directed by an interview guide, but open and conversational to allow interviewees to introduce other topics of interest), or unstructured (organized around a few general questions or topics, but informal and open-ended) depending on the context. Structured interviews are likely to yield information that can be compared and generalized, while less structured ones can explore an issue in depth and permit related issues to be raised. Interviews with key informants possessing particular knowledge of an issue are especially useful.
Survey	Surveys provide specific responses on certain issues. They can rapidly show who is interested and why and provide quantitative data. They indicate the weight of different views. Conduct surveys by post, online, or face to face.

2.2.4 Grievance Mechanism

A Grievance Mechanism constitutes the process by which people affected by the project can bring their grievances to the sponsor, in a culturally appropriate manner for consideration and redress (IFC, 1998). It is good international practice to ensure access to grievance and remedy to both the workers and the public by means of separate grievance mechanisms.

Ideally, grievance procedures should be in place from the beginning of the social and environmental assessment process and exist throughout construction and operation until the end of the project life. The promoter will duly inform workers and community members of the existence of the grievance mechanism.

The same way as for the information disclosure and consultation procedures, also the grievance procedures shall be readily understandable, accessible and culturally appropriate for the local population. It shall not be overly complicated to use nor should it require legal counsel to complete. However, the grievance redress mechanism shall not impede the access to legal counsel in case the negotiations fail. The following are desired characteristics of the grievance mechanism:

- legitimate and trusted;
- scaled to the risks and potential adverse impacts of the project;
- publicized and accessible, appropriately tailored to all potentially-affected persons and communities and other interested parties, irrespectively of their literacy and administrative capacity;
- free of cost for the stakeholders;
- includes the anonymity option, where feasible, and guarantee confidential handling of requests, if so requested by the complainant;
- fair, transparent and inclusive;
- guided by engagement and dialogue;
- predictable in terms of process;
- timely appropriate;
- not impeding access to grievance and resolution on grounds of one's financial ability to seek judicial remedy; and,
- a source of continuous learning for the promoter and the lending operation at large.

3. Summary of previous stakeholder engagement activities

During the preparation of the National ESIA (Ecobarik-Audit LLC 2016), consulting and information disclosure activities with some stakeholder groups have been undertaken.

Being nationally classified as a Category A Project, the YCCPP - 2 was subject to 4 public hearings in 2016. All hearings were held at RENCO Armenia's office.

The invitations for the sessions can be consulted in **Annex 1** to this report. Records of the hearings, the participants' lists with the signatures and the video clips were submitted to the Ministry of Nature Protection of the Republic of Armenia. They are not available for disclosure in this report.

The objective of the present SEP is to prepare a process of public consultation that will respect the requirements of the IFIs associated with the project. This new public consultation process will complement the national process undertaken in the past by:

- Encouraging the participation of the general public, interested NGOs and the concerned national authorities by means of a wide disclosure of information, a public session and a possibility for written participation;
- Presenting the changes in the design that have been done to the project since 2016;
- Record the results of the sessions and make them publicly available in the final ESIA Report.

4. Project Stakeholders

As stakeholders are identified, it is necessary to understand their level of interest and influence over the project, as well as the extent to which they are impacted (directly or indirectly).

The information obtained so far shows that there are some temporary informal houses nearby the project site (several families to the northeast and one woman to the south west). The land occupied by these temporary informal houses is not affected by the Project. All these residents are Armenian.

Table 4-1 lists these and other stakeholders identified so far for this project.

Table 4-1: Stakeholder Analysis List

Stakeholders	Stakeholder Interest	Perception of the problem/Issues to be discussed	Resources	Mandate in the project's context	Contact data
Civil Society					
Aarhus Center, NGO	Assist the public in exercising their rights granted by the international and national legislation	Environmental and social impacts of the project; Environmental and Social Management Plan	Internal budget and staff	The Centre's task is to promote the principles of the Aarhus Convention and work towards its implementation. Aarhus Centre will share the information about the public consultation meeting as well as the relevant documents with other NGOs.	Silva Ayvazyan Head of Yerevan Aarhus Centre info@aarhus.am (+374) 91 81-60-55 46 building Charents str. Yerevan
Informal Residents	They can be directly affected by environmental and social issues	Environmental and social impacts of the project; Environmental and Social Management Plan	Public resources (air, water, soil)	Not applicable	Not applicable. People are involved through publicly available invitations.
Inhabitants of surrounding areas	They can be directly affected by environmental and social issues; They can be potential sources of labor	Environmental and social impacts of the project; Environmental and Social Management Plan; Job opportunities	Work force Public resources (air, water, soil)	Not applicable	Not applicable. People are involved through publicly available invitations.
Private Sector					
Local businesses	Located in the Project Area of Influence Can be directly affected by environmental and social issues	ESIA, Environmental and Social Management Plan, SEP; Business opportunities	Internal budget and staff	Not applicable	Not applicable. Local businesses are involved through publicly available invitations.

Stakeholders	Stakeholder Interest	Perception of the problem/Issues to be discussed	Resources	Mandate in the project's context	Contact data
Media	<p>Publication of information about the EIA process</p> <p>Publication of mandatory advertisements related to the project (e.g. public consultations)</p>	Disclosure of project's information	Communication platforms (TV, radio, internet, newspapers)	The national, regional and local media fulfill the communication needs of the project.	Not applicable
Government					
Ayntap Village	<p>Located in the Project Area of Influence;</p> <p>Residents can be directly affected by environmental and social issues</p>	<p>ESIA, Environmental and Social Management Plan, SEP;</p> <p>Disclosure of project's information;</p> <p>Public consultation in order to collect comments and questions</p>	Internal budget and staff	Governments give orders in accordance with the law on implementation of public consultations on the projects of local importance, which can have economic, environmental and social consequences (for life of the people, for culture, health and social protection for local communities and public services), as well as on other issues which are of interest for all population of the administrative/ territory unit or its part.	<p>+(374 094) 722-222</p> <p>Ayntap village, Ararat Marz</p> <p>Head of Community Karen Sargsyan</p> <p>ayntap.ararat@mta.gov.am</p>
Kharberd Village					<p>+(374 093) 400-122</p> <p>Nor Kharberd village, Ararat Marz</p> <p>Head of the community Karo Kakoyan</p> <p>norkharberd.ararat@mta.gov.am</p>

Stakeholders	Stakeholder Interest	Perception of the problem/Issues to be discussed	Resources	Mandate in the project's context	Contact data
Shengavit District					+(374 11) 518-808 Building 26, G.Njdeh str. Yerevan Head of the district Armen Sargsyan
Erebuni District					+(374 11) 518-388 Building 87, Sasuntsi Davit str. Yerevan Head of the district Armen Grigoryan
Nature Protection Department of the Municipality of Yerevan	Monitoring of noise/ air emissions and effluents; Waste Management	ESIA, Environmental and Social Management Plan, SEP	Internal budget and staff	The Nature Protection Department participates in the development of state programs for the nature protection and environmental management and ensure their implementation in the territory of Yerevan	Avet Martirosyan +(374 11) 514-264 Building 1, Arghishti str. Yerevan

Stakeholders	Stakeholder Interest	Perception of the problem/Issues to be discussed	Resources	Mandate in the project's context	Contact data
Environmental Monitoring Center at Ministry of Nature Protection	Monitoring of noise/ air emissions and effluents	ESIA, Environmental and Social Management Plan, SEP	Internal budget and staff	The "Environmental Monitoring and Information Center" SNCO (Ecomonitoring) of the Ministry of Nature Protection of the RA monitors the atmospheric air, surface and groundwater, atmospheric precipitation, soil and sediment quality.	http://www.armmonitoring.am EMC: Building 46, Charents str. Yerevan, Armenia Director: Simon Papyan Laboratory: Building 27, Komitas ave., Yerevan, Armenia Deputy director of EMC: Gayane Shahnazaryan
Ministry of Nature Protection	Its permission or agreement is necessary in order to construct YCCPP-2. This permission was already given (RA Minister of Nature Protection (11.01.2017): State Expert Examination Conclusion on Expert Examination of Influence on the Environment)	ESIA, Environmental and Social Management Plan, SEP Approvals: Application, ESIA Program/ToR, ESIA Documentation/ Report	Ministry's internal budget and staff	The Ministry of Nature Protection coordinated the process of national environmental impact assessment of the planned power plant.	min_ecology@mnp.am Governmental Buildig N 3, Republic Square, Yerevan

5. Information disclosure and consultation methods

The present Section describes the following main points:

- what information will be disclosed;
- in which formats will the information be presented;
- which methods will be used to communicate this information to each of the stakeholder groups;
- which methods will be used to consult with each of the stakeholder groups;
- how the results of the process will be captured, recorded, tracked, and disseminated.

The requirements of the Armenian law on Environmental Impact Assessment and Examination and of the international financing institutions (IFC and ADB) in respect to public engagement principles and scheduling are considered for the present SEP. Three phases are considered for the planning of the engagement activities:

1. ESIA preparation;
2. Construction;
3. Operation.

5.1 Engagement during the ESIA preparation

The engagement of the stakeholders during the preparation of the ESIA consists of the following actions:

1. Notification of the Project to the local authorities;
2. Disclosure of the Draft Final ESIA Report and respective Non Technical Executive Summary:
 - a) One Public Consultation Session;
 - b) Online and written consultation.

5.1.1 Notification of the project to the local authorities

During the site visit in July 2017, FICHTNER's environmental and social specialists performed stakeholder meetings with mayors of the adjacent villages Kharberd and Ayntap, with the Heads of Departments of Erebuni and Shengavit Administrative Districts, with the Environmental Monitoring and Information Center, and with the NGO Aarhus Center. The purpose of the meetings was to introduce the Project and to discuss issues concerning the presence of houses/ sensitive receptors in the vicinity of the Project area, environmental monitoring, concerns about the Project and the public consultation process. A record of the meetings undertaken can be consulted in the ESIA Report.

The mayors of the villages Kharberd and Ayntap had no concerns regarding the implementation of the Project. No medical/ health issues of local population concerning the operation of the existing YCCPP-1 were reported. As both villages suffer under a high unemployment rate (> 70%), the mayors hope that the Project will create jobs for the local population. These statements have also been supported during the discussions with the Heads of Departments of Erebuni and Shengavit Administrative Districts.

5.1.2 Disclosure of the Draft Final ESIA and respective Non Technical Executive Summary

A national process of engagement has been undertaken during the elaboration of the previous ESIA.

For the present ESIA, which aims at covering the gaps with the IFIs' requirements, this process will be complemented by making the new Draft Final ESIA and Non-Technical Executive Summary (NTES) publicly available and open to comments during a public consultation session. In addition, online and written consultation will be planned as described in the following sections.

a) Public Consultation Session

One Public Consultation Session will be planned and undertaken by RENCO/ARMPOWER with the support of Fichtner to present the ongoing results of the ESIA process and obtain feedback from the stakeholders concerning its content and the areas which may require more attention.

The Public Consultation Session will be conducted in Yerevan. All villages affected by the project will be invited to participate in the session. Transportation to and from the meeting shall be provided by the EPC Contractor to the community members and people living in the illegal houses in order to give all interested people the chance to participate in the Public Consultation Session. The following residential complexes are in the proximity of the site (Figure 5-1):

- the nearest residential area of Shengavit District (Noragvit village) is located approx. 1,350 m to the west;
- Ayntap, a major village in the Ararat Province is located approx. 1,500 m to the south west;
- Kharberd, another major village in the Ararat Province is located approx. 1,200 m to the south;
- the nearest residential area of Erebuni District is located approx. 1,200 m to the north east.



Figure 5-1: Project site and its vicinity

Theoretically, the Public Session could be organized at the YCCPP-1's building or at RENCO Armenia's office. However, since the YCCPP -1 is located far from the city and is difficult to reach, and the RENCO Armenia's office is small, it is more advisable to organize the Session in Yerevan's Aarhus Center, submitting a preliminary application to the center coordinator.

Before the Session

Before the Session takes place, publicity of the time and place will be made by the project's developer by putting out adverts in the mass-media or posting them on its official web-page. Local authorities (Ayntap and Kharberd villages; Shengavit and Erebuni districts) shall put up notices along with a copy of the Armenian version of the Non Technical Executive Summary of the Draft Final ESIA accessible for the public in their respective governmental buildings. The local governments may also post the advert regarding the conduct of the Session on their web-pages. The Aarhus Centre Yerevan agreed to assist with promoting the Public Consultation Session and with making the Draft Final ESIA and NTES available to the public.

The inhabitants of the nearby illegal residences may experience more difficulties in accessing the public invitations for the Session. To overcome this issue, RENCO will hang posters announcing the Session and the transportation options in the area.

During the Session

The meetings will be structured in two parts: presentation and Q&A (questions and answers).

The first part will consist of a presentation of the Project and the ESIA process, namely: results of the ESIA, project impacts (construction and operation), mitigation measures, monitoring, processes for ESIA feedback, Grievance Mechanism (incl. ADB's Accountability Mechanism and IFC's Compliance Advisor Ombudsman). This will be supported with audiovisual resources (slides, pictures, videos, and one leaflet containing a summary of the project and of the ESIA, as well as relevant links for consultation of project information and placement of grievances). The session will use straightforward, non-technical language. The second part of the meetings will consist of an open Q&A session and will be coordinated in order to allow all stakeholders present to manifest their opinion.

A written record of all stakeholder grievances, criticisms and/or suggestions will be undertaken. Further to voiced manifestations, stakeholders will have the option to register their written opinion in a book to be made available until the end of the meeting. The language of the session will be Armenian.

After the Session

The findings of the public session will be entered in a minute, with the indication of the total number of participants, the list of questions and the objections and proposals put forth. The minutes will be drawn up within 1 week following the date of the conduct of the Session. The participants will be given the possibility to receive the minutes per e-mail or letter.

Should no answers be provided to the questions put forth during the conduct of the public session, the developer will deliver the answers within 15 days following the date of the conduct of the public session to the authors on the postal or email addresses indicated during registration.

b) Online and written consultation

The Draft Final ESIA in English and the NTES in Armenian will be made available for public access, with the possibility to deliver written comments in the following platforms:

- Hard copies placed in the Aarhus Center, and the local governmental buildings (Noragavit, Ayntap, Kharberd, and Erebuni District).
- Soft copy at the official web-page of the developer;
- Soft copy at the web-page of the IFIs;
- Soft copy at the web-page of Yerevan's municipality;
- Soft copy at the web-page of the Aarhus Center.

In each of the physical or online platforms where the Draft Final ESIA and NTES will be placed, forms will be made available in Armenian to allow the persons to write their comments, if desired anonymously. See **Annex 2** for a model of the comments form.

The stakeholders will be given a time frame of two weeks after the Session to place any comments to the ESIA.

The physical and online platforms for consultation will be disclosed during the Public Consultation Session.

5.2 Engagement during construction

For the communities located near the project site the effects of noise, dust, vibration, traffic, and lighting associated with construction, as well as the presence of the sites themselves, can cause disturbances and stress, as well as pose a physical or health hazard. In addition, social conflicts with the workers may also arise in these villages. To avoid such situations, whether for large capital works or minor construction activities, it is advised to give the public notification of:

- the purpose and nature of the construction activities;
- the start date and duration of the overall construction works and of specific operations (blasting, terrain clearing, transport of heavy components, etc.);
- potential impacts;
- information on whom to contact if there are concerns/complaints related to the contractor.

Also recommended is the regular disclosure of information related to the management of the environmental and social matters (application of measures, monitoring efforts and results).

In the construction phase, it is not a common procedure to undertake public debates and discussions. Instead, the construction contractor shall keep functioning grievance mechanisms. This way it is possible for the interested and affected parties to make complaints or suggestions in relation to the project's activities (the mechanism shall be open for the public and for the workers). This is the project's phase where more grievances are expected to be received and the contractor and the Project Developer shall be ready to answer to them on time and efficiently. Please refer to Section 6 for guidance on the preparation of a grievance mechanism.

5.3 Engagement during operation

Typically during operation the number of grievances and frequency of engagement with stakeholders may decrease, along with a reduction in the overall employee and contractor workforce. The following shall be undertaken in this phase for the project:

- a) In case the operator prepares an Emergency Preparedness and Response Plan, this shall be disclosed to the employees and communities so that all stakeholders likely to be affected have a basic understanding of the risks involved and what the key elements of the plan are; and that individuals from within and outside the project know what their allocated roles and responsibilities are during an emergency. Consultations shall be conducted, and formalized agreements (e.g. joint emergency plans) shall

be developed especially with emergency response service providers and the adjacent power plant. Disclose any important changes made to the Plan.

- b) Undertake a regular communication of the company's environmental and social performance (application of measures, monitoring efforts and results);
- c) Maintain the grievance mechanism - there should always be a well functioning procedure for answering public concerns whenever they may arise throughout the life of the project.

In the operational phase, it is not a common procedure to undertake public debates and discussions. Instead, the operator shall keep functioning grievance mechanisms for the public and the workers. This way it is possible for the interested and affected parties to make complaints or suggestions in relation to the project's activities.

5.4 Documentation

Keeping track of the "who, what, when, and where" of consultation is key to effective implementation of the process. Any commitments made to stakeholders should also be recorded. Careful documentation can help to demonstrate to stakeholders that their views have been incorporated into the project strategies, and is a useful resource for reporting back to stakeholders on how their concerns have been addressed. For this, a Stakeholder Log needs to be developed and shall be maintained throughout the project's life cycle. The Log records:

- stakeholder organization;
- contact details;
- issues and concerns raised;
- actions for follow-up;
- responsibilities and deadline;
- confirmation of close-out.

Please refer to **Annex 3** for the Stakeholder Log for this project. So far, only comments from the authorities consulted by Fichtner in July 2017 have been received. They are described in Section 5.1.1 and in the Stakeholder Log.

Stakeholder consultation carried out during the course of the early stages of the ESIA studies will be recorded in the final ESIA report. This will include:

- The location and dates of meetings;
- A description of the project-affected parties and other stakeholders consulted;
- Presentations and communications;

- The minute of the sessions including:
 - Number of participants;
 - An overview of the issues raised (questions, objections and proposals);
 - How the project sponsor responded to the issues raised;
 - How these responses were conveyed back to those consulted;
- Project variations and impacts on the ESIA process;
- Details of outstanding issues and any planned follow-up.

6. Grievance Mechanism

This Section presents the grievance mechanism for the general public and the workers planned for the Project.

6.1 General public grievance mechanism

In the course of the construction and operation, Project Affected People (PAP) may feel treated unjustly. This might happen for various reasons such as: the contractor does not adhere to sound construction principles, misunderstandings have arisen, or disagreement with procedures of consultation or notification. If this happens people shall be encouraged to lodge their complaints in a timely and effective manner without directly addressing the court, i.e., through a grievance mechanism.

All PAP will be notified about the Grievance Redress Mechanism (GRM) of the YCCPP -2 Project during the Public Consultation meetings, as well as through the disclosed project information leaflets. Contact data of the **RENCO's Grievance Coordinator (GC)**, part of the **Grievance Redress Committee (GRC)**, will be disclosed.

During consultation the PAP shall be notified orally or in a written form about their rights and the procedure of filing complaints. Local NGOs, e.g. the local Aarhus Centre, can inform communities about the possibility to raise complaints and how and where to address them. The grievance mechanism has to be locally implemented at the level of village institutions and local self-government, as well as bundled on national level at RENCO/ArmPower.

Grievances can be addressed at the local community level ('marzpet'), where the grievance will be recorded and forwarded to RENCO's GC. Grievances that are addressed to the EPC Contractor during the execution of civil works shall also be forwarded to RENCO's GC. Even if the constructor decides to settle the grievance on the spot, the documentation of the grievance settlement procedure needs to be prepared by RENCO's GC.

All project related complaints can in addition be directly addressed to RENCO's GC via phone, e-mail or grievance form (the SEP presents an example of the public grievances form in **Annex 4**). A project grievance hotline shall be made available by RENCO for direct complaints (at national level), and all received grievances shall be recorded in the Stakeholder Log (**Annex 3**).

The RENCO GC then decides whether to settle directly, or to arrange a meeting with the Grievance Committee. The decision has to be taken within 15 days. In case of major grievances that cannot be directly settled, permanent and non-permanent members of the Grievance Committee will be called for a meeting.

In case of failure of the grievance redress system, the PAP can submit their case to the appropriate court of law.

The EPC Contractor RENCO is obliged to carry out the work in accordance with the contractual requirements that include:

- a) Nominate a person of staff responsible for the reception and handling of grievances;
- b) Preparation of regular monitoring reports including details of any complaints that arose and how they were handled;
- c) If vulnerable affected people are identified, then the contractor will appoint professional advocates (social workers/legal experts) to assist those people during the entire process, and to act as independent advocates for them should any grievances arise;
- d) Arbitration of grievances with ArmPower and PAP.

ArmPower will carry out works that include:

- a) Nominate a person of staff responsible for grievance procedure coordination, hereby referred to as Grievance Coordinator (including first contact, periodical site visiting of mitigation measure to be implemented by contractor);
- b) A telephone line, e-mail address and contact name on project boards;
- c) Arbitration of grievances with contractor and PAP.
- d) Liaison with court.

The PAP have the option to choose a different representative, or directly liaison with ArmPower' staff responsible for grievance redress. Vulnerable households will have the support of their individual social worker and legal support, if applicable.

NGOs, e.g. Aarhus Centre or local member organizations will monitor grievance redress negotiations, assist with grievance arbitration, and raise public awareness. PAP need to be informed that in case of conflict with the community leader they can address NGO staff to follow up their complaint. NGOs will monitor the relationship between PAP and the community leader.

The aggrieved person (PAP) is encouraged to proceed in the following way:

- a) Contact contractor's designated grievance staff in the following way: in person via the designated telephone number, via email, via regular mail. Alternatively, the PAP can contact their community leader, who would convey their grievance to the contractor's designated grievance staff.
- b) Lodge a complaint and provide information on the case. Each complaint will be registered and a tracking number will be assigned to it. Responses to all complaints should be provided within 15 days (or 25 days in cases where complaint resolution requires special efforts).

- c) Agree with the contractor on a mitigation measure.
- d) Agree with the contractor on time limit for grievance settlement. Grievances have to be settled within two weeks, or otherwise specified in scheduled agreement.
- e) Sign if the mitigation measure has been implemented as agreed
- f) Seek redress from ArmPower if not satisfied with the above mentioned procedure through the designated telephone numbers, in person, or via email or regular mail. ArmPower should register all grievances and provide response within 15 days.
- g) Involve appropriate NGOs
- h) Seek redress from court if all else fails.

Although the grievance mechanism is designed to avoid lengthy court procedures, it does not limit the citizen's right to submit the case straight to the court of law.

ADB/ IFC are not directly a part of the Grievance procedure but shall receive reports about which complaints were received and how they have been followed up/ mitigated.

Special consideration has to be taken for vulnerable people as complaint mechanisms may be unusual and contact with legal procedures let alone courts of law may appear uninviting. This would prevent the most disadvantaged persons from addressing their grievance. A close monitoring on a village level by an independent social expert during the implementation of the project and a personal contact with PAP is therefore recommended.

Vulnerable PAP (all households below the poverty line) will be entitled to a legal aid/ social worker to support them with complaints procedures.

Annex 4 presents an example of the public grievances form that shall be made available in the developer's webpage.

6.2 Workers grievance mechanism

The EPC Contractor RENCO and the future operator of YCCPP-2 ArmPower are requested to implement an independent grievance management system to enable the workers (and their organizations, where they exist) to raise reasonable workplace concerns. This includes complaints related to non-compliance with Health & Safety matters, discrimination cases and non-consideration of equal opportunities.

The workers grievance mechanism shall follow the same principles as the one created for the general public: complaints must be answered in a timely and effective manner without fear of retribution; the access to the grievance mechanism shall not replace or impede the subsequent access to other redress mechanisms; the promoter will inform workers of the grievance mechanism at the time of hire and make it accessible to them.

The grievance management system shall consider the possibility to contact directly a member of the Site Management Staff. The contacted staff members must take a note of the reported complaint or non-compliance and must report it to the Site Manager.

The Site Manager is requested to solve the complaint or non-compliance within 3 working days. In case the problem cannot be solved an action procedure specifying the needed activities together with a predicted deadline for resolution of the problem must be prepared and submitted to the general manager.

The EPC Contractor and ArmPower are requested to provide as well the possibility for the workers to notify a complaint or non-compliance in a confidential way.

According to RENCO SPA a grievance mechanism for workers will be established for this Project, as it has been done in other international projects before. The system will allow staff and contractors to provide feedback on any element of the work via email or by hand delivery to a box placed on site. Grievances will be logged into a spreadsheet where they will be then delegated to the appropriate person for close out. Grievances will be confidential and staff and contractors will be in no way penalized for providing their feedback.

7. Timetable

Table 7-1 presents a preliminary schedule for the engagement of stakeholders during the ESIA Process. This schedule shall be continuously updated. Table 7-2 shows the schedule for the stakeholder engagement activities to be undertaken during construction and operation.

Table 7-1: Stakeholder Engagement and ESIA Schedule

Activity	Deliverables	Date
Disclosure of the Project to the local authorities	--	04.- 07.07.2017
Fichtner prepares the Draft ESIA Report in English	Draft ESIA Report in English Non-Technical Executive Summary in English	23.08.2017
RENCO/ARMPOWER and the IFIs review the Draft ESIA Report	--	27.08.2017
Fichtner prepares the Draft Final ESIA according to the review in English	Draft Final ESIA Report in English Non-Technical Executive Summary in English	07.12.2017
The NTES is translated into Armenian	Non-Technical Executive Summary in Armenian	20.12.2017
Preparation of a brief project/ESIA summary + public consultation invitations + official letter for the authorities	Project/ESIA summary Invitations for sessions (in English and Armenian)	05.01.2018
RENCO/ARMPOWER posts adverts in the mass-media and on its official web-page informing about the Public Consultation Session.	Adverts: brief summary of the project and invitation for the public consultation session	12.01.2018
The local governments post the advert regarding the conduct of the Session on their web-page, at their offices and in other public places.	Adverts: brief summary of the project and invitation for the public consultation session	19.01.2018
Public Consultation Session in Yerevan	--	10.02.2018 (Saturday)
The IFIs publicly disclose the Draft Final EIA Report	Draft Final ESIA Report in English Non-Technical Executive Summary in English Draft Final ESIA Report in Armenian Non-Technical Executive Summary in Armenian	27.12.2017 - 25.02.2018
The minutes of the Public Consultation Session are made available	Minutes of the session	17.02.2018

Activity	Deliverables	Date
The ESIA related documents are available for public comments	Draft Final ESIA Report in English Non-Technical Executive Summary in English Minutes of the session	12.01.2018 - 24.02.2018

Table 7-2: Stakeholder Engagement Schedule during construction and operation

Activity	Platforms	Content	Date
CONSTRUCTION			
The developer notifies the public of the construction works or a specific construction activity	Official web page of the developer	The purpose and nature of the construction activities The start date and duration of the overall construction works and of specific operations The potential environmental and social impacts	One month before construction works start
	Letters to local representatives Newspaper notice	Information on whom to contact if there are concerns/complaints related to the contractor Information related to the management of the environmental and social matters (application of measures, monitoring efforts and results). The results of the grievance mechanism	During construction works
The contractor and developer keep a functioning grievance mechanism	Nomination of a GRC and of a GC	Contact information for sending of grievances Time frame in which all recorded complaints will be responded to	During construction works
	Suggestion boxes in public locations Visible billboards Official web-page of the developer Stakeholder log		
OPERATION			

Activity	Platforms	Content	Date
Inform the public of operation related issues (community and occupational health and safety; grievance mechanism; environmental and social monitoring)	<p>Official web-page of the developer</p> <p>Letters to local representatives</p> <p>Newspaper notice</p>	<p>Emergency Preparedness and Response Plan, if existent</p> <p>The project's environmental and social performance reports</p> <p>The results of the grievance mechanism</p>	<p>Every 6 months during the life-time of the project</p>
Keep a functioning grievance mechanism	<p>Nomination of a GRC and of a GC</p> <p>Official web-page of the Project Operator</p> <p>Visible billboards</p> <p>Stakeholder log</p>	<p>Contact information for sending of grievances</p> <p>Time frame in which all recorded complaints will be responded to</p>	<p>During the life-time of the project</p>

8. Roles and responsibilities

The implementation and monitoring of the SEP will be the direct responsibility of:

- During the ESIA stage: ArmPower/RENCO;
- During Construction: RENCO SPA as EPC Contractor;
- During Operation: ArmPower/RENCO as Project Operator.

Other entities will play an important supporting role, namely:

- During the ESIA stage, Construction and Operation: the local “marzpet”; and NGOs, e.g. Aarhus Centre or local member organizations;

The responsibility to audit the implementation of the SEP belongs to the IFIs until financial closure of the project.

This Section presents a review of the responsibilities and allocated resources for implementation of the SEP.

8.1 Developer - ArmPower/RENCO

The following is the summary of the responsibilities of ArmPower/RENCO as the Project’s Developer.

- During the ESIA preparation:
 - a) Plan and undertake one Public Consultation Session (see Section 5.1);
 - b) Disclose the Draft Final ESIA Report and NTES (hard and soft copies) (see Section 5.1);
 - c) Keep and update the Stakeholder Log (see **Annex 3**);
 - d) Nominate a Grievance Redress Committee (GRC) and a Grievance Coordinator (GC), and manage the process of grievance redress for the general public (see Section 6.1).

8.2 EPC Contractor - RENCO SPA

Within the SEP, RENCO SPA as EPC Contractor has the following summarized responsibilities:

- During construction:
 - a) Keep the public informed about the construction activities, environmental and social management at site, and contact persons (see Section 5.2);
 - b) Keep and update the Stakeholder Log (see **Annex 3**);
 - c) Nominate a Grievance Redress Committee (GRC) and a Grievance Coordinator (GC), and manage the process of grievance redress for the general public (see Section 6.1) and for the workers (see Section 6.2).

8.3 Project Operator - ArmPower/RENCO

The Project Operator (ArmPower/RENCO) will have the following SEP-related responsibilities:

- During operation:
 - a) Keep the public informed about the environmental and social management at the plant (see Section 5.3);
 - b) Disclose the Emergency Preparedness and Response Plan and develop formalized agreements with emergency response service providers and the adjacent power plant (see Section 5.3);
 - c) Keep and update the Stakeholder Log (see **Annex 3**);
 - d) Nominate a Grievance Redress Committee (GRC) and a Grievance Coordinator (GC), and manage the process of grievance redress for the general public (see Section 6.1) and for the workers (see Section 6.2).

8.4 Supporting roles - local authorities and NGOs

Local authorities incl. “marzpets”, as well as NGOs will serve as a means of direct contact of the populations to present any grievances related to the project.

These entities will as well have an important role in disclosing project related information, namely the ESIA and the NTES.

9. Final remarks

The Final SEP presents the suggested methodologies, timing, and responsibilities for engaging the public and the workers during the implementation of the YCCPP 2 Project. The main focus of the SEP is to assure conformity with the requirements of IFC and ADB. It includes activities during the ESIA preparation, during construction, and during operation.

The present SEP does not necessarily include a strict engagement with the national authorities because such process has been undertaken in the past. However, it is recommended that RENCO keeps an open door for collaboration with local and national agencies, when necessary and if required by these.

In order for the SEP to be successfully implemented, it is necessary to include its dispositions into the Developer's, EPC Contractor's and Operator's own Environmental and Social Management Systems (ESMS). In case such systems are not presently implemented in any of the companies, at least one team shall be nominated in each case that will handle the E&S management at the different stages, and implement and monitor the SEP.

Transparency is important to assure an acceptance of the project by the general public, for what the information disclosure activities suggested in the SEP will play an important role. Engaging the public from the beginning of the implementation of the project and continuously throughout its life cycle is expected to bring benefits and reduce eventual unfounded reasons for grievances.

10. References

ADB, 2012: *Strengthening participation for development results - an Asian Development Bank guide to Participation*, ADB, Philippines, 2012

IFC, 1998: *Doing Better Business through Effective Public Consultation and Disclosure - A Good Practice Manual*, IFC, Washington, D.C., October 1998

IFC, 2007: *Stakeholder Engagement: a good practice handbook for companies doing business in emerging markets*, IFC, Washington, D.C., May 2007

IFC, 2012: *Performance Standard 1 - Assessment and Management of Environmental and Social Risks and Impacts*, IFC, Washington, D.C., January 2012

11. Annexes

11.1 Annex 1 - Invitations for the previous public consultation sessions

Հայաստանի Հանրապետություն

HAYASTANY HANRAPETUTIUN DAILY, ЕЖЕДНЕВНАЯ ГАЗЕТА «АЙАСТАНИ АНРАПЕТУТИУН», ՕՐԱԹԵՐԹ, ԼՈՒՅՍ Է ՏԵՄԵՆՄՄ 1990 ՀՈՎՏԵՄԲԵՐԻ 9-ԻՑ

30 ԱՊՐԷԼ 2016, ԸԱՐԱԹ, ԹԻՎ 78 (6360)

ՊԱՇՏՆԱԿԱՆ

ՀՀ նախագահի հրամանագրերով

ՀՀ նախագահ Սերժ Սարգսյանի հրամանագրով Արա ԱՅՎԱՅԱՆԸ նշանակվել է Սեֆիկայի Միացյալ Նահանգներում Հայաստանի Հանրապետության արևելագծու լիազոր դեսպան (նստավայրը՝ Մեխիկո):

Նախագահի մեկ այլ հրամանագրով Արա ԱՅՎԱՅԱՆԸ ազատվել է Լիսվալի Հանրապետությունում, Լասվալի Հանրապետությունում և Էստոնիայի Հանրապետությունում Հայաստանի Հանրապետության արևելագծու լիազոր դեսպանի պաշտոնից:

ՀՀ նախագահի հրամանագրի է ստորագրել նաև Արմեն ՀԱՐՈՒԹՅՈՒՆՅԱՆԻՆ Հայաստանի Հանրապետության դատախազի պաշտոնից հեռանալու մասին:

ՀՀ նախագահի կարգադրությամբ Արմեն ՀԱՐՈՒԹՅՈՒՆՅԱՆԻՆ ազատվել է Հայաստանի Հանրապետության նախագահի ռեֆերենտի պաշտոնից:

ՀՀ նախագահի մամուլ գրասենյակ

Խորհրդակցություն Ասկերանում

ԼՂՀ նախագահ Բակո Սահակյանը երեկ այցելել է Ասկերանի քաղաքում և անցկացրել աշխատանքային խորհրդակցություն, որի ընթացքում քննարկվել են ապրիլի 2-5-ը ադրբեջանական ազդեցության հետևանքով ստեղծված իրավիճակի և Ասկերանի քաղաքակազմի ստորաբաժանումների կողմից այդ ոլորտում օգտերափոխ լուծում Պահանջող խնդիրների իրականացմանը վերաբերող հարցեր:

Ինչպես տեղեկացրին ԼՂՀ նախագահի աշխատակազմի տեղեկավարության ղեկավար վարչությունից, ԼՂՀ նախագահը կոնկրետ հանձնարարականներ է սվել քննարկված հարցերի դասակարգման իրականացման ուղղությամբ:

Ըննարկել են առողջադասական մի շարք ծրագրեր

ԼՂՀ նախագահ Բակո Սահակյանը երեկ ընդունել է «Հայասան» համահայկական հիմնադրամի գործադիր սեօրեն Արա Վարդանյանին և հիմնադրամի Ֆրանսիայի մասնաճյուղի սեօրեն Պետրոս Թերջանյանին:

Ինչպես տեղեկացրին ԼՂՀ նախագահի աշխատակազմի տեղեկավարության ղեկավար վարչությունից, քննարկվել են Արցախի առողջադասական ոլորտում մի շարք ծրագրերի իրականացման անհրաժեշտ հարցեր:

Նախագահ Սահակյանը բարձր է գնահատել «Հայասան» համահայկական հիմնադրամի դերակատարությունը մեր հանրապետության առջև ծառայած խնդիրների լուծման գործում այն համադրելով Հայասան-Արցախ-սփյուռք եռամիասնության վառ դրսևորումներից մեկը: Հանդիմանում մասնակցության էին ԼՂՀ առողջադասական

Միասնականության և փոխօգնության դասեր

Երեխաները դաստիարակվում են այն ոգով, որով նրանց են ներկայանում մեծերը

Դժվար ժամանակներ են միասնական են ու տարածվող են միջոց միասնական լինել: Պարտավոր են միասնականության և փոխօգնության դասեր սալ նախ մեր երեխաներին, որտեղ էլ որ նրանք գտնվեն՝ Հայաստանում, Արցախում, թե սփյուռքում: Այսօր սահմանը թափող ֆազերի և ամեն ինչով նրանց թելուրկվում կանգնած հասարակության օրինակով դեր է մեծանան մեր զավակները: Քանզի վաղը նրանք էլ ստացան դասերի հանգույն են ծառայելու իրենց հայրենիքին՝ յուրաքանչյուր իր սեղանով:

Այս առումով կարևոր են այն միջոցառումները, որոնք հնարավորություն են ընձեռում օգնելու երեխաներին: Երեկ մայրաքաղաքում հյուրընկալվել էին զոհված ազատամարտիկների ընտանիքների սեփականակերտ 11 երեխա: Կազմակերպիչները հոգ էին տարել, որ տեսչի արցախցի դասարանի ռևիզիների երեւանյան ֆառորյա հանգիստը հնարավորինս հազեցան լինի:

Իսկ օրեր առաջ հայկական երկու դեսպանությունների մայրաքաղաքներից 23 երեխա միասին մկրկեցին Սուրբ Աստվածածին եկեղեցում:



Վերադարձ անցյալին չի լինելու

Առանց Արցախի մասնակցության հակամարտության լուծումն անհնար է

Առանց Արցախի Հանրապետության մասնակցության Լեռնային Ղարաբաղի հակամարտության լուծումն անհնարին է: Այս մասին արցախյան լրատվամիջոցներին զրկած հարցազրույցում ասել է ԼՂՀ նախագահ Բակո Սահակյանը, ով անդադարձել է ատրիլյան ֆառորյա դասերում, որ հետեւանումներին ու հայկական կողմի հետագա անելիքներին:



«Չկա մի հավանական զարգացում, որ խնդիրը լուծվի առանց մեր մասնակցության»:

Կան բանակցային գործընթաց սկսելու դեռմիտ, որ Արցախը լինի այդ բանակցային գործընթացի լիարժեք կողմ: Այս դասի դրությամբ մենք չենք ինքնուրույն հնարավորություն, ֆանի որ այն, ինչ թույլ է սվել Ադրբեջանը, որտեղ կերպ է խոսում այն մասին, որ մոտ առաջվա վերադարձնալու ենք բանակցային սեղանի տուրք...»,- նշել է Բակո Սահակյանը:

Արցախի նախագահն անդադարձել է վերջերս ավելի մեղմ: Դրանք չեն նոտասում մեր առաջադրանքի կատարմանը: Անհրաժեշտ է կատարելու զորակարգում այդ գնահատականները, ֆանի որ դրանք չեն նոտասում մեր աշխատանքներին: Այս տարիներին մեր կողմից բազմիցս հայտարարվել է, որ վերադարձ անցյալին չի լինելու, այդ թվում է հողերի հետ կապված: Մենք նախ հնարավորություն ենք ունեցել մեր ինքնակազմը ներկայացնելու ֆաղաքայիններին՝ նշելով, որ ներկայիս վիճակի, հողերի հետ

ԼՐԱՅՈՒԹՅՈՒՆ

Սահմանային միջադեպեր

Ապրիլի 28-ի լույս 29-ի գիշերը հայ-ադրբեջանական դեփառական սահմանագոստու հյուսիսարեւելյան հասվածում գրանցվել է հրդարարի խախտման 13 միջադեպ, հայտնում են ՀՀ ՊՆ տեղեկավարության և հասարակայնության հետ կապերի վարչությունից: Ադրբեջանական կողմը տարբեր տարաբանակալի հրաձգային և դիտակալար զինատեսակներից հիմնականում անկանոն բնույթի կրակահերթեր է արձակել հայ դիտակալների ստորայնայն: ՀՀ ՁՈՒ առաջադաս ստորաբաժանումները, ցուցաբերելով զսղվածություն, դասախասն գործողությունների են դիմել միայն խիստ անհրաժեշտ դեպքերում և վստահորեն վերահսկում են սահմանային իրավիճակը:

ԼՂՀ ՊԲ-ից ստացված օգտերափոխ տեղեկավարության համաձայն՝ ապրիլի 28-ի լույս 29-ի գիշերը դարաբաղա-ադրբեջանական հակամարտ գորբերի Կիման գծի ողջ երկայնուկ հակառակորդը Կարունակել է խախտել կրակի դաղաբացման դասակարգերը:

րելի է ծանոթանալ նաև HRADF-ի պաշտոնական

ՀՀ սննտական մրցակցության դաշտանության ղեկավարական հանձնաժողովի 2015 թվականի արտադրական գործունեության հասկանալիությունը ստորագրված է հանձնաժողովի ինտերնետային կայքում (www.competition.am):

ՀԱՅՏԱՐԱՐՈՒԹՅՈՒՆ

Երեանի Վ. Բրյուսովի անվան ղեկավարական գիտական համալսարանին 2015-2016 ուսումնական արտադրական ղեկավարական գործունեության հասկանալիությունը ստորագրել է 1/մեկ/ սեղ առկա ուսումնամբ աստիճանագրության համար՝ հետևյալ մասնագիտություններով:

1. **Գերմանական լեզուներ (անգլերեն) /ժ.02.07/ - 1 սեղ**
Փաստաթղթերի ընդունումը մինչև սույն թվականի հունիսի 4-ը ժամը 17.00 Գերառախ: Լրացուցիչ տեղեկությունների համար գանգահարել 532239 հեռախոսահամարով:

Հայտարարություն

«Էդեստ-Եներգո» ՍՊԸ-ի պարտատերերի նախնական ցուցակ ՀՀ Տրանսպորտի և կապի նախարարությանը Տրանսպորտային տեսչություն -365.000 ՀՀ դրամ -82-րդ հոդվածի «Ը» հերթ:
 Մնանկության գործով կառավարիչ Ա.Վարդանյան /հեռ.094 400 360/:

«Հրջակա միջավայրի վրա ազդեցության գնահատման եւ փորձաքննության մասին» ՀՀ օրենքի /21.06.2014թ. 30-110-Ն/, ինչպես նաև ՀՀ կառավարության 19.11.2014թ. N 1325-Ն որոշմամբ սահմանված կարգով (առաջին փուլ) 2016թ. մայիսի 10-ին, ժամը 12.00-ին Երեան քաղաքի Վ. Սարգսյան 10 հասցեում տեղի կունենա «Ռեհնկո Մոնեստեյս» ՍՊ ընկերության կողմից կառուցվող երեանի ՋԷԿ ՓԲԸ-ի արտադրական գործունեության հասկանալիությունը ստորագրելու համար հայտի միջավայրի վրա ազդեցության գնահատման հայտի վերաբերյալ հանրային կոնսուլտացիան:
Փաստաթղթերին կարելի է ծանոթանալ «Ռեհնկո Մոնեստեյս» ՍՊ ընկերությունում, Վ. Սարգսյան 10 հասցեում:

ՀԱՅՏԱՐԱՐՈՒԹՅՈՒՆ

ՀՀ Կոստյի մարզի ընդհանուր իրավասության դատարանի 20.04.2016թ. Կ/2/005704/15 որոշմամբ «Նոր Արարար» ՍՊ ընկերության նկատմամբ սկսվել է լուծարման վարչապահ միջամտության հարցերը ՀՀ Կոստյի մարզ. 1.Նշված, կառուցվող 14, գրանցման վկայական 03Ա080737, 14.05.2008թ., գրանցման համար 80.110.01224, ՀՀԳԳ՝ 03312508/Մնանկության գործով կառավարիչ Վ.Ավագյան /հեռ. 094 421 790:

ԿԱՆԱԿՈՒՄ Է

Երեւ հարկանի սեփական տուն Դիլիջանում: Ունի դաշտային շինություն, մեծակայքով զբե, անասո: Մանրամասների համար գանգահարել 094 22-75-55, 0079165395558:

ԿՈՐԵԼ Է

Չավեն Ռեիկի Մեյքոնյանի՝ Նոր Գեղիի գյուղատնտեսական-գացադաշտի եւ լեկտրաֆիկացիայի սովիտագ-տեխնիկումից 1984թ. ստացված թիվ ՋՏ 005024 դիմումը, գրանցման թիվ 4699:
Համարել անվավեր:

1) Կարգի արտադրության գործունեության վերաբերյալ տնտեսագիտական հանձնաժողովի կողմից կատարվող ստացածնոր համար՝ փաստաթուղթ ընդհանուր կրթության համարժեքության մասին):

2) ընտրված մասնագիտությանը հրատարակված առնվազն մեկ գիտական աշխատանքի պատճենը կամ գիտական ռեզյուսե տրամադրված 20 տպագրական էջի սահմաններում:

3) Օտար լեզվի և ինֆորմատիկա տեղեկատվաարդյունավետական հիմունքներ առարկաների ատեստավորման վկայականը կամ դրան համարվատարման տեղեկանքը (սահմանված ճերթին շնմով թայլային գնահատմամբ):

4) ինքնակենսագրություն և 3 լուսանկար (3x4 չափսի):

5) Բարձրագույն աշխատանքային գործակալից (առկայության դեպքում): Փաստաթղթերը ընդունվում են հայտարարության հրատարակման օրից մինչև հունիսի 4-ը (Երեւոյալ):

Հասցեն՝ ք. Երեան -25, Լայրաճյան 128, Հայաստանի պետական տնտեսագիտական համալսարան
 հեռախոս՝ 593-454
 Ռեկտորատ



«ՀՀ Արարատի և Վայոց ձորի մարզերի ընդհանուր իրավասության դատարանի վարչություն է գտնվում թիվ Ա/Կ/2/0552/02/16 քաղաքացիական գործն ըստ դիմումի Լիլիթ Հրաչիկի Հովհաննիսյանի Հայկ Արթուրի Մեղրուբյանին (ծնված 18.05.1972թ., վերջինիս նախկին քակության վայրը՝ Արարատի մարզ, քաղաք Արտաշատ, Մարտի 3-րդ շենք, 34 բնակարան) անհայտ բացակայող ճանաչելու պահանջի մասին:

Հայկ Արթուրի Մեղրուբյանի վերաբերյալ տեղեկություն ունեցող անձանց խնդրում են այդ մասին հայտնել ՀՀ Արարատի և Վայոց ձորի մարզերի ընդհանուր իրավասության դատարան (ՀՀ Արարատի մարզ, ք.Մասիս, Շերաքու 26/31) կամ գանգահարել (0236) 4-53-50 հեռախոսահամարով»:

ՀԱՅՏԱՐԱՐՈՒԹՅՈՒՆ

Վաճառվում կամ փոխանակվում է 2 սեմյականոց սեփական տուն Նոյեմբերյանի ԵՂ. Գ. Պողոպանյան: Սակերեսը՝ 41 մ: Տունը քարե է, ունի 630 մ՝ սնամերձ հողատարած: Նաեւ ունի գյուղատնտեսական նշանակության հողակտրոսներ: Գինը՝ ղայմանագրային:

ԿԱՆԱԿՈՒՄ Է ԱՌԱՆՋԱՏՈՒՆ

Ընդհանուր մակերեսը 800 մ/2, բնակելի՝ 120 մ/2, դաշտային այգի, 2 նկուղ, 3 մեքենայի արածո, կունումալ հարմարությունները՝ սանը: Գինը՝ ղայմանագրային:
Հասցեն՝ Է. Արվայան 6/11:
Հեռ.՝ (093)86-88-90, (093)55-52-78:



ԱրմենՏել տեղեկացում է
«ԱրմենՏել» ՓԲԸ (Beeline ապրանքանիշ) տեղեկացում է այն մասին, որ ընկերությունը վաճառում է իր սեփականություն հանդիսացող քաղաք Երեւանում և ՀՀ մարզերում գտնվող անշարժ գույքի օբյեկտներ:
Վաճառքի ենթակա օբյեկտների ցանկի և պայմանների վերաբերյալ մանրամասն տեղեկատվություն կարող եք ստանալ www.beeline.am կայքի «Նորություններ» բաժնում:
 Արմենիա Տելեֆոն Կոմպանի

ՍՓՅՈՒ
 ԵՐԵՎԱՆԻ ԿՈՒՆԱՎՈՐՈՒՄԻՆԻ
www.spyur.am

ԱՆՎՋԱՐ ՏԵՂԵԿԱՏՈՒ 2417

- աղրանքներ, ծառայություններ
- կազմակերպություններ

113

ՀԱՂԱՏՄԱՆ ՀԱՆՐԱՊԵՏՈՒԹՅՈՒՆ
 oruaptr

Հիմնադիր՝ «Հանրադեպտություն» ՓԲԸ
 Գրանցման վկայական N Օ2Ա-050153, գրանցման ամսաթիվ՝ 22.03.2001թ.:

Երեան 23, Արսակունյաց ղողոզա 2, 13-14-րդ հարկեր:
 Գովազդ՝ 526974: Հեռադաշտերնը (fax)՝ 548611: **www.hhpress.am: E-mail: hh@hhpress.am**
Գովազդի ղաասախանասվությունը կում է ղասվիհաուն: Հղումը «ՀՀ»-ին ղաարադիր է:
 Նյութերն ընդունվում են միայն մեքենադիր վիճակում (5 մեքենադիր էջից ոչ ավելի):
 Խմբագրությունը ղաարավոր չէ գրախոսել, խմբագրել եւ վերադարձնել չղաարված նյութերը:
Ք սառով հոդվածները գովազդային են, որոնց համար խմբագրությունը ղաասախանասվություն չի կում:
 «Տիգրան Մեծ» հրասարակչություն ՓԲԸ:
 Ծավալը՝ 4 տղագրական մամուլ: Գրանցման թիվը՝ 1113: Դասիչ (index)՝ 69120:
Գինը՝ 100 դրամ: Իջեցված է տղագրության ժ. 24.00-ին:
 ղաասախանասու արատղար՝ Սամվել ՍԱՐԳՍՅԱՆ:
 Համարի ղաասախանասու, գլխավոր խմբագրի տեղակալ՝ Արմեն ՀՈՎԱԿԻՄՅԱՆ:
Գլխավոր խմբագիր՝ Տիգրան ՀԱՐՄԱՆՅԱՆ

ISSN 1829-2097

16078

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HAYASTANY HANRAPETUTIUN DAILY,

30 April 2016, Saturday, N 78(6360)

According to the procedure established by the RA law on “Assessment and expertise environmental impact” /26.06.2014, H0-110-N/, as well as established by the N 1325-N decision of 19.11.2014 of the Government of the Republic of Armenia (first phase) at 10 V. Sargsyan st., Yerevan on 10.05.2016 at 12.00 public discussions on the application of primary assessment for the environmental impact of the projects of new power plant being constructed by “RencoArmestate” LLC in the area of Yerevan TPC CJSC, will be held.

Documents can be found at RencoArmestate LLC, 10 V. Sargsyan st..

ՌԵՆԿՈ ԱՐՄԵՍՏԵՅՏ ՍՊԸ
Գործող հասցե՝
Իտալիայի փ. 1,
0010 Երևան, ՀՀ
Հեռ.՝ + 374 10 590799
Ֆաքս՝ + 374 10 590798
email՝ rencoyerevan@renco.it

Իրավաբանական հասցե՝
Մ. Խորենացու փող.,
1-ին փակուղի, շենք 8,
0010 Երևան, ՀՀ

Երևանի քաղաքապետի առաջին տեղակալ
պարոն Կ. Արեյանին

02 05. 2016թ

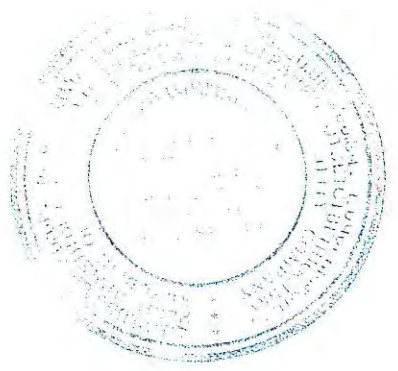
Հարգելի պարոն Արեյան

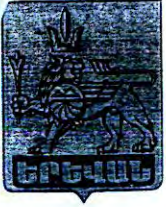
<<Շրջակա միջավայրի վրա ազդեցության գնահատման և փորձաքննության մասին>> ՀՀ օրենքի /21.06.2014թ. 20-110-Ն/, ինչպես նաև ՀՀ կառավարության 19.11.2014թ. N 1325-Ն որոշմամբ սահմանված կարգով (առաջին փուլ) 2016թ. մայիսի 10-ին, ժամը 12.00-ին Երևան քաղաքի Վ. Սարգսյան 10 հասցեում տեղի կունենա «Ռենկո Արմեստեյտ» ՍՊ ընկերության կողմից կառուցվող «Երևանի ՋԷԿ» ՓԲԸ-ի տարածքում նոր էներգաբլոկի նախագծերի շրջակա միջավայրի վրա ազդեցության նախնական գնահատման հայտի վերաբերյալ հանրային քննարկումներ:

Խնդրում եմ աջակցել և ապահովել մասնակցությունը հանրային քննարկումներին, դրանց արձանագրությունը, տեսաձայնագրությունը, ինչպես նաև արված առաջարկներն ու դիտողությունները <<Շրջակա միջավայրի վրա ազդեցության փորձաքննական կենտրոն>> ՊՈԱԿ-ին ներկայացնելու համար:

Տնօրեն՝

Ք. Կուկուրակի





ԵՐԵՎԱՆԻ ՔԱՂԱՔԱՊԵՏԱՐԱՆ

ՀՀ, 0015, ք. Երևան, Արգիշտիի 1

№ 17/20486

11.05 2016թ.

«ՌԵՆԿՈ ԱՐՄԷՍՏԵՑՏ» ՍՊԸ-Ի ՏՆՕՐԵՆ
ՊԱՐՈՆ Ք. ԿՈՒԿՈՒՐԱԿԻՆ

Հարգելի Ք. Կուկուրակի.

Ի պատասխան Ձեր՝ 02.05.2016թ.-ի գրության, հայտնում եմ, որ ս/թ մայիսի 10-ին մասնակցելով «Երևանի ՋԷԿ» ՓԲԸ-ի տարածքում կառուցվող նոր էներգաբլոկի նախագծերի շրջակա միջավայրի վրա ազդեցության նախնական գնահատման հայտի վերաբերյալ հանրային քննարկումներին՝ բնապահպանության վարչությունը տալիս է իր դրական եզրակացությունը նախատեսվող գործունեությանը:

Հարգանքով՝

Աշխատակազմի բնապահպանության

վարչության պետ՝

Ա. Մարտիրոսյան

Կատարող.

Ա. Հազարապետյան

Հեռ. 011.514-263

To the First Deputy of Yerevan Municipality

Mr. K. Areyan

02.05.2016

Dear Mr. Areyan,

According to the procedure established by the RA law on the “Assessment and expertise environmental impact” /26.06.2014, H0-110-N/, as well as established by the N 1325-N decision of 19.11.2014 of the Government of the Republic of Armenia (first phase) at 10 V. Sargsyan st., Yerevan on 10.05.2016 at 12.00 public discussions on the application of primary assessment for the environmental impact of the new power plant projects in the area of Yerevan TPC CJSC under construction by “RencoArmestate” LLC will be held.

I kindly ask you to support and ensure the presence in public discussions, for submitting the Minutes of meeting, video, as well as the proposals and observations to the “Center of expertise for environmental impact assessment” (State Non-Commercial Organization).

Director C. Cucurachi

YEREVAN MUNICIPALITY

1 Argishti str., Yerevan-0015, RA

11.05.2016

To the director of “RencoArmestate” LLC

Mr. C. Cucurachi

N 17/26486

Dear Mr. C. Cucurachi,

In response to Your letter of 02.05.2016, I inform , that, on 10.05.2016 participating in public discussions on the application of primary assessment for the environmental impact of the new power plant projects in the area of Yerevan TPC CJSC , the Department of Nature Protection submits his positive conclusion on the planned activity.

Best regards

Director of the Department
of Nature Protection of Staff

A. Martirosyan

ՀԱՅԱՏՏԱՆԻ ՀԱՆՐԱՊԵՏՈՒԹՅԱՆ

HAYASTANY HANRAPETUTIUN DAILY, ЕЖЕДНЕВНАЯ ГАЗЕТА «АЙАСТАНИ АНРАПЕТУТИОН», ՕՐԱԹԵՐԹ, ԼՈՒՅՍ Է ՏԵՄԵՆԻՄ 1990 ՀՈԿՏԵՄԲԵՐԻ 9-ԻՑ

1 ՀՈՒՆԻՍ 2016, ԶՈՐԵՔՐԱԲԹԻ, ԹԻՎ 100 (6382)

ՊԱՇՏՆԱԿԱՆ

Ընդունել են Իրանի արդարադատության նախարարին

Մայիսի 31-ին Ն.Ս.Ս.Տ. Քարեգին Բ ծայրագույն դատարար է և Ամենայն հայոց կաթողիկոսը Մայր Աթոռ Սուրբ Էջմիածնում ընդունեց Իրանի Իսլամական Հանրապետության արդարադատության նախարար Մուսաֆա Փուրմոհամմադիի գլխավորած դատավարականը, հայնոսն են Մայր Աթոռ Ս. Էջմիածնի սեղելակսվական համակարգից:

Ողջունելով նախարարի այցը Հայաստան՝ Վեհափառ հայրադատը գոհունակություն հայտնեց, որ երկու ղեկավարությունների միջև գործակցությունն օրեօր բոլոր ոլորտներում ընդլայնվում է, եւ ՀՀ անկախության արեգության մեջ հայ-իրանական հարաբերություններում շեշտադրելի վերընթաց է նկատվում:

Նորին սրբությունը գնահատեց անդրադարձավ Իրանում հայ համայնքի նկատմամբ ցուցաբերվող հոգածու վերաբերմունքին, ինչպես նաեւ հայոց սրբավայրերի ու եկեղեցական կառույցների նկատմամբ դրսեւորվող առանձնահատուկ խնամքին:



Իր հերթին Իրանի արդարադատության նախարարն ուրախություն հայտնեց հանդիպման առիթով՝ նույնպես կարեւորելով միջդեպտական կապերի զորացումը եւ սարքեր ոլորտներում առկա սեւր գործակցությունը:

Շարունակությունը՝ էջ 2

Վարչապետ Ֆոլիկ Աբրահամյանը երեկ ընդունել է Իրանի Իսլամական Հանրապետության արդարադատության նախարար Մուսաֆա Փուրմոհամմադիին, հայնոսն են ՀՀ կառավարության սեղելակսվության եւ հասարակայնության հեւ կապերի վարչությունից:



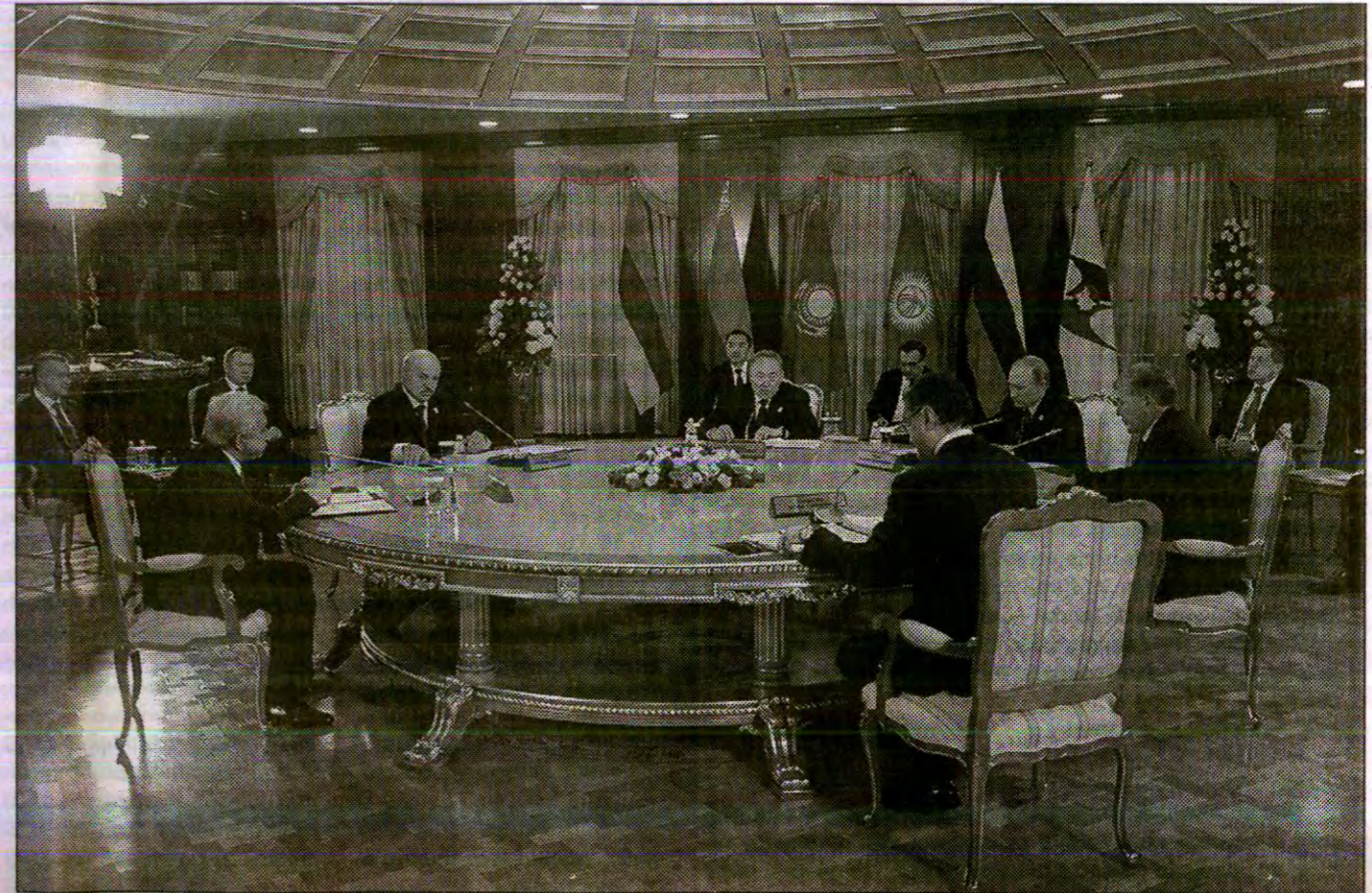
Տնտեսական ինստեգրում եւ անվտանգություն

Եվրասիական տնտեսական բարձրագույն խորհրդի նիստը Աստանայում

Երեկ Աստանայում Եվրասիական տնտեսական միության անդամ ղեկավարությունների ղեկավարների մասնակցությամբ սեղի են ունեցել Եվրասիական տնտեսական բարձրագույն խորհրդի նեղ, ադա ընդլայնված կազմով նիստերը, որոնց ներկա էր նաեւ ՀՀ նախագահ Սերժ Սարգսյանը: Նիստերին մասնակցել է նաեւ Եվրասիական տնտեսական հանձնաժողովի (ԵԱՏՀ) կոլեգիայի նախագահ Տիգրան Սարգսյանը, ով խորհրդի անդամների բննարկմանն ու հաստատմանն է ներկայացրել նիստերի օրակարգը:

Ընդլայնված կազմով նիստի ավարտին նախագահները ստորագրել են ավելի քան մեկ տասնյակ փաստաթղթեր, այդ թվում՝ Եվրասիական տնտեսական միության նավթի եւ նավթամթերքների ընդհանուր շուկայների ձեւավորման մասին հայեցակարգը:

ՀՀ նախագահ Սերժ Սարգսյանը ելույթ է ունեցել բարձրագույն խորհրդի ընդլայնված կազմով նիստում:



Տեւ էջ 3

Գազի սակագինը նվազեց 9.3 դրամով

ՀԾԿՀ հերթական նիստում բավարարվեց ներկայացված դիմումը

ՀՀ հանրային ծառայությունները կարգավորող հանձնաժողովի երեկվա նիստում բննարկվեցին բնական գազի փոխադրման սակագնի, գազամատակարարման համակարգի օդերատորի ծառայության մատուցման եւ բնական գազի բաշխման սակագների, «Գազդրոմ Արմենիա» փակ բաժնետիրական ընկերության կողմից սղառողներին վաճառվող բնական գազի սակագների սահմանման մասին



«Սակագների վերանայնացման» կազմակերպման գազի գինը 2016թ. ադրի-ի համար նվազեցվել է 9.3 դրամով:

վել է ՀՀ-ի համար՝ 1000 խմ-ի համար 165 ԱՄՆ դոլարից ցածր գնի նվազեցումից: Սակագների հաշվարկներում, ըստ մասնագետի, հաշվի են առնվել նաեւ 2013-2015թթ. գազամատակարարման համակարգում իրականացված կադրային ցերդրումների փոխհատուցման, դրամ-ԱՄՆ դոլար փոխարժեքի փոփոխության, ԵԱՀԿ-ի կողմից ներդրման եւ դաշնային մասնաբաժնի փոփոխման ծախսերի փոփոխման գործոնները: «Հինգ ընդունելով

ԼՐԱՏՎՈՒԹՅՈՒՆ

Շնորհավորական ուղերձ

Երեխաների դաշնային միջազգային օրվա առթիվ

ՀՀ Ազգային ժողովի նախագահ Քալուստ Սահակյանը շնորհավորական ուղերձ է հղել Երեխաների դաշնային միջազգային օրվա առթիվ: Ուղերձում ասվում է. «Սիրելի երեխաներ եւ ծնողներ, շնորհավորում են Երեխաների դաշնային միջազգային օրվա առթիվ:

Երեխայի դերն ու նշանակությունը ղեկավարության համար նույնն է, ինչ յուրաքանչյուր ընտանիքի համար: Այդ դերն ու կարեւորությունը չարժեւորելը, զարգացմանը չնդադատելը կնշանակի չմտածել ու քայլեր չձեռնարկել երկրի առաջընթացի համար: Խնդրում եմ աղաչել մանկության, վաստիկի աղազայի հոսանքի գրավակաճը խաղաղություն արարող եւ այն դաշնային կարողացող, իր քաղաքացիների բարեկեցությունը անբեկունեւի նուստանակեւ համարող ղեկավարներին:

HAYASTANY HANRAPETUTIUN DAILY,

1 June 2016, Wednesday, N 100 (6382)

According to the procedure established by the RA law on “Assessment and expertise environmental impact” /21.06.2014, H0-110-N/, as well as established by the N 1325-N decision of 19.11.2014 of the Government of the Republic of Armenia (second phase) at 10 V. Sargsyan st., Yerevan on 14.06.2016 at 11.00 public discussions on the application of primary assessment for the environmental impact of the projects of new power plant being constructed by “RencoArmestate” LLC in the area of Yerevan TPC CJSC, will be held.

Documents can be found at RencoArmestate LLC, 10 V. Sargsyan st., on the official Website of the RA Ministry of Nature Protection (mnp.am), 29 Komitas st., Yerevan (+374-22-02-18).



ԵՐԵՎԱՆԻ ՔԱՂԱՔԱՊԵՏԱՐԱՆ

ՆՆ, 0015, ք. Երևան, Արգիշտիի 1

№ 17/34356

«14» 06 2016թ.

ՀՀ ԲՆ «Շրջակա միջավայրի վրա ազդեցության
փորձաքննական կենտրոն» ՊՈԱԿ-ի տնօրեն
պարոն Վ. Սահակյանին

Հարգելի պարոն Սահակյան

Ի պատասխան Ձեր՝ 03.06.2016թ. հ. Վ/Ս-33/283 գրության, հայտնում եմ, որ ս/թ հունիսի 14-ին մասնակցելով «Երևանի ՋԷԿ» ՓԲԸ-ի տարածքում կառուցվող նոր էներգաբլոկի նախագծերի շրջակա միջավայրի վրա ազդեցության նախնական գնահատման հայտի վերաբերյալ հանրային քննարկումներին՝ բնապահպանության վարչությունը տալիս է իր դրական եզրակացությունը նախատեսվող գործունեությանը:

Հարգանքով՝

Աշխատակազմի բնապահպանության

վարչության պետ՝

Ա. Մարտիրոսյան

Կատարող.

Ա. Հազարպետյան

Հեռ. 011.514-263

YEREVAN MUNICIPALITY

1 Argishti str., Yerevan-0015, RA

14.06.2016

To the director of
“Center of expertise for environmental impact assessment”

State Non-Commercial Organization of RA NP

Mr. V. Sahakyan

N 17/34356

Dear Mr. Sahakyan,

in response of Your h. V/S-33/283 letter of 03.06.2016, I inform, that, on 14.06.2016 participating in public discussions on the application of primary assessment for the environmental impact of the projects of new power plant being constructed in the area of Yerevan TPC CJSC, the Department of Nature Protection submits his positive conclusion on the planned activity.

Best regards

Director of the Department

of Nature Protection of Staff

A. Martirosyan

Հայաստանի Հանրապետություն

HAYASTANY HANRAPETUTIUN DAILY, ЕЖЕДНЕВНАЯ ГАЗЕТА «АЙАСТАНИ АНРАПЕТУТИОН», ԾՐԱԹԵՐԹ, ԼՈՒՅՍ Է ՏԵՄԵՈՒՄ 1990 ՀՈԿՏԵՄԲԵՐԻ 9-ԻՑ

23 ՀՈՒՆԻՍ 2016, ԸՄԲԸԹ, ԹԻՎ 138 (6420)

ՊԱՇՏՈՆԱԿԱՆ

Նախագահը դասախոսական բարեփոխումներին նվիրված խորհրդակցություն է անցկացրել

Երեկ նախագահ Սերժ Սարգսյանը հանրապետությունում իրականացվող դասախոսական բարեփոխումներին նվիրված խորհրդակցություն է անցկացրել: Պասսախանասու մարմիններին ղեկավարների մասնակցությամբ ֆննսրկվել է հանրապետության նախագահի կարգադրությամբ հաստատված 33 իրավական և դասական բարեփոխումների 2012-2016թթ. ռազմավարական ծրագրի կատարման վիճակը:

Ռազմավարական ծրագրի նդասակն է Հայաստանի Հանրապետությունում ձեռնարկված ժամանակակից ժողովրդավարական դեմոկրատիայի և զարգացման իրականացման համապատասխանող իրավական համակարգի և դասական իշխանություն:



Երկրի ղեկավարը նշել է, որ ռազմավարական ծրագիրը մեր իրավական և դասական համակարգի զարգացման համար էական նշանակություն ունեցող փաստաթուղթ է, և դրա լիակատարումը իրականացումը խիստ կարևոր է բարեփոխումների արդյունավետ իրականացման և զարգացման համար:

Զննարկված արդյունքներով արձանագրվել է, որ ծրագրի կատարման շարքի շուրջ տարիների ընթացքում եղել են ինչպես դրական ձեռքբերումներ, այնպես էլ լուրջ թերացումներ և բացթողումներ: Խորհրդակցության ավարտին հանրապետության նախագահը դասախոսական մարմինների ղեկավարներին հանձնարել է միջնա տարիները զորոն միջոցներ ձեռնարկել չկատարված ծրագրային զորոնություններն առավելագույնս արդյունավետ իրականացնելու համար:

33 նախագահի մամո զրասնյակ

ՀԲ մասվիրակության հես ֆննարկվել է CARMAC 2 ծրագրի ընթացքը

ՀՀ գյուղատնտեսության նախարար Սերգո Կարապետյանը ընդունել է Համաբնակչության բանկի մասվիրակությանը, որի կազմում էին ՀԲ ծրագրի մասնակցներ. Համայնների գյու-

Հայաստանում բռնի ուժով հարցեր չեն լուծվելու

Զինված խուճրդ ղեխ է սրափվի և ոգսվի հեսբայլ կասարելու հնարավորությունից

Երեկ Հայաստանի Հանրապետության նախագահի մոտ սեղի է ունեցել խորհրդակցություն ազգային անվանագության ծառայության, ոստիկանության, դասախոսության և ֆննչական մարմինների ղեկավարների մասնակցությամբ, հայտնում են 33 նախագահի մամո զրասնյակից: Երկրի ղեկավարին ներկայացվել է 2016թ. հուլիսի 17-ին ՀՀ ոստիկանության ղախակառարելային գնդի սարածում սեղի ունեցած զինված հարձակման և դրան հաջորդած իրադարձությունների մանրամասները, ինչպես նաև իրականացվող միջոցառումների արդյունքները:

Հանրապետության նախագահին զեկուցվել է նաե, որ ղախակառարելային գնդի սարածում ղախակող ղախանդներին ազատ արձակելու, զինված խմբի անդամների կողմից զենից վայր դնելու և իշխանություններին հանձնվելու նդասակող արտանակարար վարվում են ակտիվ բանակցություններ, ձեռնարկվում են իրավիճակից թելադրող այլ անհրաձեռ զորոնություններ:

Հանրապետության նախագահն ընդգծել է, որ սեղծված իրավիճակին խաղաղ հանգուցալուծում տալու համար ղեխ է ձեռնարկված հնարավոր բոլոր միջոցները, կարետուր է ենթադրալ բոլոր իրավախախտումների համակողմանի և անաչառ ֆննությունը, ինչպես նաև մեղավորների համար ղախածի անխուսափելիության արդյունավետ: Խորհրդակցության արդյունքներով իրավադատ մարմինների ղեկավարներին սրվել են անհրաձեռ հանձնարարականներ:

«Մինչ մեր հերթական խորհրդակցությունը սկսելը մեկ անգամ եա փաստենք, որ մեր երկիրն այս օրերին արդում է դոժվարին և ղախախախտումներ օրեր: ղախառներին, իհարկե, այս ղախին չեն անդրադառնալու: Հիմա դրա ժամանակը չէ: Կասեմ միայն, որ բոլորս ղեխ է սրանից դասեր ֆաղենք:

Մեկ անգամ եա ցավակցում են զոհված զնդադես Արթուր Վանոյանի ընտանիին և հարազատներին: Բոլորս ղախ օրենք մրա առաջ: Մեմ ղեխ է անենք ամեն ինչ, որ ղեխալի այս բարդ իրավիճակը կարգավորվի, և ման ոդրեզություն այլեա չկրկնվի:

Այս վիճակի ակունքում է մեր իրողության մեջ ամենավատագրավոր մտայնությունը՝ հարցերը լուծել բռնությամբ և ուժի կիրառմամբ: Այս մտայնության հեսագա զարգացումը հղի է ատ վսանգավոր հեսեանմներով հենց մեր երկրի և ղեխակառարության համար:

Հայաստանում բռնի ուժով, հարձակումով և ղախանդ վերցնելով հարցեր չեն լուծվելու: Եվ դա երբեք մենք բոլոր չենք սալու: Այս իրավիճակի հանգուցալուծումը ղեխ է լիցնի Հայաստանի և մեր հասարակության, ղեխության հասունության կարետուրազույն ֆննություն:

Ոստիկանության ղախեկառարակային գնդի սարածն զրաված զինալներին կոչ են անում ցուցաբերել զուղվածություն և իրենց սաղրիչ զորոնություններով չվսանգել ուրիցների կանը:



անի Հանրապետության Սահմանադրության և օրենքների խախտող ղախառներին:

Անձնական վրեժխնդրության բոլոր փորձերը կասեցվելու են օրենքի ուժով:

Այո, Հայաստանում դոժոհներ ատ կան: Սակայն թող ոչ ոք չսխալվի և չմսածի, որ կարող է ռեել աղթ կամ ղախառ ատազորել մեր ղեխակառարության հիմքերը ֆայլելու համար:

Հորդորում են մեր հանրության բոլոր ներկայացուցիչներին իրենց ֆաղախական և ֆաղախադիական իրավունքները իրացնել բացառադես խաղաղ և օրենքի արգանակներում: Հորդորում են նաե, որ սուր չսան ծախառաղ ֆայլեր և սաղրանմներ իրահող անձանց առաջարկներին և զաղափարներին: Դա հղի է մո մարդկային կորուստների լուրջ վսանգով:

Հորդորում են, որ յուրաքանչյուր ոք զիտակցի այդ սաղրանմներից և ծախառաղ ֆայլերից բխող իրական վսանգները:

Հանձնարարում են ձեզ՝ իրավադատ մարմինների ղեկավարներին, որ ղեխառ ձեռ զորոնությունը արունակել

ջոցները իրավիճակին վերցնական խաղաղ հանգուցալուծում տալու համար:

Կրկին կոչ են անում զինված խմբին՝ ժամ առաջ վայր դնել զենից:

Մեմ զորոնում ենք և զորելու ենք համբերասար: Մեր երկրի յուրաքանչյուր ֆաղախադու կյանը և առողջությունը քանի է մեզ համար:

Մեմ չենք զնացել այսդիտի իրավիճակներում դասական համարող ձանաղառով: Սրանով մենք հնարավորություն ենք սվել զինված խմբին հեսբայլ կասարելու համար: Հուտով են, որ մրան կարափվեն:

Բայց մենք իրավունք չունենք բոլոր սալու, որ մեր ողջ հանրությունն այս լարվածության դասանող դառնա:

Կարծում են, որ այս իրավիճակն արդեն ավելի երկար է սետում, ֆան մենք կարող ենք մեզ բոլոր սալ: Աղրիլ ամսից դեռ այնքան ատ ժամանակ չի անցել, որ ղեխառ մեր հասարակությունն իրեն բոլոր սա մոռանալու սեղի ունեցածի մասին:

Մեկ անգամ եա բոլորս զզոնության և զուղվածության կոչ են անում՝ հանում Հայաստանի Հանրապետու-

ԳՈՎԱԶԳԴ ԾԱՆՈՒՅՈՒՄ

ՆԱԽԱԶԵՆՈՒԹՅՈՒՆ

Գիրքը՝ նաեւ էկրանին

Դա ոչ թէ «դավաճանություն», այլ կյանքը երկարացնել է

Ժամանակակից «լեզուն» փոխում է զրփ մասին դասկերացումները: Եթէ, ասենք, օրինակ՝ 30 տարի առաջ գիրք միայն թղթից գիրք էր, ադա այսօր այն նաեւ փոքրիկ էկրանի սեւով է: Ու դեռ չենք կարող ասել, թէ 30 տարի հետո գիտությունն ընթերցանության համար ինչ նորություն կառաջարկի:

Ոմանց կողմից որդես «դասական» գրի հանդեմ «դավաճանություն» ընդունվող էլեկտրոնային սարքերակը, եթէ չասենք, որ փրկեց գրի «ֆիզիկական» կյանքը՝ կրկնակի որդես դավաճանություն գիտության ու նորարարության նկատմամբ: Ահա թէ ինչու՝ միջոց է, որ գիրքն ընթերցվում է միայն ընթերցանության համար: Հասկալոթես կրթական ծրագրերում ներառված գրականությունը սերտել է լիցի: Իսկ դա ենթադրում է զրփ դարբերաբար թերթում: Եվ որքան կարող է զոյափետել արդեն դեղնած, հնացած, երբեմն նաեւ զրեթե փերվող թուղթը: Ի վերջո այդօրինակ էջի ճակատագիրը կլինի արտատառանային միջոցով կաղը գրի հետ:

Եվ ինչու չօգսվել ժամանակի թելադրանքից՝ դասիդանելով, այսուրեւ ասած՝ բնօրինակը: Հասկալոթես որ այդոյիսի հնարավորությունն ընձեռող կայքերի թիվը վերջին տրջանում կարեես սասանում է: Օրինակ՝ «gq.am»-ն առաջարկում է բազմաթամր գրականություն՝ ինչոթես օնլայն ընթերցանության, այնոթես էլ ներթեոնման համար: Այդ հասցեից օրական կատարվում է միջինը օուը 320, ամսական ավելի քան 9100 բեռնում: «Գրքանոլ» նախաձեռնության հիմնադիրներից Հասանիկ Մելիսեթյանը «ՀՀ»-ի հետ զրույցում լեցեց՝ քանի որ կայրում էլեկտրոնային զրեթի քանակն առայժմ այդքան էլ լաս է, եւ ընթերցողն ընսերլու լայն հնարավորություն չունի, ուսի սեղադրված թուր զրեթն էլ հավասար քանակով են ներթեոնվում: Իսկ վերջին ժամանակներում ամենալասը ներթեոնվել են երիս Մարիա Ռենարկի եւ Վարդգես Պեսոսյանի զրեթը:

Գրեթն էլեկտրոնային դարձնելը բավականին ժամանակասար եւ ալքասասար զործընթաց է: «Պասկերացրեք լրասադասձեռնահանվում է յուրաքանչյուր էջ, այնուիեսես դրանք մակվում են, համարդասասիքանցվում մեր կայքի համար մակված հասուկ չափանիչին, ադա մի քանի ֆորմասով դասիդանվում եւ հետո միայն սեղադրվում կայրում: Մի զիրը թվայնացնելու համար 10-20 օր ժամանակ է դասիանցվում», ալքասանքները ներկայացնում է Հասանիկը:

Կայրում հիմա սեղադրված է մոտավորադես 50 էլեկտրոնային զիրք: Բայց էլեկտրոնայնացման ալքասանքները արունակական են: Նասանակում է՝ զրեթի բազան արունակում է թարմացվել: Միայն թէ հայալեզու գրականությունն էլեկտրոնային սարքերակով ավելի փչ է: Դա դասձառնեղը, ըստ «Գրքանոլ» նախաձեռնության հիմնադրի, բազմաթիվ են՝ սկսած հրամանաձեռ. հնոն ենթարուն է հեռոնմանահին հրավոնքներ:

ՀԱՅՏԱՐԱՐՈՒԹՅՈՒՆ

2016 թ. հուլիսի 31-ին, ժամը 13-ին, ՎԱՅԱՆ ՏԵՐՅԱՆԻ ԾՆՆՈՂԱՎԱՅՐՈՒՄ Վրասանի Նինոծմինդայի արջանի Գանձա գյուղում, սեղի կունենա «ՏԵՐՅԱՆՎԱՆ ՕՐ» ավանդական տոնահանդեսը, նվիրված մեծանունը ուոեսին:



«Տեդյան» մակրության կենսոն «Ջավախ» հայրենակցական միություն

Տոնահանդեսին մեկնող ավարունեղը կարծվեն «Տեդյան» մակրության կենսոնին հարող սարածից (հասցեն՝ Երեան, Տեդյան փ. թիվ 72), հուլիսի 31-ին, ժամը 07.00-ին:

Տոնահանդեսից հետո ավարունեղը կմեկնեն ՎԱՅԱՆ ՏԵՐՅԱՆԻ տուն-թանգարան եւ Փարվանա լիճ:

<<Հրջակա միջավայրի վրա ազդեցության զնահասման եւ փորձամոնության մասին>> ՀՀ օրենքի /21.06.2014թ. ԳՈ-110-Ն/, ինչոթես նաեւ ՀՀ կառավարության 19.11.2014թ. N 1325-Ն որոմամբ սահմանված կարգով (երոող փուլ) 2016թ. օգոսոսի 2-ին, ժամը 11.00-ին Երեան քաղաքի Վ. Սարգսյան 10 հասցեում սեղի կունենա «Ռենկո Արմեսեսյ» ՄՊ ընկերության կողմից կառուցվող Երեանի ՋԷՎ ՓԲԸ-ի սարածմուն նոր էներգաթրոլի նախազծերի հրջակա միջավայրի վրա ազդեցության զնահասման հայաի վերաբերյալ հանրային քննարկումներ:

Փասաթթերին կարելի է ծանոթանալ «Ռենկո Արմեսեսյ» ՄՊ ընկերությունում, Վ. Սարգսյան 10 հասցեում, ՀՀ բնադասիդանության նախարարության դասոնակալ կայրում (mnp.am), Բ. Երեան, Կոմիսաս 29 հասցեում: +374-22-02-18

ՀԱՅՏԱՐԱՐՈՒԹՅՈՒՆ

2016 թվականի օգոսոսի 25-ին ժամը 11.00-ին Գեղարունիսի մարզի Վարսերի գյուղադեսարում սեղի կունենա համայնի վարչական սարածմուն զոնվող ԱՏՏ 1 05-086-0128 ծածկագրով 0,10 հա քնակավայրերի հասարակական կառուցադասման հողակոնրերի աձուղ վաձառ: Հասարակական կառուցադասման հողակոնրի 1 ոն-ի մեկնարկային զինը 380 դրամ է Աձուրդի մասնակցության զումարը՝ 1000 դրամ, նախավաձարը՝ մեկնարկային զին 5%-ը Աձուրդի որված հողերի նկատմամբ սերվիոսներ եւ այլ սահմանափակումներ չկան Աձուրդի մասնակցության հայեսղը ընդունվում են մինչես 2016 թվականի օգոսոսի 19-ը ժամը 17.00 Լրացուիչ սեղեկությունների համար դինել Վարսերի գյուղադեսարում: Հեռ. 0261-2-74-63 Վարսերի գյուղադեսարում

ՀԱՅՏԱՐԱՐՈՒԹՅՈՒՆ

ՀՀ Արմավիրի մարզի ընդհանր իրակառության առաջին աջանի դասարանի 30.05.2016թ. թիվ ԱՐՂՈՈ4004/16 վեռով Արտար Վանիկի Վարդանյանը /անձնագիր՝ ԱՁՈ888010, օրված՝ 11.04.2008թ. 057-ի կողմից՝ մասնակել է սանկ-միոն օրինական ուծի մեղ է մել 30.05.2016թ. եւ նոյն դասարանի 04.07.2016թ. որոմամբ Արտար Վանիկի Վարդանյանը սանկության զորեղ կառավարիչ է նասակվել Կարեն Ասարյանը:

Պասեսերն իրենց դասանցեղը ներկայացում են ՀՀ Արմավիրի մարզի ընդհանր իրակառության դասարան՝ «Արմավրյան մասին» ՀՀ օրենքի 46-րդ հողվածի կարգով՝ սանկության մասին հայասարադեսարմեց հետ մեկնայա ժամվոթես:

Պասեսերների առաջին ժողրվ նասակված է 12.09.2016թ. ժամը 12.00-ին, ՀՀ Արմավիրի մարզի ընդհանր իրակառության առաջին աջանի դասարանի օնում Բ.Արմավիր, Հանրադեսարում 41/:



«ԳԱՋՊՐՈՍ ԱՐՄԵՆԻԱ» ՓԲԸ **ЗАО "ГАЗПРОМ АРМЕНИЯ"**

0091, Երեան, Թրիփսյան խճուղի 43 Հեռ. (374 10) 294728, 294933, Ֆասա 294728
0091, Ереван, Третьяковское шоссе 43 Լեռ. (374 10) 294728, 294933 Փաս 294728

HAYASTANY HANRAPETUTIUN DAILY,

23 July 2016, Saturday, N 138(6420)

According to the procedure established by the RA law on “Assessment and expertise environmental impact” /21.06.2014, H0-110-N/, as well as established by the N 1325-N decision of 19.11.2014 of the Government of the Republic of Armenia (third phase) at 10 V. Sargsyan st., Yerevan on 02.08.2016 at 11.00 public discussions on the application of primary assessment for the environmental impact of the projects of new power plant being constructed by “RencoArmestate” LLC in the area of Yerevan TPC CJSC, will be held.

Documents can be found at RencoArmestate LLC, 10 V. Sargsyan st., on the official Website of the RA Ministry of Nature Protection (mnp.am), 29 Komitas st., Yerevan (+374-22-02-18).



ԵՐԵՎԱՆԻ ՔԱՂԱՔԱՊԵՏԱՐԱՆ

ՀՀ, 0015, ք. Երևան, Արգիշտիի 1

№ 17/16676 և

« 02 08 2016 » թ.

«ՌԵՆԿՈ ԱՐՄԷՍԵՅՏ» ՍՊԸ-Ի ՏՆՕՐԵՆ
ՊԱՐՈՆ Ք.ԿՈՒԿՈՒՐԱԿԻՆ

Հարգելի Ք. Կուկուրակի.

Հայտնում եմ, որ ս/թ օգոստոսի 2-ին մասնակցելով «Երևանի ՋԷԿ» ՓԲԸ-ի տարածքում կառուցվող նոր էներգաբլոկի նախագծերի շրջակա միջավայրի վրա ազդեցության գնահատման հայտի վերաբերյալ հանրային քննարկումներին՝ բնապահպանության վարչությունը տալիս է իր դրական եզրակացությունը նախատեսվող գործունեությանը:

Հարգանքով՝

Աշխատակազմի բնապահպանության

վարչության պետի ժ/պ՝

Ս.Սարգսյան

Կատարող.

Ա. Հազարապետյան

Հեռ. 011.514-263

YEREVAN MUNICIPALITY

1 Argishti str., Yerevan-0015, RA

02.08.2016

To the director of “RencoArmestate” LLC

Mr. C. Cucurachi

N 17/16676

Dear Mr. Cucurachi,

I inform, that, on 02.08.2016 participating in public discussions on the application of assessment for the environmental impact of the projects of new power plant being constructed in the area of Yerevan TPC CJSC, the Department of Nature Protection submits his positive conclusion on the planned activity.

Best regards

Temporary executor of the Department

of Nature Protection of Staff

S. Maksapetyan

ՏԵԽՆԻԿԱԿԱՆ ԱՌԱՋԱԴՐԱՆՔ

/նախատեսվող գործունեության/

SU 37

<<23>> 06 2016թ

Սույն առաջադրանքը կազմված է <<Շրջակա միջավայրի վրա ազդեցության գնահատման և փորձաքննության մասին>> ՀՀ օրենքի (այսուհետ՝ Օրենք) դրույթների համաձայն և հիմք է հանդիսանում նախատեսվող Ա կամ Բ կատեգորիայի գործունեության փորձաքննության հիմնական փուլին ներկայացվող շրջակա միջավայրի վրա ազդեցության հիմնական գնահատման հաշվետվության մշակման համար՝ ըստ ստորև ներկայացվող պահանջների.

- 1. Ձեռնարկողի անվանումը և հասցեն՝ <<Ռենկո Արմեստեյտ>> ՍՊԸ /ք. Երևան, Մ. Խորենացու փող. 1-ին փակուղի, շենք 8/
- 2. Նախատեսվող գործունեությունը և նրա կատեգորիան՝ <<Համակցված շոգեգազային ցիկլով էներգաբլոկի>> կառուցման նախնական գնահատման հայտ <<Ա>> կատեգորիա
- 3. Ազդակիր համայնքը (ներքը)՝ Քաղաք Երևան
- 4. Շրջակա միջավայրի վրա ազդեցության գնահատման գործընթացում դիտարկվող օբյեկտները և բնութագրերը նախատեսել համաձայն Օրենքի 7-րդ հոդվածի 1-ին մասի 1-ից 13-րդ կետերի՝ Անհրաժեշտ է դիտարկել կետերում նշված բոլոր օբյեկտները և բնութագրերը:
- 5. Շրջակա միջավայրի և մարդու առողջության վրա ազդեցության գնահատման հաշվետվության բովանդակությունը և նրան կից ներկայացվող փաստաթղթերը նախատեսել համաձայն Օրենքի 18-րդ հոդվածի 2-րդ մասի 1-ից 15-րդ և 3-րդ մասի 2-ից 6-րդ կետերի՝ Շրջակա միջավայրի վրա ազդեցության գնահատման հաշվետվությունում անհրաժեշտ է ներառել նշված բոլոր կետերի ցուցանիշները և փաստաթղթերը:
- 6. Համապատասխան ոլորտի պետական լիազորված մարմնի եզրակացության կամ կարծիքի վերաբերյալ աահանօր

7. Գործընթացի մասնակիցները համաձայն Երևանի քաղաքապետարան, հանրություն: Օրենքի 4-րդ հոդվածի 1-ին մասի 22-րդ կետի
8. Հանրության ծանուցումը և Գնահատման ընթացքում քննարկումների իրականացումը կատարել քաղաքապետարանը ձեռնարկողի հետ համատեղ պետք է իրականացնի համատեղ պետք է իրականացնի հանրության ծանուցում և հանրային քննարկումներ: Արձանագրությունները, տեսաձայնագրության կրիչը, հանրության դիտողությունների հիմնավորված պատասխանների ամփոփաթեթը պետք է ներառել շրջակա միջավայրի վրա ազդեցության գնահատման հաշվետվությունում և ներկայացնել ՀՀ բնապահպանության նախարարություն՝ փորձաքննության:
9. Պետական տուրքի չափը՝ 500.000 (հինգ հարյուր հազար) դրամ՝ Ա կատեգորիայի համար
10. Ստացողը և հաշվի համարը՝ ՀՀ ֆինանսների նախարարության գանձապետարան՝ 900005000196
11. Վճարման նպատակը՝ Նախատեսվող գործունեության փորձաքննության գործընթացի իրականացման համար
12. Փորձաքննության հիմնական փուլի սկիզբը համաձայն Օրենքի 19-րդ հոդվածի և «Շրջակա միջավայրի վրա ազդեցության փորձաքննության իրականացման կարգը սահմանելու մասին» ՀՀ կառավարության որոշման Տեխնիկական առաջադրանքի համապատասխան կազմված ՇՄԱԳ հաշվետվությունը՝ ՀՀ բնապահպանության նախարարություն՝ շրջակա միջավայրի վրա ազդեցության փորձաքննություն և ներկայացնելը:

<<Շրջակա միջավայրի վրա ազդեցության փորձաքննական կենտրոն>> ՊՈԱԿ-ի տնօրեն



Վ.Սահակյան

<<Շրջակա միջավայրի վրա ազդեցության փորձաքննական կենտրոն>> ՊՈԱԿ-ի փոխտնօրեն

Ս.Փահլևանյան

<<Շրջակա միջավայրի վրա ազդեցության փորձաքննական կենտրոն>> ՊՈԱԿ-ի մասնագետ

Ա.Մինասյան

TECHNICAL SPECIFICATION

/of the planned activity/

TS 37

23.06.2016

The present specification is made according to the RA law clauses on the “Assessment and expertise environmental impact” (hereinafter referred to as Law) and is taken as a base for the planned A or B category activity for the processing of the report of main assessment of environmental impact being submitted to the expertise general phase, according to the following specifications:

1. The name and address of undertaker:	“RencoArmestate” LLC / 8 M. Khorenatsi St., 1st Blind Alley, Yerevan/
2. The planned activity and its category:	Primary assessment application, “A” category for the “Combined cycle power plant”
3. The affected community (communities):	Yerevan city
4. To foresee the objects and characteristics being observed during the process of the Environmental impact assessment according to the Law 1-13 points of the 1 st part of the 7 th article:	It is necessary to observe all the objects and characteristics indicated in the points.
5. To foresee the content of report of the human health and environmental impact assessment and the attached documents according to the Las 2-6 points of the 3 th part and 1-15 points of the 2 nd part of 18 th article:	In the reports of the environmental impact assessment is necessary to include all the indicated documents and indicators of the points.

6. The requirement on the opinion or conclusion of state licensed body of the relevant field:	
7. The participants of the process according to the Las 22 nd point of the 1 st part of the 4 th article:	Yerevan municipality, society
8. To execute the public notice and the implementation of discussions according to the 7 th and 8 th parts, 1 st and 2 nd points of the 5 th part, 3 th part, 2 nd and 3 th points of the 2 nd part of the Law 26 th article and according to the N1325-N decision of 19.11.2014 on the “Establishment of the public notice and discussions implementation procedure”:	During the assessment the municipality should realize public notice and public discussions with the undertaker. The minutes of meeting, the video flash, the answers summary sheet based on public remarks should be included in the report of the environmental impact assessment and should be submitted to the expertise of the RA Ministry of Nature Protection.
9. The amount of state fee:	500.000 (five hundred thousand) AMD for A category
10. The recipient and the account:	treasury of RA Ministry of Finance – 900005000196
11. Payment purpose:	For the implementation of the planned activity expertise
12. The beginning of the expertise general phase according to the Law 19 th article and to the decision of the Government of the Republic of Armenia on the “Establishment of procedure of the implementation of the environmental impact expertise”:	The submission of the environmental impact assessment report made according to the technical specification to the expertise of environmental impact – to the RA Ministry of Nature Protection .

Director of “Center of expertise for
Environmental impact assessment”
State Non-Commercial Organization

V. Sahakyan

Deputy director of “Center of expertise for

Environmental impact assessment”

State Non-Commercial Organization

S. Pahlevanyan

Specialist of “Center of expertise for

Environmental impact assessment”

State Non-Commercial Organization

A. Minasyan

11.2 Annex 2 - Form for comments

Comments to the Draft Final ESIA Report				
Do you wish to receive an answer to your comments?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, please mark how you wish to be contacted	<input type="checkbox"/> Post	<input type="checkbox"/> Telephone	<input type="checkbox"/> E-mail	<input type="checkbox"/> Others
	Address:	Contact number:	E-mail address:	Please specify:
Preferred language for communication	<input type="checkbox"/> Armenian	<input type="checkbox"/> Russian	<input type="checkbox"/> English	<input type="checkbox"/> Others
	Please specify:			
<input type="checkbox"/> I prefer to remain anonymous				
Gender:				
Title:				
Name: <i>(Please do not fill this field if you would like to remain anonymous)</i>				
Signature: <i>(Please do not fill this field if you would like to remain anonymous)</i>				
Local:				
Date:				

11.3 Annex 3 - Stakeholder Log

#	Entity/Individual person's name	Representative	Contact details	Communication media	Comment	Answer and Action for follow-up	Responsibility	Deadline	Confirmation of close-out
1	Municipality of Kharberd	Karo Kakoyan, Mayor	+(374 093) 400-122 Nor Kharberd village, Ararat Marz norkharberd.ararat@mta.gov.am	Personal meeting	04.07.2017 No concerns regarding the implementation of the Project; no medical/ health issues of local population concerning the operation of the existing YCCPP-1 were reported; the mayors hope that the Project will create jobs for the local population	04.07.2017 Not applicable	Not applicable	Not applicable	Not applicable
2	Municipality of Ayntap	Karen Sargsyan, Mayor	+(374 094) 722-222 Ayntap village, Ararat Marz ayntap.ararat@mta.gov.am						
3	Municipality of Yerevan, Head of Erebuni Administrative District	Edgar Mkrtchyan, Head of Department	+(374 11) 518-388 Building 87, Sasuntsi Davit str. Yerevan						
4	Municipality of Yerevan, Head of Shengavit Administrative District	Armen Sargsyan, Head of Department	+(374 11) 518-808 Building 26, G.Njdeh str. Yereva						

11.4 Annex 4 - Public Grievances Form

Description of Incident or Grievance (What happened? Where did it happen? Who did it happen to? What is the result of the problem?)				
Date of Incident/Grievance:				
<input type="checkbox"/> One time incident/grievance?		Date:		
<input type="checkbox"/> Happened more than once?		How many times?		
<input type="checkbox"/> On-going (currently experiencing problem)				
Do you have suggestions on how to solve the problem?				
Do you wish to receive an answer to your grievance?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, please mark how you wish to be contacted	<input type="checkbox"/> Post	<input type="checkbox"/> Telephone	<input type="checkbox"/> E-mail	<input type="checkbox"/> Others
	Address:	Contact number:	E-mail address:	Please specify:
Preferred language for communication	<input type="checkbox"/> Armenian	<input type="checkbox"/> Russian	<input type="checkbox"/> English	<input type="checkbox"/> Others
	Please specify:			
<input type="checkbox"/> I prefer to remain anonymous				
Gender:				
Title:				
Name: <i>(Please do not fill this field if you would like to remain anonymous)</i>				
Signature: <i>(Please do not fill this field if you would like to remain anonymous)</i>				
Local:				
Date:				



The legal framework of the earthcover pollution standardization in Armenia and the results of the YCCPP2 territory research



Customer
Renco Armestate LLC

Executer
Consecoard LLC

Yerevan, 2018

CONTENT

1. Legal framework.....	3
1.1. RA land code.....	3
1.2. Sublegal acts.....	3
2. The standardization of soil pollution	4
2.1. The standardization of soil pollution.....	4
2.2. Soil classification by hazardness and the assessment of impact	6
3. ANALYSIS OF MONITORING RESULTS CARRIED OUT IN THE YEREVAN TPP-2 TERRITORY	9
3.1. Introduction	9
3.2. Soil pollution assessment in the territory of Yerevan TPP-2.....	10
4. Conclusion	12

ABBREVIATION LIST

RA	Republic of Armenia
RF	Russian Federation
TLV	Threshold limit value
TPP	Thermal power plant
SN	Sanitary normative
LLC	Limite Liability Company

1. Legal framework

1.1. RA land code

The Land Code defines the basic directions of State regulatory system improvement concerning land relations, development of various organizational and legal forms of land economy, fertility of land, land use efficiency raise, protection and improvement of an environment – favorable for human vitality and health and the legal framework concerning the protection of the rights on land. The land code has been passed on 02.05.2001.

The Article 6 of the Code defines “Due to its target position, the available land of the Republic of Armenia is classified:

- 1) Agricultural
- 2) Settlement
- 3) Industrial, for entrails-use and production
- 4) **Energetic**, transport, communicational, public structural
- 5) Specially protected areas
- 6) Special importance
- 7) Forestry
- 8) Water
- 9) Reserved land

The lands of the thermal power plant due to target position are classified as “Energetic”.

According to the Article 15 of the Code: “Lands allocated for construction and maintenance of thermal, nuclear and hydro plants, high voltage cables, gas pipes and use on other energetic purposes are considered the lands of energy objects”.

The Article 16 defines “The goals and objectives of land protection”, under the 7th clause of which “in order to provide for protection of human health and environment, the Government defines the general requirements of the protection the earth from pollution, the maximum allowable norms of land contaminative substances, lands pollution level assessment order.

1.2. Sublegal acts

Based on the RA land code requirements the RA Government has passed several sublegal acts, the main ones of which in the land use and protection fields are the followings:

- “The technical regulation of the general requirements of the protection of the lands form pollution, the list of the contaminating substances, polluting the lands, and the assessment of the lands pollution level” (RA Government resolution N1277-N of 24.08.2006),

- “The technical regulation of the requirements for the decision of land fertile layer removal norms and the protection and use of the removed fertile layer” (RA Government resolution N1026-N of 20.07.2006),
- “The order of the assessment of the impact due to the economical activity on the land resources” (RA Government resolution N 92-N of 25.01.2005).

The land resources pollution indexes and the requirements for them are regulated by the “Sanitary rules and norms, hygienic requirements, for the soil quality N2.1.7.003-10”, approved by the order N01-N of 25.01.2010 of the RA Minister of healthcare.

2. The standardization of soil pollution

The soil pollution permissible level is regulated by the “The technical regulation of the general requirements of the protection of the lands from pollution, the list of the contaminating substances, polluting the lands, and the assessment of the lands pollution level” (RA Government resolution N1277-N of 24.08.2006) and “Sanitary rules and norms, hygienic requirements, for the soil quality N2.1.7.003-10” (order N01-N of 25.01.2010 of the RA Minister of Healthcare).

2.1. The standardization of soil pollution

The threshold limit values (TLV) of the chemicals (including also the pesticides) in the soil are defined in the table 1 of the sanitary norms N2.1.7.003-10 (presented with abridgements, considering the possibility of existence in YCCPP2 territory).

Table 1

THE THRESHOLD LIMIT VALUES OF CHEMICALS IN SOIL

N	Denomination of the substances	TL value mg/kg, considering the background (clarck)	Limiting indexes
15.	Petrol	0,1	Air-migration
16.	Benzol	0,3	Air-migration
19.	Vanadium	150,0	General sanitary
52.	Xylols	0,3	Translocation
61.	Nitrates	130,0	Water-migration
74.	Mercury	2,1	Translocation
75.	Lead	32,0	General sanitary
79.	Sulfur compounds (S), elementary sulfur	160,0	General sanitary
80.	Hydrogen sulfide	0,4	Օդամիգրացիոն
81.	Sulphuric acid	160,0	General sanitary
85.	Styrene	0,1	Air-migration
87.	Antimony	4,5	Air-migration
88.	Toluene	0,3	Air-migration,

N	Denomination of the substances	TL value mg/kg, considering the background (clarck)	Limiting indexes
			Translocation
96.	Potassium Chloride	360,0	Water-migration
102.	Cobalt	5,0	General sanitary
103.	Manganese		General sanitary
	a) turf-podzolic black soil, derived by 0,1N H ₂ SO ₄	700,0	
	pH 4,0	300,0	
	pH 5,1—6,0	400,0	
	pH ≥ 6,0	500,0	
	b) pH 4,8		
	turf-podzolic black soil, derived by ammonium acetate buffer		
pH 4,0	140,0		
pH 5,1—6,0	60,0		
pH ≥ 6,0	80,0		
		100,0	
104.	Copper	3,0	
105.	Nickel	4,0	General sanitary
106.	Lead	6,0	General sanitary
107.	Zinc	23	Translocation
109.	Chrome	6,0	General sanitary

However the direct use of TLVs according to the sanitary norms N 2.1.7.003-10, is applied only to certain construction types:

“10. In the soils of residential construction territories, territories, envisaged for the recreation areas for health purposes, sanitary protection zones of water supply centralized systems structures it is not allowed:

- excess of threshold limit values or orienting permissible quantities with chemical pollutants by sanitary-toxicological indicators”,

...

“15. For the assessment of the soil sanitary condition of the sanitary protection zones residential construction, pre-school, school organizations, yard playground territories, recreation areas for health purposes, water supply centralized systems structures, including the water intake”.

For other activity types (industrial, agriculture, not civil construction) only land use proposals are presented.

According to the pollution level, the land use proposals are defined in the Annex 2 of the Sanitary norms N 2.1.7.003-10.

Annex 2. THE LAND USE PROPOSALS, ACORDING TO THE POLLUTION LEVEL

<i>Land pollution class</i>	<i>Land usage offer</i>
Clean	Usage without restriction
Permissible	Usage without restriction, except for the objects of high vulnerability - children's, school organizations, residential areas, sports, playground, children's recreational areas, resort zones, water objects, water mains
Moderately dangerous	For filling of trenches and pits during construction, for areas foreseen for landscaping, by adding 0.2m layer of clean soil
Dangerous	Restricted use for filling of pits during construction, adding no less than 0.5m layer of clean soil. In case of an epidemic hazard, disinfection (dezinvasion) is carried out on the recommendation of the hygienic anti-epidemic controls authorities, with further laboratory supervision
Emergency dangerous	Transportation and utilization in special polygons. In case of an epidemic hazard, disinfection (dezinvasion) is carried out on the recommendation of the hygienic anti-epidemic controls authorities, with further laboratory supervision

2.2. Soil classification by hazardness and the assessment of impact

Classification of soil by hazardness and the assessment of impact is made according to “The technical regulation of the general requirements of the protection of the lands form pollution, the list of the contaminating substances, polluting the lands, and the assessment of the lands pollution level” (RA Government resolution N1277-N of 24.08.2006).

Lands protection requirements and classification of land by pollution levels are provided in chapters III and IV of the regulation.

III. GENERAL REQUIREMENTS FOR THE LAND PROTECTION FROM POLLUTANTS

4. General requirements for the land protection from pollutants include

...

b) industrial and household trashes (if they contain elements necessary for soil nutrition or chemical amelioration) using as fertilizer or chemical amelioration to thoroughly examine their chemical composition to prevent the importation of heavy metals and other toxic elements and compounds into the soil;

c) Removal and utilization of waste, emissions, outflow, wastewater and their sediments by implementing soil pollution preventing measures.

d) pesticides, mineral fertilizers, storage and transportation of other chemicalization by implementing measures to prevent environmental pollution.

e) the planning of cleaning structures that exclude the chemical pollution of soil in the designs of new industrial organizations to be constructed, and technological lines;

f) excluding pollution and contamination of industrial and domestic wastes, coarse objects, stones, macadam and construction waste during the construction, structuring and other works, of linear structures and meliorative objects.

IV. LIST OF LAND POLLUTING CHEMICAL SUBSTANCES AND REQUIREMENTS FOR SOIL CLASSIFICATION BY POLLUTING CHEMICAL SUBSTANCES IMPACT

6. Lands according to chemical pollution are classified on the basis of threshold limit value (TLV) of chemical substances in soil and on background levels of these substances.

By pollution, the lands are classified as:

a) highly polluted lands where the content of polluting chemicals exceeds their maximum permissible concentration or approximate permissible concentration, related to the chemical pollution have low biological activity, significant changes in physical-mechanical, chemical and biological characteristics, as a result of which the chemicals content in crops exceeds the defined norms,

b) moderately polluted lands where excessive permissible concentrations of chemicals are observed, with no apparent change in soil properties,

c) less polluted lands, where the content of chemicals does not exceed the permissible concentration but is higher than the background level

7. The hazardness of soil pollution is determined by the potential adverse effects of pollution on the environment (water, air), nutrients and human health, as well as biological activity and self-cleaning ability of the land.

By the hazardness, the degree of chemical pollution of soil is divided into the following categories:

safe,

permissible,

moderately hazardous,

hazardous,

highly hazardous.

The method of soil pollution assessment is provided in Chapter V of the Regulation.

V. EVALUATION OF LANDS POLLUTION DEGREE IMPACT CALCULATION AND ASSESSMENT

12. The impact of land pollution degree is calculated on the basis of the land pollution concentration coefficient, integral index of heterogeneous land pollution indices and the land counteracting response reaction rate.

13. Soil pollution concentration coefficient (H_i) is calculated according to the formula-1

$$H_i = \frac{C}{C_{\phi}} \quad \text{or} \quad H_i = \frac{C}{C_{UB\phi}} \quad (1)$$

where

C - is the total content of pollutants, mg / kg,

$C_{\text{с}}$ -is the average background level of pollutants¹, mg / kg,

$C_{\text{УПВ}}$ -is the threshold limit value mg/kg

14. integral indicator of heterogeneous soil pollution ($H_{\text{с}}$) is calculated according to formula 2,

$$H_{\text{с}} = \text{or } \sum_j \frac{C_j}{C_{\text{с}j}} \quad (2)$$

where

C_j - is the sum of controlled contaminants, mg / kg,

$C_{\text{с}}$ -is the sum of background levels of pollutantss, mg / kg.

15. Land counteracting response reaction rate. (K_h) according to the chemical pollution impact on the state of the land, is calculated by formula 3,

$$K_h = \frac{[A - A_{\text{с}}]}{A_{\text{с}}} \quad (3)$$

where

A -and $A_{\text{с}}$ -are controlled parameters respectively, in polluted and background test samples.

16. The land pollution degree is considered:

a) according to the sanitary number in accordance with the norms in Table N2.

Table N 2

Land characteristics by pollution	Sanitary number
Clean (Practically)	0,98 and greater than that
Low contaminated	From 0,85 to 0,98
Contaminated	From 0,7-to 0, 85
Highly contaminated	Is less than 0,7-

b) according to the pollution hazardness categories and the hazardness classes of organic and inorganic compounds contained in the soil in accordance with the norms in Table N 3.

¹ Soil background pollution or background level, the content of pollutants in the soil of a particular territory before import of such pollutants as a result of new activity.

Table N 3

Pollution category	Sanitary number	Indicator of pollution sum number	Content in soil, mg / kg					
			Hazard 1-st class		Hazard 2-nd class		Hazard 3-rd class	
			organic compound	inorganic compound	organic compound	inorganic compound	organic compound	inorganic compound
Safe	0,98 and more than that	–	From background value up to (TLV)	From background value up to (TLV)	From background value up to (TLV)	From background value up to (TLV)	From background value up to (TLV)	From background value up to (TLV)
Permissible	0,98 and more than that	Is less than 16-	From 1-up to 2 TLV	From background value 2 up to TLV	From 1-up to 2 TLV	From background value 2 up to TLV	From 1-up to 2 TLV	From background value 2 up to TLV
Moderately hazardous	From 0,85-up to 0,98	From 16-up to 32					From 2 up to 5 TLV	From TLV up to Ψ_{maxim} .
Hazardous	From 0,7-up to 0,85	From 32-up to 128	From 2 up to 5 TLV	From TLV up to Ψ_{maxim} .	From 2 up to 5 TLV	From TLV up to Ψ_{maxim} .	From 2 up to 5 TLV	
Extremely hazardous	Is less than 0,7	Is more than 128	From 2 up to 5 TLV	From TLV up to Ψ_{maxim} .	From 2 up to 5 TLV	From TLV up to Ψ_{maxim} .		

Ψ - is the maximum permissible level of substances by one of the hazard indicators.
 The pollution total index is the sum of the concentration coefficients of pollutant chemical substances determined by formula 1.

3. ANALYSIS OF MONITORING RESULTS CARRIED OUT IN THE YEREVAN TPP-2 TERRITORY

3.1. Introduction

Soil pollution assessment in the Republic of Armenia is carried out according to the above-mentioned technical regulation (**N1277-N resolution**) methodology. **However, that methodology practically is taken from the relevant standards of the Russian Federation without modification, the TLVs are particularly taken from “Санитарные нормы СанПиН 42-128-4433-87 “Санитарные нормы допустимых концентраций химических веществ в почве” (“Sanitary Standards of Maximum Allowable Concentration (MAC) of Chemical Substances in the Soil” Sanitary norms SanPiN 42-128-4433-87).** In relation to pollution degree, the soil use proposals (Annex 2), Chemical pollution level of land (Table 2), according to the pollution dangerousness category and the dangerousness classes of organic and inorganic compounds (Table 2) are taken from **СанПиН 2.1.7.1287-03 (SanPiN 2.1.7.1287-03)** of the Russian Federation (table 3 and annex 1 respectively).

However such kind of imitation has generated several complications, that do not allow to assess definitely the pollution impact or degree. The calculation methodology of soil pollution integral concentration coefficient and integral index of heterogeneous soil pollution is based on such an approach, that the background pollution level of soil is essentially lower, than threshold limit

values. It is acceptable for the Russian Federation, because the overwhelming majority of soil background pollution of that country is very low, however lower, than TLVs.

Based on the geographical conditions and geological structure of territories, in Armenia the content of heavy metals background in soli is very high and in many places significantly higher than TLVs.

Besides, accepting the brief options of the Russian Federation normative documents, the definitions and grounds of many issues were left out.

It should be particularly mentioned, that in СанПиН (SanPiN) 42-128-4433-87 the pollutants classes of danger are defined, and in the technical regulation approved by the 1277-N resolution there is no such definition. In the annex of the N 430-N order of 201.12.2006 of the RA Minister of Nature Protection the “List of waste classified according to danger” is established. However, that normative act regards only the waste and there is no classification of elementary metals.

3.2. Soil pollution assessment in the territory of Yerevan TPP-2

No background pollution data of Yerevan TPP-2 territory have been found in the literary sources and internet sources.

On the order of “RENCO ARMESTATE” LLC, sampling has been carried out from 45 points in the territory and the samples analysis have been carried out in the Ministry of Nature Protection Monitoring Center laboratory.

In order to evaluate the soil pollution and determine the use procedure of that soil, calculations have been carried out according to the “**Technical regulations for general requirements for landprotection from pollution, list of substances polluting the land and assessment of land pollution level” methodology (N1277-N resolution)**”.

3.2.1. Calculation of soil pollution concentration coefficient

The calculation has been done according to the formula 1 of technical regulation:

$$H_i = \frac{C}{C_{\phi}} \quad \text{or} \quad H_i = \frac{C}{C_{UI\phi_i}} \quad (1)$$

Taking into account the chance of choice and registered background value data, the calculation has been done according 2nd variant of formula.

Such pollutants have been included in the calculations, in one or two analysis of which the excessive TVLs have been registered.

Table 3.1.

Pollutants	Unit of measure	Threshold limit value	Average measured concentration	Maximum measured concentration	Pollution concentration coefficient
Vanadium	mg/kg	150.0	98.3	166.6	0.65
Chromium	mg/kg	6.0	72.7	230.8	12.1
Manganese	mg/kg	400.0	568.0	834	1.4
Cobalt	mg/kg	5.0	23.8	38.7	4.8

Pollutants	Unit of measure	Threshold limit value	Average measured concentration	Maximum measured concentration	Pollution concentration coefficient
Nickel	mg/kg	4.0	31.0	48.1	7.8
Copper	mg/kg	3.0	46.4	125.3	15.5
Zinc	mg/kg	23.0	54.1	119.8	2.4
Arsenic	mg/kg	2.0	13.4	19.9	6.7

3.2.2. Integral index of heterogeneous soil pollution

The integral index of heterogeneous soil pollution (H_{ϕ_j}) is calculated according to the 2nd formula:

$$H_{\phi_j} = \text{Or } \sum_j \frac{C_j}{C_{\phi_j}} \quad (2)$$

where

C_j – is sum of pollutantns to be controlled, mg/kg,

C_{ϕ_j} – is the sum of pollutants background levels, mg/kg.

As the background pollution level is higher, than TLVs, here the previous subparagraph approach is also applied and the background value has been replaced with TLVs. This approach is more acceptable, as the result is stricter.

C_j – is the sum of average values of pollutants that exceed TLVs

C_{ϕ_j} – is the sum of pollutants TLVs, mg/kg.

Table 3.2.

Pollutants	Unit of measure	Threshold limit value	Average measured concentration	Maximum measured concentration
Vanadium	mg/kg	150.0	98.3	166.6
Chromium	mg/kg	6.0	72.7	230.8
Manganese	mg/kg	400.0	568.0	834
Cobalt	mg/kg	5.0	23.8	38.7
Nickel	mg/kg	4.0	31.0	48.1
Copper	mg/kg	3.0	46.4	125.3
Zinc	mg/kg	23.0	54.1	119.8
Arsenic	mg/kg	2.0	13.4	19.9
Sum		593	907.7	1583.2

$$H_{\phi_j} = 907.7 : 593 = 1.53$$

In case of maximum indexes: $H_{\phi_j} = 1583.2 : 593 = 2.67$

In order to determine the soil use procedure, the obtained coefficients are put in the third column of the technical regulation 3rd table - "Total pollution index".

In both cases (average factor - 1.53, maximum concentrations factor – 2.67) the index is less than 16 and the soil category is "permissible". Besides, even in case of use of separate substances pollution indexes factors, none of them does not exceed the "16" index.

The soil classification according to categories mentioned in the table 3 is carried out in two ways – on the basis of pollution total indexes and TLV or its multiple. In addition, on some lines of this table there are not the TLV indexes (second method).

In the previous subsection it is presented that this or any other normative act does not contain a defined pollutant classification of danger. So that method cannot be used.

Besides, it should be taken into consideration that the soil of Yerevan generally has a high background of heavy metals. This is highlighted by the investigations carried out in the vicinity of USA Embassy and the investigations done by American University in other places. It is also mentioned on the main layout of Yerevan, zoning project of Yerevan and in other documents.

4. Conclusion

The RA normative acts listed in the Report do not contain any barrier or restriction on carrying out an industrial activity or construction of an industrial facility on any landcover. These normative acts define the maximum threshold limit values of hazardous substances in the soil, but in the same normative acts it is mentioned several times, that it is prohibited to carry out construction of residential buildings, schools and preschool facilities or to install potable water containers, if there are excessive TLVs in the soil of that area.

For other activities, the soil use ***proposals*** are only mentioned.

The carried out calculations have shown, that the land pollution level does not generate any restriction, or requirement of taking additional measures.

Director of "Consecoard" LLC
Vram Tevosyan

Yerevan YCCPP-2

Soil, Surface water & Groundwater Study



Project-No.: 17.10.453

13.02.2018

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Contents

- 1. Scope of Work**
- 2. Geology & Hydrogeology**
- 3. Field Work**
 - 3.1 Soil Borings & Sampling**
 - 3.2 Groundwater wells & Sampling**
- 4. Analysis Results**
 - 4.1 Soil**
 - 4.2 Groundwater**
 - 4.3 Surface water**
- 5. Evaluation**
 - 5.1 Soil**
 - 5.2 Groundwater**
 - 5.3 Surface water**
- 6. Risk Analysis**
- 7. Recommendations**
- 8. Summary**

Attachment:

1. General Plan
2. Detailed Plan
3. Soil profiles of the new wells
4. Geoterproject Report
5. Analysis Results Report
6. Photodocumentation

1. Scope of work

In Yerevan the Thermal Power Plant (TPP) II is planned on a site south of the city center of Yerevan next to the existing power plant TPP1. RENCO SPA will be the EPC Contractor for this Project, which will be operated by ArmPower CJSC, a subsidiary company of RENCO SPA.

Within the scope of the Environmental Impact Assessment prepared for YCCPP-2, it is necessary to get information about the near surface geology and especially about potential contamination of the soil, surface and groundwater. Our tasks are:

- Survey of field work and support of the local contractor (drilling, sampling)
- Evaluation of field work and analytical results
- Comparison to international and local standards / threshold values
- Design of a complete study with risk analysis

Field work, sampling and chemical analysis were performed considering Armenian standards. Evaluation follows international standards (EU, Germany, Armenia).

2. Geology & Hydrogeology

The area is located in Armenia ca. 8.5 km south of the Yerevan city center on an altitude from ca. 925 – 933 m above sea-level with following coordinates:

40°06`51``N
44°29`48``E

The total size of the investigated area is ca. 74,000 m².

The investigation area is situated in the “Little Caucasus” region. The regions climate is considered to be dry terrestrial with hot summers with high temperature up to + 41°C and cold winters with minimum temperature of – 31°C. The quantity of annual precipitation does not exceed 300-400 mm.

The geology at the YCCPP-2 site shows under fill-up materials (mixture of construction waste like concrete, gravel, sand and silt / clay) quaternary sediments (debris, gravel, sand, silt) up to 30 meters. Gypsum content is reported from a former geotechnical investigation. The base of the quaternary sediments is at an altitude of ca. 900 m. Beneath these sediments are tertiary (Miocene) sediments containing gypsum and igneous rocks.

The first groundwater table is supposed to be between less than 1 to 3 meters below surface depending on the geomorphological relief; the groundwater has a high mineralisation (sulphate up to 2000 mg/l).

3. Field work

Totally 45 boreholes and 3 wells with sampling and analysis were performed by Geoterproject Ltd., 27 Azatutyun Ave., Yerevan, Armenia; Geoterproject was directly contracted by RENCO SPA.

The field work was performed from November 11th till November 29th. Attachment 2 shows the map with boreholes (numbers & depths), attachment 3 contains the soil profiles and technical construction of the new groundwater wells; for the 45 boreholes no information about the soil layers is available.

3.1 Soil Borings & Sampling

Totally 45 boreholes were distributed over the area with a diameter of 110 mm. They were drilled from 2 meters (20 x) to 4 meters (25 x). The sampling depth was 1.7 to 1.9 m respectively 3.7 to 3.9 m.

3.2 Groundwater Wells & Sampling

Three new groundwater wells were installed with a depth of 10 meters.

Groundwater table was measured between 1.9 to 2.7 m below surface. The soil description of the wells is shown in attachment 3.

4. Analysis results

The chemical analysis were performed by order of Geoterproject Ltd by the Environmental Monitoring and Information Center in Yerevan. See attachment 5 for soil and water test reports.

The comparison with threshold values is done with Armenian, European (EU-WFD) and German (BBodSchG, VWV-BW, OGewV) standards which are shown in each chart.

Abbreviations:

TPH	Total Petroleum Hydrocarbons
PAH	Polycyclic Aromatic Hydrocabons
DE VWV-BW	Deutschland / Germany Verwaltungsvorschrift über Orientierungswerte für die Bearbeitung von Altlasten und Schadensfällen, Landesanstalt für Umweltschutz Baden-Württemberg
P-M3	Prüfwerte zum Schutz der Gesundheit von Menschen auf kontaminierten Flächen - Gewerbeflächen German: Baden-Württemberg administrative regulation
BBodSchG	Bundesbodenschutzgesetz; Federal Soil Protection Act
EU-WFD	EU Wasserrahmenrichtlinie; EU Water Framework Directive
GrwV	Verordnung zum Schutz des Grundwassers; Groundwater Protection

	Regulation; German implementation EU-WFD
OGewV	Oberflächengewässerverordnung; Surface Water Regulation
BOD ₅	biochemical oxygen demand in 5 days
COD-Cr	chemical oxygen demand bichromate

4.1 Soil

The results from the laboratory analysis in original matrix (mg/kg) are shown on following tables:

	Borehole 1	Borehole 2	Borehole 3	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	20	19.7	28.6		
Sodium	20604	18717	25508		
Magnesium	14366	13974	27846		
Aluminum	65270	64620	33130		
Potassium	7608	6564	10249		
Calcium	85760	81470	96790		
Titanium	2359	2508	2574		
Vanadium	90.5	96.9	124.5	150	
Chromium	61.7	55.4	230.8	6	500
Iron	47020	45310	53160		
Manganese	473	400.4	839.5	400 – 700 (depending on pH)	
Cobalt	23.3	21.2	38.7	5	
Nickel	32.7	31.9	48.1	4	300
Copper	40	39.9	125.3	3	
Zinc	65.2	59.1	119.8	23	
Arsenic	9.3	9.1	17.2	2	130
Selenium	9.1	9	12.7		
Strontium	444	423.7	506.3		
Molybdenum	1.222	1.473	1.515		
Cadmium	0.1364	0.1516	0.1602		60
Tin	0.8928	1.141	0.9202		
Stibium	0.3494	0.4252	0.4446	4.5	
Barium	652.4	588.9	505.4		
Lead	10.1	12.5	13.7	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.2282	0.1493	ND	0.3	9
Xylene	0.009	0.0122	ND	0.3	
Petroleum Hydrocarbons	10.93	24.93	13.46		

Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100
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ND: not detected

	Borehole 4	Borehole 5	Borehole 6	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	27.3	7.6	6.1		
Sodium	24474	6119	5833		
Magnesium	26671	5128	4629		
Aluminum	30040	19200	18480		
Potassium	8032	6655	5215		
Calcium	99230	16790	15000		
Titanium	2901	3867	4370		
Vanadium	121.8	163.3	166.6	150	
Chromium	145.2	85.1	77.9	6	500
Iron	52510	34070	34600		
Manganese	749.4	417.2	374.9	400 – 700 (depending on pH)	
Cobalt	30.6	18.8	17.9	5	
Nickel	44.8	40.7	39.9	4	300
Copper	113.9	44.1	42.4	3	
Zinc	89.3	79.5	78	23	
Arsenic	15.7	10.3	10.1	2	130
Selenium	10.8	4.3	3.9		
Strontium	539.8	182	165.2		
Molybdenum	1.773	1.273	1.471		
Cadmium	0.152	0.1102	0.1156		60
Tin	1.1488	1.2748	2.1542		
Stibium	0.4944	0.4968	0.588	4.5	
Barium	519.7	517.8	273.7		
Lead	15.7	10.7	13.8	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.3736	0.4483	0.0154	0.3	9
Xylene	0.0066	0.0079	0.0052	0.3	
Petroleum Hydrocarbons	38.21	45.85	21.78		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

	Borehole 7	Borehole 8	Borehole 9	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	22.8	21.6	19.7		
Sodium	9215	8765	10102		
Magnesium	19369	17971	14135		
Aluminum	28510	27900	51710		
Potassium	8030	6823	8130		
Calcium	188220	172690	85330		
Titanium	2296	2624	2372		
Vanadium	93.3	93.7	122.9	150	
Chromium	136.1	101.7	76.1	6	500
Iron	48020	46530	50190		
Manganese	874	681.9	631.9	400 – 700 (depending on pH)	
Cobalt	38.3	37.8	26.2	5	
Nickel	38.3	37.2	37.9	4	300
Copper	40.7	37.2	44.9	3	
Zinc	50.1	41.4	55.6	23	
Arsenic	14.2	13.8	16.6	2	130
Selenium	11.3	9.7	9.3		
Strontium	709.4	655	416.6		
Molybdenum	0.837	1.011	1.998		
Cadmium	0.1446	0.197	0.156		60
Tin	0.8692	1.1072	0.8976		
Stibium	0.4038	0.4572	0.4524	4.5	
Barium	353.4	369.4	535.7		
Lead	10.2	10.9	11.6	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.0612	0.6002	0.0191	0.3	9
Xylene	0.0063	0.0254	0.0054	0.3	
Petroleum Hydrocarbons	37.81	221.48	7.73		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

	Borehole 10	Borehole 11	Borehole 12	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	17.9	17	7		
Sodium	9465	9111	5023		
Magnesium	13595	13279	4533		
Aluminum	49230	47200	19640		
Potassium	7636	7347	6284		
Calcium	82490	79700	44150		
Titanium	2330	2283	2180		
Vanadium	120.7	119	101	150	
Chromium	74.6	72.5	60.4	6	500
Iron	48750	47790	24720		
Manganese	613.6	597.1	345.4	400 – 700 (depending on pH)	
Cobalt	26.2	25	17.1	5	
Nickel	37.3	36.6	29.7	4	300
Copper	42.7	44.6	25.6	3	
Zinc	54.1	52.7	41.8	23	
Arsenic	16	15.8	14.6	2	130
Selenium	9.5	9.1	6.1		
Strontium	406.5	404.1	197.7		
Molybdenum	1.953	1.957	1.142		
Cadmium	0.1444	0.1538	0.1056		60
Tin	0.8664	0.877	0.7492		
Stibium	0.459	0.458	0.3366	4.5	
Barium	537.1	535.2	251.9		
Lead	12.3	12.2	10.1	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.0061	0.1045	0.0201	0.3	9
Xylene	0.0039	0.0062	0.0019	0.3	
Petroleum Hydrocarbons	7.36	9.64	10.15		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

	Borehole 13	Borehole 14	Borehole 15	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	6.7	16.4	11.9		
Sodium	5004	8911	9003		
Magnesium	4371	12767	10420		
Aluminum	19280	46560	45670		
Potassium	6350	7271	7264		
Calcium	44430	78080	107480		
Titanium	2190	2244	2686		
Vanadium	101.5	118.8	112.7	150	
Chromium	59.4	71	94.4	6	500
Iron	24570	47400	52240		
Manganese	344.6	596.9	821.3	400 – 700 (depending on pH)	
Cobalt	16.8	25.2	32.2	5	
Nickel	29.3	35.9	39.3	4	300
Copper	25.3	42.9	38.2	3	
Zinc	41.5	53.2	53.6	23	
Arsenic	14.1	15.8	19.7	2	130
Selenium	5.1	9.1	10.3		
Strontium	199.3	405.5	550.4		
Molybdenum	1.154	1.907	3.066		
Cadmium	0.109	0.1442	0.1516		60
Tin	0.7526	0.8864	0.9146		
Stibium	0.3394	0.4542	0.3976	4.5	
Barium	252	538.5	796.5		
Lead	10.2	12.4	12.9	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.0036	0.0085	0.01064	0.3	9
Xylene	0.0016	0.0065	0.00816	0.3	
Petroleum Hydrocarbons	8.81	11.85	14.81		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

	Borehole 16	Borehole 17	Borehole 18	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	11.4	10.4	9.6		
Sodium	9075	8580	7589		
Magnesium	10303	9874	8950		
Aluminum	44970	43360	39060		
Potassium	7419	6864	6184		
Calcium	106190	104140	95550		
Titanium	2617	2545	2395		
Vanadium	112	109.6	102.9	150	
Chromium	94.8	94	89.2	6	500
Iron	51320	50820	49200		
Manganese	799.4	782.2	759.4	400 – 700 (depending on pH)	
Cobalt	33.3	33.6	34.6	5	
Nickel	38.8	39.2	38.1	4	300
Copper	36.5	38.2	37.6	3	
Zinc	52.2	52.4	50.1	23	
Arsenic	20.3	19.9	18.8	2	130
Selenium	10.1	10.9	10.6		
Strontium	546.4	542.8	527.8		
Molybdenum	3.057	3.063	2.959		
Cadmium	0.156	0.1684	0.1544		60
Tin	1.016	1.0224	1.0344		
Stibium	0.3928	0.4136	0.399	4.5	
Barium	781	805.8	804.5		
Lead	12.8	14	14.4	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.0128	0.0117	0.005	0.3	9
Xylene	0.0098	0.009	0.003	0.3	
Petroleum Hydrocarbons	17.77	16.29	13.954		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

	Borehole 19	Borehole 20	Borehole 21	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	7.8	6.9	6.7		
Sodium	7650	6675	4942		
Magnesium	6020	5147	4433		
Aluminum	30930	26660	19220		
Potassium	6890	6248	6217		
Calcium	51500	46670	43480		
Titanium	1920	1851	2131		
Vanadium	107	105.9	99.6	150	
Chromium	55	52.8	60.7	6	500
Iron	33830	33320	24050		
Manganese	527	534.4	339.5	400 – 700 (depending on pH)	
Cobalt	20.5	21	16.6	5	
Nickel	26.6	26.2	29.1	4	300
Copper	122.3	121.3	25.5	3	
Zinc	73.1	73.4	41.1	23	
Arsenic	12.6	12.3	14.4	2	130
Selenium	8.5	7.6	5.4		
Strontium	358.4	344.8	201.7		
Molybdenum	0.0008	0.773	1.164		
Cadmium	0.00017	0.1606	0.097		60
Tin	0.00097	0.9938	0.7516		
Stibium	0.00038	0.3852	0.3408	4.5	
Barium	723	761	253.3		
Lead	14	15.6	10.3	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.0085	0.0119	0.0307	0.3	9
Xylene	0.0065	0.0059	0.0051	0.3	
Petroleum Hydrocarbons	11.848	12.398	5.331		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

	Borehole 22	Borehole 23	Borehole 24	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	7.1	6.7	9.7		
Sodium	6988	6710	5764		
Magnesium	5541	5093	6338		
Aluminum	27970	26810	32020		
Potassium	6501	6333	6154		
Calcium	48830	46130	63510		
Titanium	1923	1858	1821		
Vanadium	105.7	104.7	96.2	150	
Chromium	53.9	52.1	78.4	6	500
Iron	33080	32770	36550		
Manganese	529.5	515.7	580.1	400 – 700 (depending on pH)	
Cobalt	21.2	20	20.4	5	
Nickel	26.6	26	29.3	4	300
Copper	119.3	116.9	34.8	3	
Zinc	72.5	71.7	42.7	23	
Arsenic	12.4	11.9	15.3	2	130
Selenium	7.8	7.5	2		
Strontium	358.9	348.1	419.6		
Molybdenum	0.847	0.761	1.126		
Cadmium	0.1462	0.151	0.135		60
Tin	0.979	0.9852	0.899		
Stibium	0.3974	0.3742	0.4296	4.5	
Barium	773.4	760.9	535		
Lead	15.5	15.4	16	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.0141	0.0166	0.0225	0.3	9
Xylene	0.0033	0.0039	0.0064	0.3	
Petroleum Hydrocarbons	4.68	5.5	9.09		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

	Borehole 25	Borehole 26	Borehole 27	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	10	6.6	10.9		
Sodium	5992	4778	6480		
Magnesium	6598	4326	6536		
Aluminum	33640	18910	36450		
Potassium	6474	6104	7216		
Calcium	64720	42940	69270		
Titanium	1837	2145	1961		
Vanadium	96.7	98.8	102	150	
Chromium	81.5	59	80.7	6	500
Iron	36770	24090	38990		
Manganese	567.7	340.9	606.6	400 – 700 (depending on pH)	
Cobalt	20.8	17.1	20.6	5	
Nickel	29.5	29.4	28.9	4	300
Copper	36.1	25.6	35.7	3	
Zinc	42.2	40.9	44.3	23	
Arsenic	15.6	14.1	15.9	2	130
Selenium	2.2	5.5	2.1		
Strontium	428.1	200	428.2		
Molybdenum	1.149	1.144	1.148		
Cadmium	0.1464	0.1088	0.1354		60
Tin	0.8936	0.7794	0.8736		
Stibium	0.4072	0.3324	0.4032	4.5	
Barium	526.4	254.5	503.9		
Lead	15.5	10.4	13.7	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.0086	0.0062	0.0013	0.3	9
Xylene	0.0047	0.004	ND	0.3	
Petroleum Hydrocarbons	8.44	7.56	12.52		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

	Borehole 28	Borehole 29	Borehole 30	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	11.6	8.7	5.4		
Sodium	7417	8053	10675		
Magnesium	7346	6179	4878		
Aluminum	39210	39700	26490		
Potassium	7757	7108	5049		
Calcium	74740	83940	25860		
Titanium	2048	1992	1886		
Vanadium	106.1	105.6	73.2	150	
Chromium	84.6	72.5	35.9	6	500
Iron	39370	54710	20430		
Manganese	621.1	822.3	459.1	400 – 700 (depending on pH)	
Cobalt	20.8	28.7	17.9	5	
Nickel	29.7	22.9	29	4	300
Copper	36.8	42.2	24.5	3	
Zinc	45.9	41.1	57.2	23	
Arsenic	16.5	13.9	7.5	2	130
Selenium	2.1	10.9	7.3		
Strontium	433.6	302.2	360		
Molybdenum	1.155	1.53	1.839		
Cadmium	0.1428	0.1624	0.1112		60
Tin	0.8682	0.9872	0.8906		
Stibium	0.3996	0.4488	0.3196	4.5	
Barium	493.5	1235.1	817		
Lead	12.9	17.8	15.9	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.0055	0.0055	0.008	0.3	9
Xylene	0.0033	0.0035	0.0057	0.3	
Petroleum Hydrocarbons	5.37	6.69	11.16		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

	Borehole 31	Borehole 32	Borehole 33	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	6	8.4	9.9		
Sodium	10833	7499	8261		
Magnesium	4922	5759	6414		
Aluminum	26990	36780	41470		
Potassium	5181	6723	7595		
Calcium	27150	76930	88900		
Titanium	1930	1893	1992		
Vanadium	73.4	101.7	105.1	150	
Chromium	34.5	65.4	71.4	6	500
Iron	21310	52060	54950		
Manganese	475.5	776.3	812.1	400 – 700 (depending on pH)	
Cobalt	17.8	26.4	27.2	5	
Nickel	29.5	20.8	21.9	4	300
Copper	24.7	40.2	40.7	3	
Zinc	57.4	39.3	41.2	23	
Arsenic	7.7	13.1	13.7	2	130
Selenium	6.7	10.8	10.9		
Strontium	365.6	296.6	311.4		
Molybdenum	1.852	1.441	1.539		
Cadmium	0.0958	0.156	0.1644		60
Tin	0.8842	0.9892	0.9772		
Stibium	0.3296	0.4256	0.4538	4.5	
Barium	810.9	1185.2	1192.4		
Lead	15.4	17.2	16.4	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.0656	0.0534	0.0427	0.3	9
Xylene	0.0215	0.0175	0.014	0.3	
Petroleum Hydrocarbons	18.29	14.87	11.9		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

	Borehole 34	Borehole 35	Borehole 36	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	8	6.9	6		
Sodium	6990	13698	11868		
Magnesium	5464	6136	5346		
Aluminum	34890	32680	30320		
Potassium	6632	6061	5445		
Calcium	75960	29990	27350		
Titanium	1729	2137	1994		
Vanadium	95.8	82	76	150	
Chromium	65	37	35.2	6	500
Iron	50240	22000	21110		
Manganese	747.3	501.1	478.6	400 – 700 (depending on pH)	
Cobalt	27.5	17.5	17.3	5	
Nickel	21.5	30	28.6	4	300
Copper	39.2	24.3	24.1	3	
Zinc	38.8	59.7	58.2	23	
Arsenic	13.5	8	7.6	2	130
Selenium	11.2	6.4	6.7		
Strontium	287.8	381.2	366.9		
Molybdenum	1.431	1.904	1.801		
Cadmium	0.1416	0.1252	0.1060		60
Tin	0.9826	0.8734	0.8528		
Stibium	0.4552	0.3264	0.3238	4.5	
Barium	1229.1	752.8	779.8		
Lead	18.7	12.4	13.7	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.0138	0.00133	0.00951	0.3	9
Xylene	0.0106	ND	0.00684	0.3	
Petroleum Hydrocarbons	19.26	12.64	13.29		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

	Borehole 37	Borehole 38	Borehole 39	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	8.6	9.2	9.8		
Sodium	5905	6464	6886		
Magnesium	7370	8176	8490		
Aluminum	36160	39270	41290		
Potassium	5398	5484	5668		
Calcium	84900	89850	93860		
Titanium	1567	1598	1611		
Vanadium	70.9	72.4	74	150	
Chromium	60.6	63.3	65.1	6	500
Iron	42160	42180	42960		
Manganese	584.6	579.4	594	400 – 700 (depending on pH)	
Cobalt	27.8	28.2	28.3	5	
Nickel	25	24.7	25.4	4	300
Copper	35.2	36	37.1	3	
Zinc	38.8	39.2	40.4	23	
Arsenic	13.6	13.8	14.4	2	130
Selenium	8.4	8.2	8.3		
Strontium	386.9	392.9	397.9		
Molybdenum	1.408	1.487	1.496		
Cadmium	0.1298	0.1542	0.1784		60
Tin	0.7906	0.7796	0.7988		
Stibium	0.3298	0.3216	0.3312	4.5	
Barium	649.7	629.1	633		
Lead	12.5	11.4	11.3	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.048	0.0044	0.0715	0.3	9
Xylene	0.0158	0.0026	0.0042	0.3	
Petroleum Hydrocarbons	13.39	4.33	6.6		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

	Borehole 40	Borehole 41	Borehole 42	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	8.7	9.2	9.8		
Sodium	6253	10781	11251		
Magnesium	7653	8010	8604		
Aluminum	37290	31740	33000		
Potassium	5669	6315	6709		
Calcium	87170	64400	66010		
Titanium	1594	2181	2284		
Vanadium	73.4	62.8	66.7	150	
Chromium	62.7	52.5	53.4	6	500
Iron	40680	30660	31560		
Manganese	574.5	364.8	385.1	400 – 700 (depending on pH)	
Cobalt	28.9	18.5	17.4	5	
Nickel	24.3	27.6	27.1	4	300
Copper	36.3	30.2	29.9	3	
Zinc	38.9	48.8	49.6	23	
Arsenic	14.1	10.4	10.5	2	130
Selenium	8.8	7.7	7.2		
Strontium	386.8	437.1	445.3		
Molybdenum	1.450	1.903	1.883		
Cadmium	0.1558	0.162	0.1404		60
Tin	0.8112	1.1134	1.1008		
Stibium	0.335	0.3064	0.3034	4.5	
Barium	634.3	700.7	678.7		
Lead	12.1	14	13.3	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.0804	0.00156	0.0014	0.3	9
Xylene	0.0048	0.00179	0.0016	0.3	
Petroleum Hydrocarbons	7.42	10.121	9.01		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

	Borehole 43	Borehole 44	Borehole 45	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	10.2	8.8	10.1		
Sodium	11823	10212	11714		
Magnesium	8911	7969	8641		
Aluminum	34400	29490	34320		
Potassium	6585	5942	6760		
Calcium	66480	60770	67820		
Titanium	2319	2135	2322		
Vanadium	66	62.8	67	150	
Chromium	53.2	50.7	53	6	500
Iron	31660	29860	31820		
Manganese	387.4	369.6	384.7	400 – 700 (depending on pH)	
Cobalt	17.5	18.6	16.9	5	
Nickel	27.2	27.5	27.4	4	300
Copper	29.9	29.2	29.8	3	
Zinc	49.6	48.5	50.5	23	
Arsenic	10.3	10.1	10.5	2	130
Selenium	6.7	8	7.5		
Strontium	454.1	449.7	451.1		
Molybdenum	1.878	1.917	1.9		
Cadmium	0.158	0.1460	0.1536		60
Tin	1.0932	1.137	1.112		
Stibium	0.2992	0.3082	0.3074	4.5	
Barium	681.3	715	665.6		
Lead	13	15.3	12.7	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.0116	0.0052	0.0041	0.3	9
Xylene	0.0083	0.0022	0.0018	0.3	
Petroleum Hydrocarbons	16.22	12.65	10.12		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

4.2 Groundwater

The results from the laboratory analysis in original are shown on following table:

Parameter	Sample No.			Unit	German Imple-mentation EU-WFD GrwV	German standards BBodSchG
	Borehole 1	Borehole 2	Borehole 3			
pH	7.41	7.96	7.55			
Minerals	1495	1490	3145	mg/l		
BOD ₅	1.18	1.01	1.6	mgO ₂ /l		
COD-Cr	64	32	60	mgO/l		
Lithium	34.91	11.49	58.3	µg/l		
Sodium	200.6	442	304.5	mg/l		
Magnesium	28.5	2.81	82.19	mg/l		
Aluminium	31.83	802.61	28.89	µg/l		
Potassium	2.5	0.2753	6.02	mg/l		
Calcium	188	15.59	485.8	mg/l		
Titanium	7.26	57.56	5.83	µg/l		
Vanadium	84.95	759.87	52.84	µg/l		
Chrom	4.41	12.37	9.98	µg/l		50
Iron	125.09	912.14	106.59	µg/l		
Manganese	238.24	74.39	464.01	µg/l		
Cobalt	1.1	5.4	2.33	µg/l		50
Nickel	14.96	5.41	25.28	µg/l		50
Copper	7	9.47	10.74	µg/l		50
Zinc	4.64	3.78	7.41	µg/l		500
Arsenic	22.94	215.5	16.57	µg/l	10	10
Selen	6.73	8.75	8.42	µg/l		10
Strontium	2.42	406.03	5.59	mg/l		
Molybdenum	72.97	219.4	58.45	µg/l		50
Cadmium	0.25	0.59	0.16	µg/l	0.5	5
Tin	0.04	0.1	0.05	µg/l		40
Stibium	0.25	0.31	0.16	µg/l		
Barium	39.86	31.43	36.57	µg/l		
Lead	0.08	0.18	0.09	µg/l	10	25
BETX	<1	0,56	<1	µg/l		20
Benzol	<1	<1	<1	µg/l		1
TPH	168	7407	<1	µg/l		200
PAH	ND	ND	ND	µg/l		0.2

ND = Not detected

4.3 Surface Water

The results from the laboratory analysis in original are shown on following table:

Parameter	Sample No. "B" - Before channel		Armenian Water Quality Scale and Standards					German Standards OGewV
	Result	Unit	1	2*	3	4	5	
pH	7.45		6.5 – 9.0					5.5-8.5
Minerals	666	mg/l						
BOD ₅	2.52	mgO ₂ /l	3	5	9	18	>18	<3
COD-Cr	42	mgO/l	10	25	40	80	>80	
Lithium	26.6	µg/l	1	36	50	<2500	>2500	
Sodium	64.94	mg/l	4.96	9.92	19.84	39.68	>39.68	
Magnesium	27.5	mg/l	2.8	50	100	200	>200	
Aluminium	0.0138	mg/l	65	130	260	5000	>5000	
Potassium	5.74	mg/l	1.54	3.08	6.16	12.32	>12.32	
Calcium	68.06	mg/l	9.7	100	200	300	>300	
Titanium	6.72	µg/l	7	14	28	56	>56	
Vanadium	14.96	µg/l	1	2	4	8	>8	
Chrom	4.34	µg/l	1	10	100	250	>250	
Iron	106.72	µg/l	0.08	0.16	0.5	1	>1	
Manganese	26.11	µg/l	5	10	20	40	>40	
Cobalt	0.34	µg/l	0.14	0.28	0.56	1.12	>1.12	
Nickel	3.31	µg/l	1	11	50	100	>100	34
Copper	1.83	µg/l	3	23	50	100	>100	
Zinc	2.5	µg/l	3	100	200	500	>500	
Arsenic	6.77	µg/l	0.13	20	50	100	>100	
Selen	2.1	µg/l	0.47	20	40	80	>80	
Strontium	387.97	µg/l						
Molybdenum	3.24	µg/l	7	14	28	56	>56	
Cadmium	0.021	µg/l	0.02	1.02	2.02	4.02	>4.02	0.45
Tin	0.0006	µg/l	0.09	0.18	0.36	0.72	>0.72	
Stibium	0.0912	µg/l	0.19	0.38	0.76	1.52	>1.52	
Barium	32.3	µg/l	9	18	36	1000	>1000	
Lead	0.21	µg/l	0.3	10.3	25	50	>50	14
BETX	<1	µg/l	10	30	42	50	>50	50
TPH	<1	µg/l	0.05	0.1	0.3	0.5	>0.5	
PAH	ND	µg/l	--	--	--	--	--	0.27

* = standard value in Armenia

1 = Excellent 2 = Good 3 = Moderate 4 = Poor 5 = Bad

ND = not detected / not analysed

Parameter	Sample No. "C" - From channel		Armenian Water Quality Scale and Standards					German Standards OGewV
	Result	Units	1	2*	3	4	5	
pH	7.76		6.5 – 9.0					5.5-8.5
Minerals	593	mg/l						
BOD ₅	2.87	mgO ₂ /l	3	5	9	18	>18	<3
COD-Cr	26	mgO/l	10	25	40	80	>80	
Lithium	25.28	µg/l	1	36	50	<2500	>2500	
Sodium	82.2	mg/l	4.96	9.92	19.84	39.68	>39.68	
Magnesium	21.96	mg/l	2.8	50	100	200	>200	
Aluminium	3.3	µg/l	65	130	260	5000	>5000	
Potassium	4.715	mg/l	1.54	3.08	6.16	12.32	>12.32	
Calcium	50.65	mg/l	9.7	100	200	300	>300	
Titanium	6.09	µg/l	7	14	28	56	>56	
Vanadium	17.7	µg/l	1	2	4	8	>8	
Chrom	3.73	µg/l	1	10	100	250	>250	
Iron	80.14	µg/l	0.08	0.16	0.5	1	>1	
Manganese	8.18	µg/l	5	10	20	40	>40	
Cobalt	0.55	µg/l	0.14	0.28	0.56	1.12	>1.12	
Nickel	4.04	µg/l	1	11	50	100	>100	34
Copper	1.53	µg/l	3	23	50	100	>100	
Zinc	0.6	µg/l	3	100	200	500	>500	
Arsenic	7.58	µg/l	0.13	20	50	100	>100	
Selen	1.1	µg/l	0.47	20	40	80	>80	
Strontium	254.36	µg/l						
Molybdenum	5.98	µg/l	7	14	28	56	>56	
Cadmium	0.03	µg/l	0.02	1.02	2.02	4.02	>4.02	0.45
Tin	0.003	µg/l	0.09	0.18	0.36	0.72	>0.72	
Stibium	0.12	µg/l	0.19	0.38	0.76	1.52	>1.52	
Barium	16.72	µg/l	9	18	36	1000	>1000	
Lead	0.092	µg/l	0.3	10.3	25	50	>50	14
BETX	<1	µg/l	10	30	42	50	>50	50
TPH	<1	µg/l	0.05	0.1	0.3	0.5	>0.5	
PAH	ND	µg/l	--	--	--	--	--	0.27

Parameter	Sample No. "H" - After channel		Armenian Water Quality Scale and Standards					German Standards OGewV
	Result	mg/l µg/l	1	2*	3	4	5	
pH	7.47		6.5 – 9.0					5.5-8.5
Minerals	661	mg/l						
BOD ₅	3.91	mgO ₂ /l	3	5	9	18	>18	<3
COD-Cr	30	mgO/l	10	25	40	80	>80	
Litium	27	µg/l	1	36	50	<2500	>2500	
Sodium	59.63	mg/l	4.96	9.92	19.84	39.68	>39.68	
Magnesium	27.46	mg/l	2.8	50	100	200	>200	
Aluminium	13.2	µg/l	65	130	260	5000	>5000	
Potassium	5.58	mg/l	1.54	3.08	6.16	12.32	>12.32	
Calcium	67.72	mg/l	9.7	100	200	300	>300	
Titanium	6.374	µg/l	7	14	28	56	>56	
Vanadium	13.205	µg/l	1	2	4	8	>8	
Chrom	4.477	µg/l	1	10	100	250	>250	
Iron	106.66	µg/l	0.08	0.16	0.5	1	>1	
Manganese	28.988	µg/l	5	10	20	40	>40	
Cobalt	0.304	µg/l	0.14	0.28	0.56	1.12	>1.12	
Nickel	3.085	µg/l	1	11	50	100	>100	34
Copper	1.679	µg/l	3	23	50	100	>100	
Zinc	2.253	µg/l	3	100	200	500	>500	
Arsenic	6.365	µg/l	0.13	20	50	100	>100	
Selen	2.069	µg/l	0.47	20	40	80	>80	
Strontium	391.98	µg/l						
Molybdenum	2.763	µg/l	7	14	28	56	>56	
Cadmium	0.019	µg/l	0.02	1.02	2.02	4.02	>4.02	0.45
Tin	0.006	µg/l	0.09	0.18	0.36	0.72	>0.72	
Stibium	0.11	µg/l	0.19	0.38	0.76	1.52	>1.52	
Barium	32.977	µg/l	9	18	36	1000	>1000	
Lead	0.692	µg/l	0.3	10.3	25	50	>50	14
BETX	<1	µg/l	10	30	42	50	>50	50
TPH	<1	µg/l	0.05	0.1	0.3	0.5	>0.5	
PAH	ND	µg/l	--	--	--	--	--	0.27

5. Evaluation

There are no uniform international standards, therefore the evaluation is done by following standards: BBodSchG / Germany and GrwV (German implementation EU-WFD). The threshold values of these lists are similar in several European countries. The analytical results are compared to the threshold values of Armenia if existing. Exceeding results are written in **bold** letters in the above tables.

5.1 Soil

The bold printed results in chapter 4.1 are exceeded threshold values. Overall the Armenian threshold values of the hygienic requirements were often exceeded: the parameters Chromium, Cobalt, Nickel, Copper, Zinc, Arsenic and Lead always exceeded the threshold values; the parameter Manganese is often exceeded and rarely the values for Vanadium and Toluene are too high. On the other hand, the international standards for soil quality (the German VWV BW P-M3) are always respected, the values are typical for industrial areas. The Armenian hygienic requirements are far more strict than the international standards.

The RA Sanitary Norms 2.1.7.003-10 foresee proposals for land use based on the degree of contamination of the soils.

Proposals for land use based on the degree of pollution (Annex of the RA Sanitary Norms 2.1.7.003-10)

Category of contamination	Summary indicator of contamination	Proposals for land use
"Clean"	—	Using without any limitation
"Permissible" (allowable)	Less than 16	Use without restriction, with the exception of high vulnerability objects: school buildings, residential construction areas, sport's and children's playgrounds, health and resort areas, water objects, water mains
Moderately dangerous	16 - 32	For filling of trenches and pits during construction, in the areas intended for landscaping, adding 0.2m layer of clean ground
Dangerous	32 - 128	Restricted use for the filling of scrapers during construction, adding no less than 0.5m layer of clean ground. In the event of an epidemic hazard, by the recommendation of the hygienic anti-epidemic supervision body, disinfection (dezinvasion) is carried out with further laboratory supervision.
Extremely dangerous	More than 128	Transfer and handling in special polygons. In the event of an epidemic hazard, by the recommendation of the hygienic anti-epidemic supervision body, disinfection (disinvasion) is carried out with further laboratory supervision.

The „Indicator of Contamination“ described in the table above is established by the Armenian Decision N 1227-N “On establishment of technical regulations for general requirements for protection of lands from pollution, list of substances polluting the lands, and assessment of level of land pollution”. It is calculated as follows:

$$\text{Indicator of Contamination} = \frac{\text{Average concentration}}{\text{National MAC}}$$

Focusing on the pollutants for which the MAC is exceeded, the following table shows the calculation of the Indicator of Contamination for the site.

Substances (heavy metals)	Unit	Maximum permissible concentration (National standard)	Average concentration	Indicator of contamination Factor
Vanadium	Mg/kg	150.0	98.3	0.65
Chromium	Mg/kg	6.0	72.7	12.1
Manganese	Mg/kg	400.0	568.0	1.4
Cobalt	Mg/kg	5.0	23.8	4.8
Nickel	Mg/kg	4.0	31.0	7.8
Copper	Mg/kg	3.0	46.4	15.5
Zinc	Mg/kg	23.0	54.1	2.4
Arsenic	Mg/kg	2.0	13.4	6.7
Lead	Mg/kg	6.0	13.4	2.2

The results show that the soil at site falls under the category „Permissible (allowable)“. This means that for the construction of the PP, no restrictions are imposed and the soil may be used.

5.2 Groundwater

In all three groundwater samples the results show several values exceeding the international standards (Arsenic, Molybdenum etc.). There are no national quality standards for groundwater. The sample 2 has to be pointed out, because here are the highest values for most of the analysed parameters. Remarkable is the value for TPH (Total Petroleum Hydrocarbons) with 7,400 mg/l.

5.3 Surface water

All three surface water samples show exceeding national threshold values for following parameters: COD-Cr, Sodium, Potassium, Vanadium, Iron and Cobalt. The international standards (German standards: OGewV) are mostly complied with (only the BOD₅ value is once exceeded slightly). The exceedances are verified before, at, and after the discharge point, and therefore no specific influence from the YCCPP-1's discharge can be determined.

6. Risk Analysis

The soil exceeds national quality standards, but it is classified as “Permissible (allowable)“. Both nationally and internationally, no special treatment before construction is required.

The groundwater exceeds international threshold values. It is assumed that these contaminations have their origin from areas in the groundwater upstream.

For surface water, nearly no international threshold values are exceeded, but nationally it can be classified as within the 5th grade (“bad” quality). Most relevant for the assessment is the indication that the discharge of water of YCCPP-1 does not seem to have a negative influence on the water quality of the river.

7. Recommendations

- Soil: no treatment of the soil is necessary before construction.
- Groundwater: in case the water is used by the project (not foreseen presently), it shall be treated to respect international standards
- Surface water: the report does not show an influence of the existing power plant in the water quality of the river. It is recommended that the water discharged from the new power plant is treated to fulfil international standards before discharge.

8. Summary

In connection with the planned project „Yerevan Combined Cycle Power Plant (YCCPP) 2“ a soil, surface water and groundwater study was requested. According to this it is necessary to get information about the near surface geology and especially about potential contamination of the soil, surface water and groundwater.

U/C-tec GmbH was asked to supervise this study. Primarily tasks were:

- Survey of field work or support of the local contractor (drilling, sampling)
- Evaluation of field work and analytical results
- Comparison to international and local standards / threshold values
- Design of a complete study with risk analysis and recommendations

Field work, sampling and chemical analysis were performed following Armenian standards. Evaluation follows international and national standards (EU, Germany, Armenia).

Totally 45 boreholes and 3 wells with sampling and analysis were performed by Geoterproject Ltd., 27 Azatutyun Ave., Yerevan, Armenia; Geoterproject was directly contracted by RENCO SPA.

The field work was realized from November 11th to November 29th.

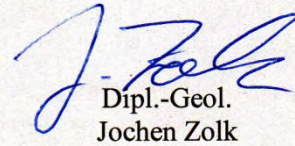
The analytical results were compared to Armenian and European / German threshold values. The comparison shows that:

- Soil samples show compliance with international standards. The soil is also nationally classified as “Permissible (allowable)” and no remediation measures are therefore necessary.
- Groundwater samples show non-compliance with international standards.
- Surface water samples show compliance with almost all international standards, and show non-compliance with national standards. The non-compliance cannot be attributed to the existing power plant.

The results of this study are based on punctual investigations (drillings). It is possible that between the drillings other conditions could appear.

Walldorf, 13.02.2018

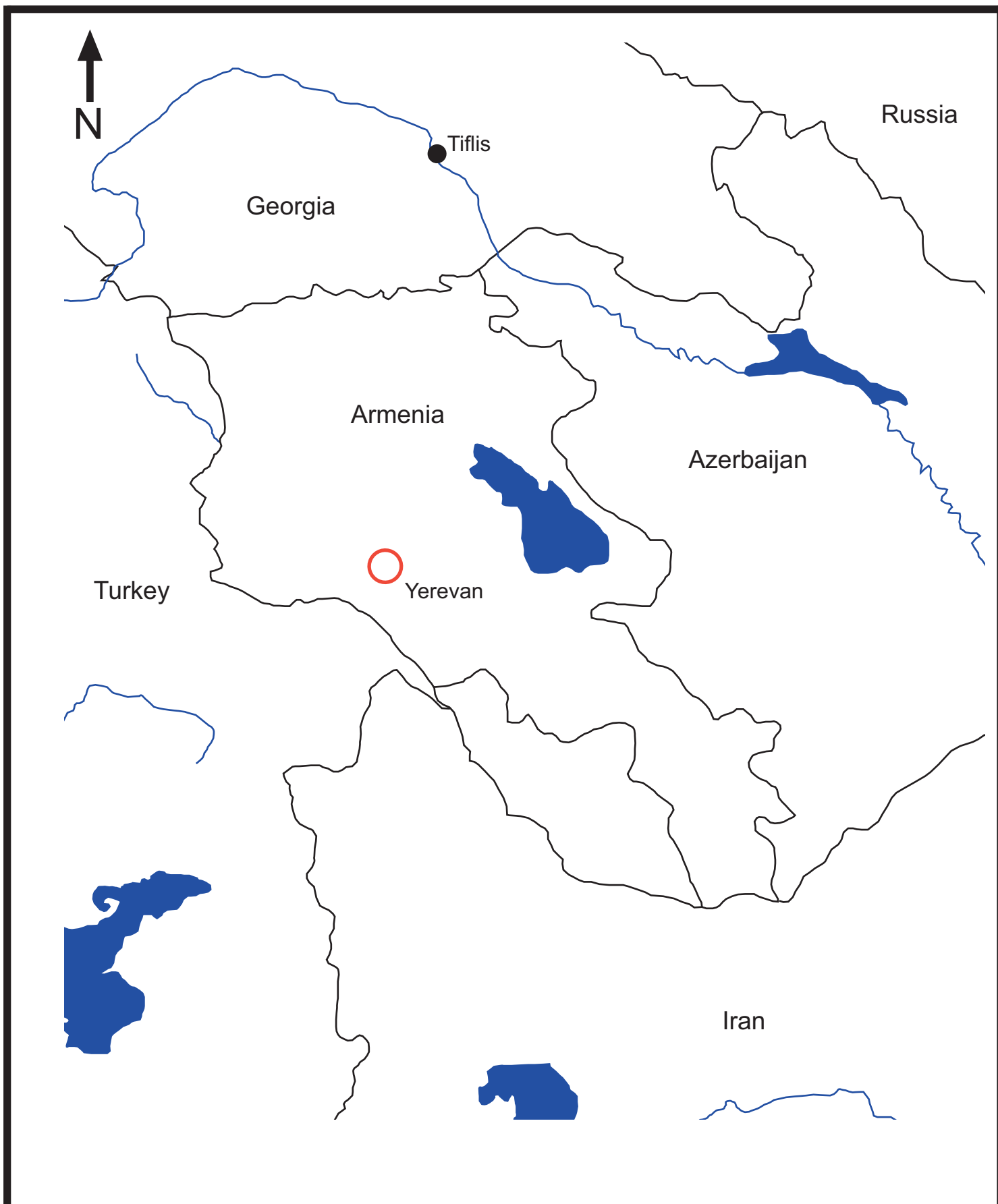
Dipl.-Geol.
Gerd M. Wiedenbeck
U/C-tec GmbH




Dipl.-Geol.
Jochen Zolk


Revised by Fichtner, 14.02.2018

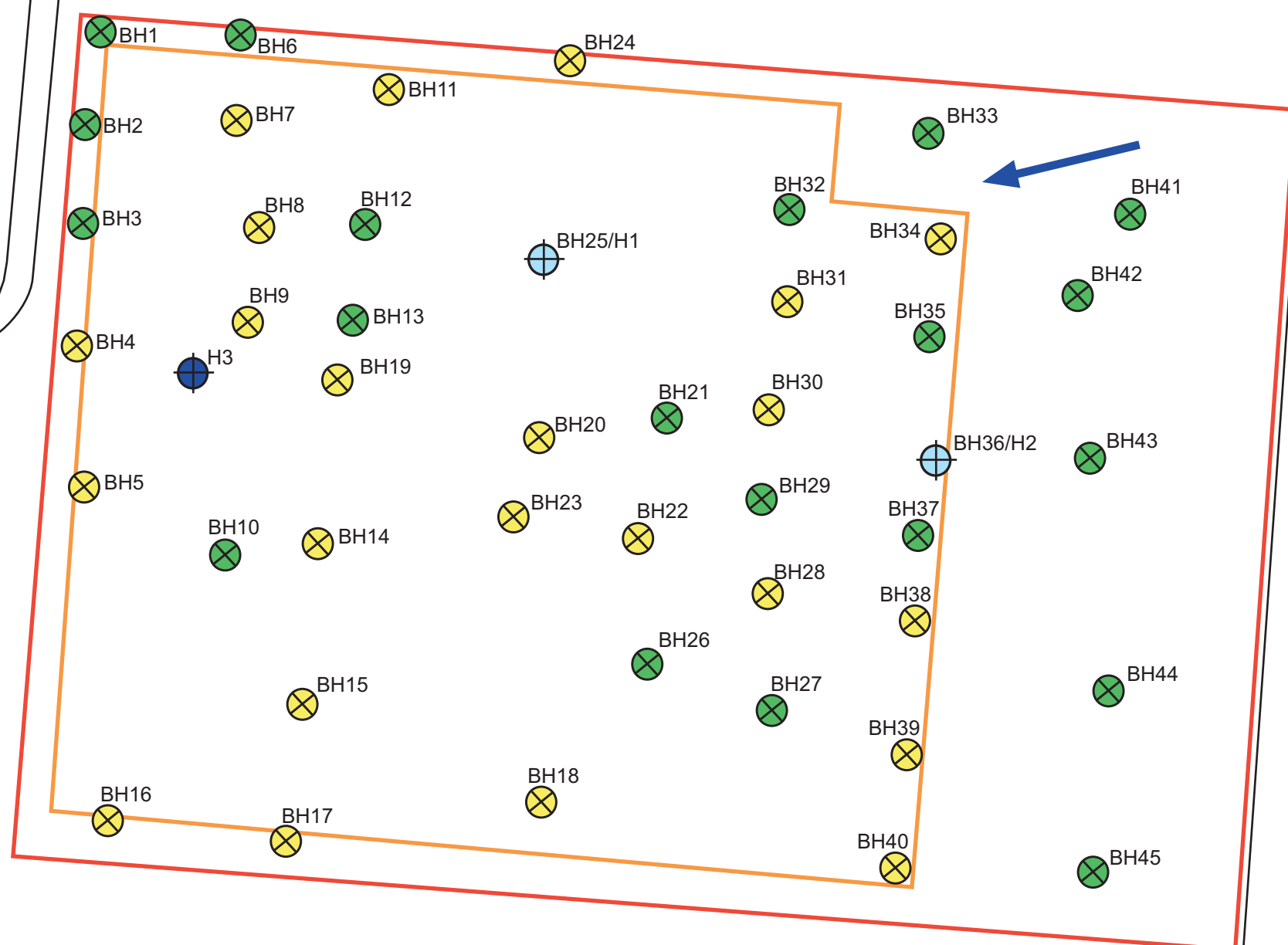
Annex 1










Scale:	Description: General Plan	Project: Yerevan YCCPP-2, Soil and groundwater study
Project-no.: 17.10.453		 Umwelt Consulting & Technologie
Client: Fichtner GmbH & Co. KG	Date: 17.01.2018	


YCCPP-1

Annex 2 




-  investigation area
-  construction site YCCPP-2
-  2m borehole drillings
-  4m borehole drillings
-  groundwater wells
-  4m borehole drillings upgraded to groundwater wells
-  direction of water movement 06.05.2017



Scale: 1 : 1.400	Description: Detailed Plan		Project: Yerevan YCCPP-2, Soil and groundwater study
Project-no.: 17.10.453			
Client: Fichtner GmbH & Co. KG	Date: 17.01.18	Attachment: 2	 Umwelt Consulting & Technologie

Annex 3

SIGN AND SYMBOLS (see DIN 4023)

SAMPLING AND GROUNDWATER
 Grade of soil samples add. DIN 4021 Tab.1
 groundwater after compl. of boring

TYPES OF SOIL

clay clayey T t 
 sand S 

KONSISTENZ wch ζ soft fst || solid

U/C-tec GmbH	Project: Fichtner GmbH & Co KG, YEREVAN YCCPP-2 Soil & Groundwater study Plan description: Borehole 1 H - 3 H Soil profiles from groundwater wells	Enclosure no: -
		Project no: -
		Date: 25.01.2018
		Scale: 1 : 75
		Principal: JR

1		2			3		4	5	6	
... m below invest. point		a) Type of soil and additions b) Additional remarks ¹⁾			Remarks Special samples Water duct Boring tools Core loss		Gained samples			
c) State of drill chips		d) State of drilling process	e) Color				Type	No.	Depth in m bottom edge	
f) Usual denomination		g) Geological denomination ¹⁾	h) ¹⁾ Group	i) Lime contents						
4,00		a) sand, clayey, with gravel, sandy-clayey and sandy liners	b)	c)						d)
10,00		a) clay, with content of gypsum crystals	b)	c)	d)	e) motley	f)	g)	h)	i)

Enclosure: 3
Report:
FN:

Date: 25.01.2018

No.: Borehole 1 H / Page 1

Project: Fichtner GmbH & Co KG, YEREVAN YCCPP-2 Soil & Groundwater study-soil profiles from groundwater wells

Project: Fichtner GmbH & Co KG, YEREVAN YCCPP-2 Soil & Groundwater study-soil profiles from groundwater wells

Project: Fichtner GmbH & Co KG, YEREVAN YCCPP-2 Soil & Groundwater study-soil profiles from groundwater wells

Project: Fichtner GmbH & Co KG, YEREVAN YCCPP-2 Soil & Groundwater study-soil profiles from groundwater wells

Project: Fichtner GmbH & Co KG, YEREVAN YCCPP-2 Soil & Groundwater study-soil profiles from groundwater wells

Project: Fichtner GmbH & Co KG, YEREVAN YCCPP-2 Soil & Groundwater study-soil profiles from groundwater wells

Project: Fichtner GmbH & Co KG, YEREVAN YCCPP-2 Soil & Groundwater study-soil profiles from groundwater wells

Project: Fichtner GmbH & Co KG, YEREVAN YCCPP-2 Soil & Groundwater study-soil profiles from groundwater wells

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Project: Fichtner GmbH & Co KG, YEREVAN YCCPP-2 Soil & Groundwater study-soil profiles from groundwater wells

Project: Fichtner GmbH & Co KG, YEREVAN YCCPP-2 Soil & Groundwater study-soil profiles from groundwater wells

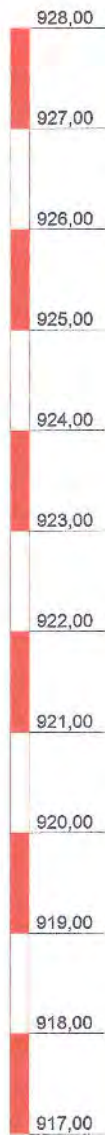
Project: Fichtner GmbH & Co KG, YEREVAN YCCPP-2 Soil & Groundwater study-soil profiles from groundwater wells

Project: Fichtner GmbH & Co KG, YEREVAN YCCPP-2 Soil & Groundwater study-soil profiles from groundwater wells

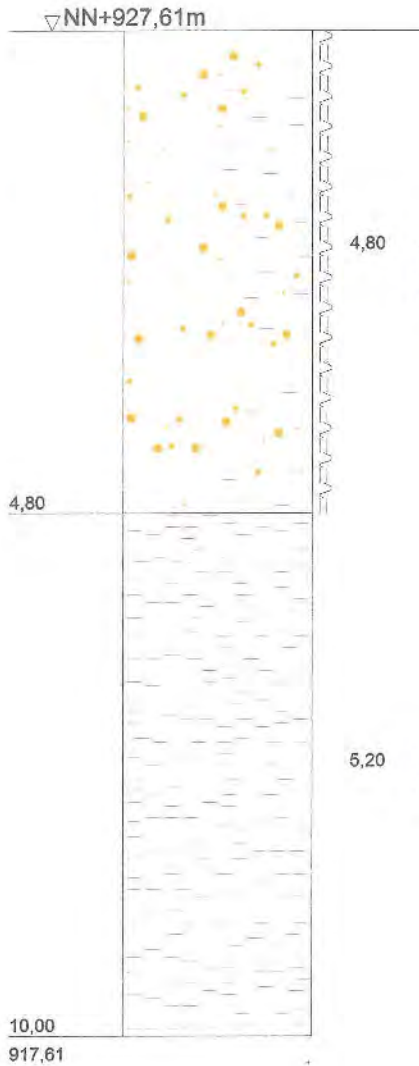
¹⁾ Notation is done by scientific reviewer

Borehole 1 H

NN+m



1,90 GW



4,80 sand, clayey, with gravel, sandy-clayey and sandy liners, soft to solid

5,20 clay, with content of gypsum crystals, motley

<h2>U/C-tec GmbH</h2>	Project: Fichtner GmbH & Co KG, YEREVAN YCCPP-2 Soil & Groundwater study Plan description: Borehole 1 H Soil profiles from groundwater wells	Enclosure no: -
		Project no: -
		Date: 25.01.2018
		Scale: 1 : 75
		Principal: JR

1		2			3		4	5	6
... m below invest. point		a) Type of soil and additions b) Additional remarks ¹⁾			Remarks Special samples Water duct Boring tools Core loss		Gained samples		
c) State of drill chips		d) State of drilling process	e) Color				Type	No.	Depth in m bottom edge
f) Usual denomination		g) Geological denomination ¹⁾	h) ¹⁾ Group	i) Lime contents					
7,00		c) <i>soft to solid</i>	d)	e)					
10,00		a) <i>clay, with content of gypsum crystals</i>	b)	c)		d)	e) <i>motley</i>		
		f)	g)	h)	i)				

Enclosure: 3

Report:

FN:

List of soil courses

for borings without continuous gaining of core samples

Project: **Fichtner GmbH & Co KG, YEREVAN YCCPP-2 Soil & Groundwater study-soil profiles from groundwater wells**

Boring

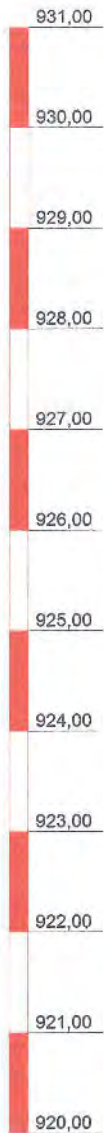
No.: **Borehole 2 H / Page 1**

Date: **25.01.2018**

¹⁾ Notation is done by scientific reviewer

Borehole 2 H

NN+m



▽ NN+930,38m

2,60 GW



7,00 sand, clayey, with gravel, sandy-clayey and sandy liners, soft to solid

3,00 clay, with content of gypsum crystals, motley

10,00
920,38

U/C-tec GmbH

Project:
Fichtner GmbH & Co KG, YEREVAN YCCPP-2
Soil & Groundwater study

Plan description:

Borehole 2 H
Soil profiles from groundwater wells

Enclosure no: -

Project no: -

Date: 25.01.2018

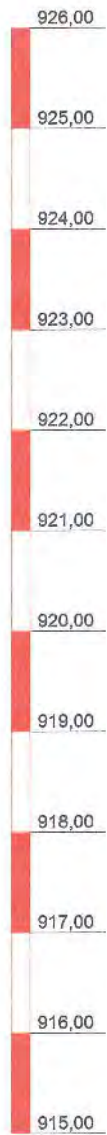
Scale: 1 : 75

Principal: JR

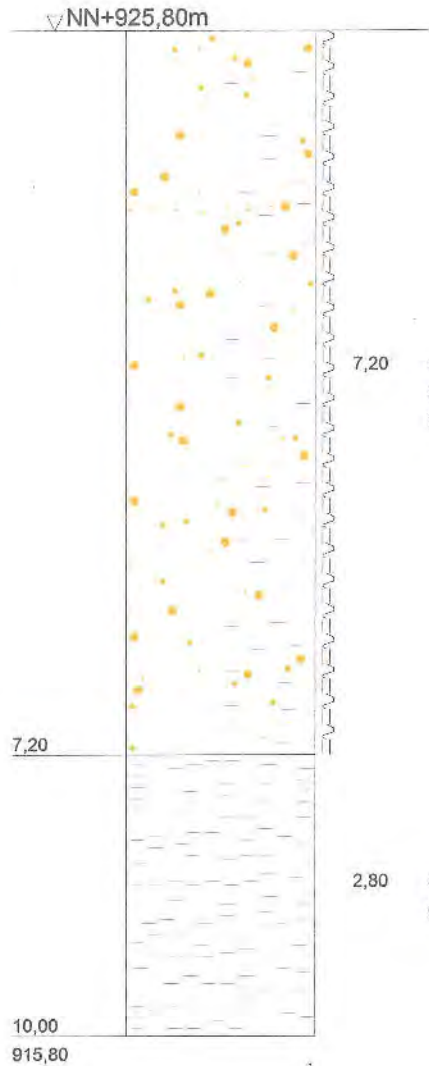
1		2			3		4	5	6	
		List of soil courses for borings without continuous gaining of core samples					Enclosure: 3			
							Report:			
							FN:			
Project: <i>Fichtner GmbH & Co KG, YEREVAN YCCPP-2 Soil & Groundwater study-soil profiles from groundwater wells</i>										
Boring No.: <i>Borehole 3 H / Page 1</i>										
Date: <i>25.01.2018</i>										
... m below invest. point	a) Type of soil and additions		Remarks Special samples Water duct Boring tools Core loss			Gained samples				
	b) Additional remarks ¹⁾					Type	No.	Depth in m bottom edge		
	c) State of drill chips	d) State of drilling process							e) Color	
	f) Usual denomination	g) Geological denomination ¹⁾				h) ¹⁾ Group	i) Lime contents			
7,20	a) <i>sand, clayey, with gravel, sandy-clayey and sandy liners</i>									
	b)									
	c) <i>soft to solid</i>	d)							e)	
	f)	g)							h)	i)
10,00	a) <i>clay, with content of gypsum crystals</i>									
	b)									
	c)	d)							e) <i>motley</i>	
	f)	g)							h)	i)
¹⁾ Notation is done by scientific reviewer										

Borehole 3 H

NN+m



2,70 GW



7,20 sand, clayey, with gravel, sandy-clayey and sandy liners, soft to solid

2,80 clay, with content of gypsum crystals, motley

U/C-tec GmbH

Project:
Fichtner GmbH & Co KG, YEREVAN YCCPP-2
Soil & Groundwater study

Plan description:

Borehole 3 H
Soil profiles from groundwater wells

Enclosure no: -

Project no: -

Date: 25.01.2018

Scale: 1 : 75

Principal: JR

Annex 4

FIELD FORM

			Date: 11.11.2017-13.11.2017			
Samplers:			Signatures:		Weather conditions:	
Sample ID (as in bag)	Sample name (as in bag)	Time	Depth, m	GPS Coordinates	Sample description (type and moisture)	Anthropogenic/ Natural Features in area
Borehole 1	sandy loam	10.00	2.0	x-4440534.591 y-457058.321	Low moisture	Cloudy
Borehole 2	sandy loam	10.30	2.0	x-4440512.100 y-457054.471	Low moisture	Semi-cloudy
Borehole 3	sandy loam	11.00	2.0	x-4440488.082 y-457053.117	Low moisture	Cloudy
Borehole 4	sandy loam with gravel	12.00	4.0	x-4440458.083 y-457052.391	Moisture	Cloudy
Borehole 5	sandy loam with gravel	12.30	4.0	x-4440423.059 y-457053.989	Moisture	Cloudy
Borehole 6	sandy loam with gravel	10.00	2.0	x-4440533.241 y-457092.539	Low moisture	Sunny
Borehole 7	sandy loam with gravel	11.00	4.0	x-4440513.103 y-457091.482	Moisture	Sunny
Borehole 8	sandy loam	11.45	4.0	x-4440487.820 y-457096.105	Moisture	Sunny
Borehole 9	Sand with gravel	12.30	4.0	x-4440462.755 y-457093.727	Low moisture	Sunny
Borehole 10	sandy loam	13.15	2.0	x-4440407.791 y-457087.129	Moisture	Sunny
Borehole 11	sandy loam	13.45	4.0	x-4440520.939 y-457128.533	High moisture	Sunny
Borehole 12	sandy loam with gravel	14.00	2.0	x-4440487.313 y-457122.281	Low moisture	Sunny
Borehole 13	Sand with gravel	14.40	2.0	x-4440463.202 y-457119.314	Low moisture	Sunny

FIELD FORM

Samplers:			Signatures:		Weather conditions:	
Sample ID (as in bag)	Sample name (as in bag)	Time	Depth, m	GPS Coordinates	Sample description (type and moisture)	Anthropogenic/ Natural Features in area
Borehole 14	Sand with gravel	10.00	4.0	x-4440410.149 y-457110.018	Low moisture	Sunny
Borehole 15	Sand	10.40	4.0	x-4440371.347 y-457106.387	Low moisture	Sunny
Borehole 16	Sandy loam	11.00	4.0	x-4440343.253 y-457059.644	High moisture	Sunny
Borehole 17	Sand	12.00	4.0	x-4440338.463 y-457102.657	Moisture	Sunny
Borehole 18	Sandy loam	10.30	4.0	x-4440347.060 y-457164.130	Water-saturated	Sunny
Borehole 19	Sand	11.00	4.0	x-4440449.492 y-457115.310	High moisture	Sunny
Borehole 20	Sandy loam	11.45	4.0	x-4440436.107 y-457164.288	Moisture	Sunny
Borehole 21	Cabble stone, gravel	12.00	2.0	x-4440440.311 y-457195.398	Moisture	Sunny
Borehole 22	Sand	10.30	4.0	x-4440411.802 y-457188.518	Moisture	Sunny
Borehole 23	Sand with cabble stone and gravel	11.10	4.0	x-4440416.503 y-457158.038	High moisture	Sunny
Borehole 24	Sand with gravel	12.40	4.0	x-4440527.997 y-457172.447	High moisture	Sunny
Borehole 25	Sandy loam	13.30	4.0	x-4440479.585 y-457165.229	High moisture	Sunny
Borehole 26	Sandy loam	14.15	2.0	x-4440379.155 y-457190.612	High moisture	Sunny

FIELD FORM

Samplers:			Signatures:		Weather conditions:	
Sample ID (as in bag)	Sample name (as in bag)	Time	Depth, m	GPS Coordinates	Sample description (type and moisture)	Anthropogenic/ Natural Features in area
Borehole 27	Sand	14.40	2.0	x-4440369.032 y-457220.183	Moisture	Sunny
Borehole 28	Sandy loam	15.15	4.0	x-4440397.024 y-457219.620	Moisture	Sunny
Borehole 29	Sandy loam	15.40	2.0	x-4440420.874 y-457218.826	Moisture	Sunny
Borehole 30	Sandy loam	16.10	4.0	x-4440442.961 y-457220.607	Moisture	Sunny
Borehole 31	Clay loam	10.40	4.0	x-4440468.739 y-457225.429	High moisture	Sunny
Borehole 32	Sand	11.10	2.0	x-4440490.630 y-457225.574	High moisture	Sunny
Borehole 33	Sand	12.00	2.0	x-4440509.348 y-457259.649	Low moisture	Sunny
Borehole 34	Sand	11.00	4.0	x-4440483.511 y-457262.589	Moisture	Sunny
Borehole 35	Sand	11.40	2.0	x-4440459.617 y-457259.840	Moisture	Sunny
Borehole 36	Sandy loam	12.30	4.0	x-4440430.635 y-457260.629	Moisture	Sunny
Borehole 37	Sand	13.15	2.0	x-4440411.296 y-457256.538	Low moisture	Sunny
Borehole 38	Sandy loam	13.50	4.0	x-4440390.927 y-457255.824	Moisture	Sunny
Borehole 39	Sand with gravel	14.30	4.0	x-4440359.317 y-457253.071	Moisture	Sunny

FIELD FORM

Samplers:			Signatures:		Weather conditions:	
Sample ID (as in bag)	Sample name (as in bag)	Time	Depth, m	GPS Coordinates	Sample description (type and moisture)	Anthropogenic/ Natural Features in area
Borehole 40	Sand with cabble stone and gravel	15.10	4.0	x-4440331.207 y-457250.792	High moisture	Sunny
Borehole 41	Sandy loam	11.00	2.0	x-4440489.050 y-457308.720	Low moisture	Sunny
Borehole 42	Sand	11.40	2.0	x-4440468.929 y-457295.788	Low moisture	Sunny
Borehole 43	Sand with gravel	12.30	2.0	x-4440429.310 y-457298.440	Low moisture	Sunny
Borehole 44	Sand	13.10	2.0	x-4440374.051 y-457302.843	Low moisture	Sunny
Borehole 45	Sand with gravel	13.50	2.0	x-4440329.460 y-457298.229	Low moisture	Sunny

REPORT

On geological survey and laboratory analysis of Yerevan TPP new
area

(Part 1)



Yerevan 2017

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R E P O R T

On geological survey and laboratory analysis of Yerevan TPP new
area

(Part 1)

Client: 'Renco Armestate' LLC

Director

R. Manukyan

Chief specialist

F. Avetisyan

Yerevan 2017

Contents

	page
1. Introduction, description of the works.....	4
2. Area and site overview.....	6
3. The format of the geological works (45 boreholes) and conditions: annex 3.....	8
4. Bibliography.....	9

Text annex

1 Copy of the terms of reference.....	1
2 Hydro-geological boreholes lithological columns	2
3 Copy of license.....	3

Graphic annex

1 Space picture of the area	1
2 The map of the actual materials.....	2

1. Introduction, description of the works

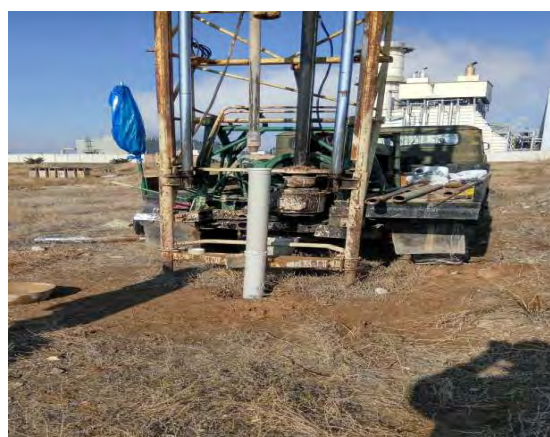
Pursuant to the contract N17/09, signed on 8.11.2017 by “Renco Armestate” LLC and “Geoterproject” Ltd, as well as annex N1 (technical specification), during November-December of 2017 the company “Geoterproject” Co. Ltd has carried out a complex geological survey and laboratory analysis of the territory of Yerevan TPP new area in Republic of Armenia.

The schematic plan of the area has been provided by the Client.

The study area is situated in the south-eastern part of Yerevan, in Erebuni district, RA.

The following operations have been carried out:

1. Collecting of the data on geotechnical and projective surveys carried out in these and neighboring areas, their coordination, comparison and analysis.
2. On the area mentioned by the client (75.000 square m.) for soil and water sampling had been done geological reconnaissance by drilling. These drilling works have been carried out by drilling rig UGB-50M (d=151mm, 131mm, 127mm and 112mm) by the dry mechanical column method, with a screw auger, core selection. 45 boreholes have been drilled in the proposed areas. 20 boreholes with 2m depth, 25 boreholes with 4m depth with overall volume of 140m³/l.





Pic: Drilling and sumpeling works.

3. Using the drilled holes core, the sampling of soils has been carried out depending on non-disturbed and disturbed structure. Depths according to the technical task (2m and 4m, 45 boreholes, one sample from each).
4. For underground waters sampling have been drilled 3 hidro-geological boreholes, each by 10m depth with fastening. Drilling was made with a diameter of 151 mm, PVC porous tubes are installed in each of 3 hydro-geological wells. Each boreholes walls and the middle of the filter was made topping by sand. From each hydro-geological borehole was taken one water sample. From 1st borehole at the depth of 1.9m, from 2nd at the depth of 2.6m and from 3rd at the depth of 2.7m: depending on the groundwater stabilization level. See Appendix 3 hydro-geological wells columns.
5. On the area mentioned by the client has been carried out sampling of 3 of surface water samples from the following locations:
Sample 1, upstream of the sewage discharge point of the Yerevan TPP1,
Sample 2 downstream of the sewage discharge point of the Yerevan TPP1,
Sample 3 at the sewage discharge point of the Yerevan TPP1 (access had been provided).
6. Carried out field and fund works office exploration.

7. Had been carried out analysis of the implemented works.

The field survey works, engineering-geological operations and office works were coordinated and headed by the director of “Geoterproject” Co. Ltd R. Manukyan and chief specialist geological engineer F. Avetisyan.

2. Area and site overview

The study area is located near the existing Yerevan TPP, in the south-eastern part of Yerevan, RA, towards South from Yerevan TPP.

The absolute levels vary from 923.0m to 930.0m.



Pic. The space photo of the area

The study area is located in warm climatic zone, with hot summer and cold, windless winter.

The absolute maximum air temperature is $+41^{\circ}\text{C}$, the minimum- -30° .

Winds, having South-Western direction of maximum 5.9m/sec. speed predominate in winter (January), while winds of North-Eastern direction – in summer (June). Winds with the velocity up to 24m/sec may occur once in 20 years. Wind velocity pressure reaches up to 45kg/m².

Annual atmospheric precipitation is 302mm.

The highest snow cover in this area reaches 58cm, pressure- 70kg/m².

Maximum depth of frost in soil is 60cm.



The geological structure of the area and the study site is represented by radical clays, generally covered by contemporary alluvial, dilluvial-prolluvial, and technogenic generations, formed of clayey and sandy soils.

From the seism tectonic respect the territory and the study area are located within the limits of corrugated zone of Armenia. The territory is one of the seism active zones in Armenian plateau.

From the hydro-geologic respect the area underground waters are related to alluvial and dilluvial generations, belong to layer waters type.

3. The format of the geological works (45 boreholes) and the conditions

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“Geoterproject LLC” 2016



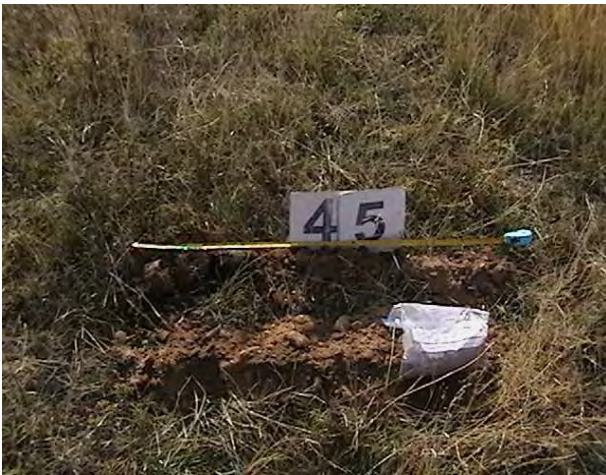


















Client: "Geoterproject" LTD

Contract number: 22-1/17

Date of receiving of sample: 13.11.2017

Date of issue of results: 20.12.2017

Soil sampling: Client

APPROVED
Deputy Director

G. Shahnazaryan

Sample ID: Borehole 1

Sample name (as in bag): Sandy loamy

SOIL TEST REPORT

N	Testing parameter	Unit	Measured value	Maximum permissible concentration
1	Lithium	g/kg	0.0200	NA*
2	Sodium	g/kg	20.604	NA
3	Magnesium	g/kg	14.366	NA
4	Aluminum	g/kg	65.27	NA
5	Potassium	g/kg	7.608	NA
6	Calcium	g/kg	85.76	NA
7	Titanium	g/kg	2.359	NA
8	Vanadium	g/kg	0.0905	0.15
9	Chromium	g/kg	0.0617	0.006
10	Iron	g/kg	47.02	NA
11	Manganese	g/kg	0.4730	0.7
12	Cobalt	g/kg	0.0233	0.005
13	Nickel	g/kg	0.0327	0.004
14	Copper	g/kg	0.0400	0.003
15	Zinc	g/kg	0.0652	0.023
16	Arsen	g/kg	0.0093	0.002
17	Selenium	g/kg	0.0091	NA
18	Strontium	g/kg	0.4440	NA
19	Molybdenum	mg/kg	1.222	NA
20	Cadmium	mg/kg	0.1364	NA
21	Tin	mg/kg	0.8928	NA
22	Stibium	mg/kg	0.3494	4.5
23	Barium	g/kg	0.6524	NA
24	Lead	g/kg	0.0101	0.032
25	Benzene	mg/kg	<0.0001	0.3
26	Ethylbenzene	mg/kg	<0.0001	NA
27	Toluene	mg/kg	0.2282	0.3
28	Xylene	mg/kg	0.0090	0.3
29	Petroleum Hydrocarbons	mg/kg	10.93	NA
30	Polycyclic Aromatic Hydrocarbons	mg/kg	ND*	NA

NA*-not assigned

ND-not detected

Submitted:

Head of Water quality research laboratory

A. Zurnachyan



ENVIRONMENTAL MONITORING AND INFORMATION CENTER

State non-commercial organization

46 Charents Str., 0025 Yerevan, Armenia, Tel.: (+374) 10 272007

Client: "Geoterproject" LTD

Contract number: 22-1/17

Date of receiving of sample: 17.11.2017

Date of issue of results: 20.12.2017

Soil sampling: Client

Sample ID: Borehole 19

Sample name (as in bag): Sand



APPROVED

Deputy Director

G. Shahnazaryan

SOIL TEST REPORT

N	Testing parameter	Unit	Measured value	Maximum permissible concentration
1	Lithium	g/kg	0.0078	NA
2	Sodium	g/kg	7.65	NA
3	Magnesium	g/kg	6.02	NA
4	Aluminum	g/kg	30.93	NA
5	Potassium	g/kg	6.89	NA
6	Calcium	g/kg	51.50	NA
7	Titanium	g/kg	1.92	NA
8	Vanadium	g/kg	0.107	0.15
9	Chromium	g/kg	0.055	0.006
10	Iron	g/kg	33.83	NA
11	Manganese	g/kg	0.527	0.7
12	Cobalt	g/kg	0.0205	0.005
13	Nickel	g/kg	0.0266	0.004
14	Copper	g/kg	0.1223	0.003
15	Zinc	g/kg	0.0731	0.023
16	Arsen	g/kg	0.0126	0.002
17	Selenium	g/kg	0.0085	NA
18	Strontium	g/kg	0.3584	NA
19	Molybdenum	mg/kg	0.0008	NA
20	Cadmium	mg/kg	0.00017	NA
21	Tin	mg/kg	0.00097	NA
22	Stibium	mg/kg	0.00038	4.5
23	Barium	g/kg	0.723	NA
24	Lead	g/kg	0.0140	0.032
25	Benzene	mg/kg	<0.0001	0.3
26	Ethylbenzene	mg/kg	<0.0001	NA
27	Toluene	mg/kg	0.0085	0.3
28	Xylene	mg/kg	0.0065	0.3
29	Petroleum Hydrocarbons	mg/kg	11.848	NA
30	Polycyclic Aromatic Hydrocarbons	mg/kg	ND	NA

NA*-not assigned

ND-not detected

Submitted:

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46 Charents Str., 0025 Yerevan, Armenia, Tel.: (+374) 10 272007

Client: "Geoterproject" LTD

Contract number: 22-1/17

Date of receiving of sample: 21.11.2017

Date of issue of results: 20.12.2017

Water sampling: Client

APPROVED

Deputy Director

G. Shahnazaryan

Sample ID: C

Sample name (as in water sampling bottle): from channel

WATER TEST REPORT

N	Testing parameter	Unit	Measured value	Maximum permissible concentration
1	pH	-	7.76	6.5-9
2	Mineralization	mg/L	593	148
3	BOD ₅	mgO ₂ /l	2.87	5
4	COD-Cr	mgO/L	26	25
5	Lithium	mg/L	0.02528	0.036
6	Sodium	mg/L	82.20	10
7	Magnesium	mg/L	21.96	50
8	Aluminium	mg/L	0.0033	0.13
9	Potassium	mg/L	4.715	3
10	Calcium	mg/L	50.65	100
11	Titanium	mg/L	0.00609	NA
12	Vanadium	mg/L	0.01770	0.002
13	Chromium	mg/L	0.00373	0.011
14	Iron	mg/L	0.08014	0.16
15	Manganese	mg/L	0.00818	0.01
16	Cobalt	mg/L	0.00055	0.00028
17	Nickel	mg/L	0.00404	0.011
18	Copper	mg/L	0.00153	0.023
19	Zinc	mg/L	0.00060	0.1
20	Arsen	mg/L	0.00758	0.02
21	Selenium	mg/L	0.00110	0.02
22	Strontium	mg/L	0.25436	NA
23	Molybdenum	mg/L	0.00598	0.014
24	Cadmium	mg/L	0.00003	0.001
25	Tin	mg/L	0.000003	0.00018
26	Stibium	mg/L	0.00012	0.00038
27	Barium	mg/L	0.01672	0.018
28	Lead	mg/L	0.000092	0.01
29	Benzene	mg/L	<0.001	0.03
30	Ethylbenzene	mg/L	<0.001	NA
31	Toluene	mg/L	<0.001	NA
32	Xylene	mg/L	<0.001	NA
33	Petroleum Hydrocarbons	mg/L	<0.001	0.1
34	Polycyclic aromatic hydrocarbons	mg/L	ND**	NA

BOD₅-Biochemical Oxygen 5-days Demand, COD-Cr Chemical Oxygen Demand bichromate

NA*-not assigned

ND*-not detected

Submitted:

Head of Water quality research laboratory

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Client: "Geoterproject" LTD

Contract number: 22-1/17

Date of receiving of sample: 21.11.2017

Date of issue of results: 20.12.2017

Water sampling: Client

APPROVED
Deputy Director

G. Shahnazaryan

Sample ID: B

Sample name (as in water sampling bottle): Hrazdan river, before channel

WATER TEST REPORT

N	Testing parameter	Unit	Measured value	Maximum permissible concentration
1	pH		7.45	6.5-9
2	Mineralization	mg/L	666	148
3	BOD ₅	mgO ₂ /l	2.52	5
4	COD-Cr	mgO/L	42	25
5	Lithium	mg/L	0.0266	0.036
6	Sodium	mg/L	64.94	10
7	Magnesium	mg/L	27.50	50
8	Aluminum	mg/L	0.0138	0.13
9	Potassium	mg/L	5.74	3
10	Calcium	mg/L	68.06	100
11	Titanium	mg/L	0.00672	NA
12	Vanadium	mg/L	0.01496	0.002
13	Chromium	mg/L	0.00434	0.011
14	Iron	mg/L	0.10672	0.16
15	Manganese	mg/L	0.02611	0.01
16	Cobalt	mg/L	0.00034	0.00028
17	Nickel	mg/L	0.00331	0.011
18	Copper	mg/L	0.00183	0.023
19	Zinc	mg/L	0.00250	0.1
20	Arsen	mg/L	0.00677	0.02
21	Selenium	mg/L	0.00210	0.02
22	Strontium	mg/L	0.38797	NA
23	Molybdenum	mg/L	0.00324	0.014
24	Cadmium	mg/L	0.000021	0.001
25	Tin	mg/L	0.0000006	0.00018
26	Stibium	mg/L	0.0000912	0.00038
27	Barium	mg/L	0.0323	0.018
28	Lead	mg/L	0.00021	0.01
29	Benzene	mg/L	<0.001	0.03
30	Ethylbenzene	mg/L	<0.001	NA
31	Toluene	mg/L	<0.001	NA
32	Xylene	mg/L	<0.001	NA
33	Petroleum Hydrocarbons	mg/L	<0.001	0.1
34	Polycyclic aromatic hydrocarbons	mg/L	ND*	NA

BOD₅-Biochemical Oxygen 5-days Demand, COD-Cr Chemical Oxygen Demand dichromate

NA*-not assigned

ND*-not detected

Submitted:

Head of Water quality research laboratory

A. Zurnachyan



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Client: "Geoterproject" LTD

Contract number: 22-1/17

Date of receiving of sample: 21.11.2017

Date of issue of results: 20.12.2017

Water sampling: Client

Sample ID: H

Sample name (as in water sampling bottle): Hrazdan river, after channel

APPROVED
Deputy Director
G. Shahnazaryan



WATER TEST REPORT

N.	Testing parameter	Unit	Measured value	Maximum permissible concentration
1	pH	-	7.47	6,5-9
2	Mineralization	mg/l.	661	148
3	BOD ₅	mgO ₂ /l	3.91	5
4	COD-Cr	mgO/L	30	25
5	Lithium	mg/L	0.0270	0.036
6	Sodium	mg/L	59.63	10
7	Magnesium	mg/l.	27.46	50
8	Aluminum	mg/L	0.0132	0.13
9	Potassium	mg/L	5.58	3
10	Calcium	mg/L	67.72	100
11	Titanium	mg/L	0.006374	NA
12	Vanadium	mg/L	0.013205	0.002
13	Chromium	mg/L	0.004477	0.011
14	Iron	mg/L	0.106664	0.16
15	Manganese	mg/L	0.028988	0.01
16	Cobalt	mg/L	0.000304	0.00028
17	Nickel	mg/L	0.003085	0.011
18	Copper	mg/L	0.001679	0.023
19	Zinc	mg/L	0.002253	0.1
20	Arsen	mg/L	0.006365	0.02
21	Selenium	mg/L	0.002069	0.02
22	Strontium	mg/L	0.391978	NA
23	Molybdenum	mg/L	0.002763	0.014
24	Cadmium	mg/L	0.000019	0.001
25	Tin	mg/L	0.000006	0.00018
26	Stibium	mg/L	0.000110	0.00038
27	Barium	mg/L	0.032977	0.018
28	Lead	mg/L	0.000692	0.01
29	Benzene	mg/L	<0.001	0.03
30	Ethylbenzene	mg/L	<0.001	NA
31	Toluene	mg/L	<0.001	NA
32	Xylene	mg/L	<0.001	NA
33	Petroleum Hydrocarbons	mg/L	<0.001	0.1
34	Polycyclic aromatic hydrocarbons	mg/L	22*	NA

BOD₅-Biochemical Oxygen 5-days Demand, COD-Cr Chemical Oxygen Demand dichromate

NA*-not assigned

ND*-not detected

Submitted:

Head of Water quality research laboratory

A. Zurnachyan

Annex 5



Foto 1: Entrance area to YTPP-2 site

Fotos 1 – 8 were taken by GefaÖ in 2017



Foto 2: Area overview with construction site (center) and TPP-1 on the right side



Foto 3: Larger overview of the area, view NW



Foto 4: On the site, view to SE



Foto 5: On the site with some waste



Foto 7: On the site, view to NE



Foto 7: On the site, view to N with TPP1



Foto 8: On the site with old barrels and pollution with unknown liquid



Foto 9: Drilling works from November, 15th of borehole 14 (4 meters)



Foto 10: Drilling core from borehole 14 ready to take sample.



Foto 11 : Taking soil sample from borehole 14 in plastic bag



Foto 12: Drilling core of borehole 13 with soil sample. TPP1 in the background.



The legal framework of the emissions standardization in Armenia and the assessment of the planned YTPP-2 emissions



Customer
Renco Armestate LLC

Executer
Consecoard LLC

Yerevan, 2018

Contents

1	Main principles.....	3
2	Permits	3
3	Normatives of hazardous substances emissions limit values	4
4	Legal frameworrk	4
4.1	<i>Law abuot protection of atmospheric air of the Republic Armenia</i>	4
4.2	<i>Sub-legal acts</i>	4
5	Assessment of the planned YTPP-2 emissions	5
5	Conclusion	7
	ANNEX 1.	8
	LAW OF THE REPUBLIC OF ARMENIA	8
	ANNEX 2.	10
	ANNEX 3.	15
	ANNEX 4.	16
	ANNEX 5.	17
	ANNEX 6.	18

ABBREVIATION LIST

RA	Republic of Armenia
TLV	Threshold limit value
ELV	Emissions limit value
TPP	Thermal power plant
EIA	Environmental impact assessment
LLC	Limite Liability Company

1 Main principles

The standardization of the hazardous substances in Armenia is carried out on the basis of sanitary-hygienic principle. The main criteria is the consideration of the sanitary norms of the given substances content in the air of public areas (cities, settlements, villages).

The emissions simultaneous maximum quantity (on the edge of the tube) is defined on the conditions that after dispersion the given substance ground level concentration, considering the unfavourable weather condition and background pollution, does not exceed the maximum threshold limit emissions one-time concentration (maximum one-time TLV).

This order has been passed yet during SSSR, the aim of which was the protection of the population.

2 Permits

The enterprises get separate permits for the impacts on the different components of the environment, such as for water use and wastewater leaks, emissions to the atmospheric air, placement of hazardous refuses, separately. All of them are given by the RA Ministry of Nature Protection.

The permits are given based on the normative projects of the water use, limit permissible leaks (LPL), emissions limit value (ELV) and refuses formation.

The order, form and the content of the permits are defined in the relevant legal and sub-legal acts.

In 2011 changes have been made in the RA law "On the atmospheric air protection". Together with other changes, the enterprise's minimum limit of the pollution potential has been defined, based on which the way of the definition and release of the emission norm of the substances, polluting the atmosphere, is defined. According to that change, based on the ELV project, the emission permit is given only to those enterprises, the required air use¹ (RAU) of which exceeds 2billion m³.

For the enterprises the RAU of which is from 200mln to 2billion m³, the emission norm is defined based on the factual emissions (RA Government resolution N259 of 22.04.1999). The enterprises the RAU of which is less than 200mln, are not to be registered. In case of having more than 2billion m³ RAU, the enterprises develop drafts of Emissions limit vales (ELV) normatives and submit them to the RA Ministry of Nature Protection for approval and for getting emissions permit.

Starting from the moment of giving emissions permit, the emissions quantities, presented in the ELV draft, become normatives of the relevant enterprise (equipment).

¹ Required air use- the volume of the clean air, necessary for rarefying the polluting substances emissions up to threshold limit values level

The emissions permit is given to the objects, which are under construction, enlargement and reconstruction, on the basis of the state ecological expertise positive conclusion, for a term of 1 year, starting from the commissioning day. After that term the emissions standardization is realized according to the atmospheric air protection law.

3 Normatives of hazardous substances emissions limit values

The ELV normative draft describes technologies, used raw materials and products, sources of emission parameter query of sources, emission substances names. In the draft there are mentioned substances with a hazardous amount of impact, the timeframe for achieving the ELV norms and the costs required for it, the extent of damage, caused to the environment by the organization's emissions.

Based on technological processes, quantities and productivity of consumed substances, the quantities of all emissions are calculated at average annual, t / year, as well as short-term emissions at maximum productivity with g/sec quantity.

Based on these data, The Ministry of Nature Protection of Armenia performs a dispersion calculation compares the calculated concentration of each substance with the established maximum lump-sum TLVs and if the results do not exceed the TLV, an emission permit is given.

4 Legal framework

4.1 Law about protection of atmospheric air of the Republic Armenia

« The subject of the RA law “On the atmospheric air protection” is the regulation of the public relations in the field of the atmospheric air cleanliness protection, minimization and prevention of the hazardous impacts on the atmospheric air.

The law has passed on 10.11.1994, after which several changes have been made.

The articles, referring to the standardization of the hazardous substances emissions, are given in the annexes.

4.2 Sub-legal acts

In pursuance of the requirements of the law, the Government of the Republic of Armenia has made the following resolutions:

- a. “On the approval of the state registration order of the harmful impacts on the atmospheric air” (22.04.1999 N 259)
- b. ON DEFINING THE DEVELOPMENT AND APPROVAL PROCEDURE OF ENVIRONMENTAL AIR POLLUTING SUBSTANCES EMISSION LIMITS NORMATIVES AND ON DECARING THE RESOLUTIONS OF THE GOVERNMENT OF ARMENIA N 192 OF MARCH 30, 1999 AND N953-N OF AUGUST 21, 2008 AS INVALID (27 December 2012, N 1673-N)

- c. “ON THE APPROVAL OF THE NORMATIVES OF ENVIRONMENTAL AIR POLLUTING SUBSTANCES THRESHHOLD LIMIT VALUES (CONCENTRATIONS-TLV) IN SETTLEMENTS” (2 February 2006, N 160)

The air quality of the workplaces in the productive enterprises areas is defined by:

The rules “ON DETERMINING “THE CHEMICALS THRESHOLD LIMIT VALUES IN THE WORK ZONE AIR OF WORKPLACES OF ORGANIZATIONS” N 2.2.5-004-10 SANITARY RULES AND NORMS”, approved by the resolution N27 of 6 December, 2010, of the RA Ministry of Healthcare

The productive organizations should organize sanitary-protective zones in order to mitigate or minimize their impact.

These zones are defined by the CH 245-71 construction norms, which may be adjusted in the result of comparison with the TLVs of the concentrations, received in the result of the hazardous substances emissions dispersion.

Those articles or sections of the listed normative acts, which refer to the emissions standardization, are given in the annexes of the present report.

5 Assessment of the planned YTPP-2 emissions

In 2016-2017, the planned power plant EIA works were organized by “Renco Armestate” LLC, according to the RA acting legislation. Emissions quantities calculation was done in the EIA framework. Taking into account that it is planned to install gas turbine equipment of Siemens production, which correspond to IPPC “Reference Document on BAT fo Large Combustion Plants” European normative document requirements, the calculation was done on the basis of this normative document specific factors.

Emissions dispersion calculation of obtained quantities was done with “Raduga” computer program and the results are presented in the table 1.

Table 1.

№	Poluttants	Residential zones maximum one-time TLV ² , mg/m ³	Maximum near-ground concentrations	
			mg/m ³	on TLV
1	Nitrogen dioxide	0.2	0.0876	0.438
2	Carbon monoxide	5	0.0585	0.0117

² RA GOVERNMENT N 160-N RESOLUTION OF 02.02.2006 “ON THE APPROVAL OF THE NORMATIVES OF ENVIRONMENTAL AIR POLLUTING SUBSTANCES THRESHHOLD LIMIT VALUES (CONCENTRATIONS-TLV) IN SETTLEMENTS”

As it is seen in the table, the obtained maximum near-ground concentrations do not exceed the Republic of Armenia standards.

Those calculations in EIA have been presented to the Republic of Armenia Ministry of Nature Protection and, in the result of the carried put expertise, a positive conclusion has been obtained by the Republic of Armenia Ministry of Nature Protection.

At the end of 2017, based on the changes done in the project, according to which the power plant project capacity has been slightly increased, at the same time the stack height has been significantly increased, a ELV normatives draft development of the power plant has been undertaken by “Renco Armestate” LLC.

The draft has been developed according to the N 1673-N resolution methodology.

Emissions calculations have been done according to the European Environment Agency EMEP/EEA “Air pollutant emission inventory guidebook”³.

Specific emissions factors for combustion of various technologies and power equipment are presented in the guidebook, according to the produced energy quantity.

For gas turbines the factors of Guidbook 3-17 Table⁴ have been used.

The emissions quantities are presented in the table 2.

Table 2.

Substance name	TLV one-time maximum, mg/m ³	Substance emission, t/year
1	2	3
Carbon monoxide	5.0	365.5
Nitrogen dioxide	0.2	36.5
Hydrocarbons - limit	1.0	12.2

The table form is taken from the guidebook of “Approval and development order of normatives of the substances polluting the atmospheric air” approved by the RA Government N 1673-N resolution of 27.12.2012. In the second column of this table the maximum TLV is clearly mentioned. It is needed to mention also, that this normative on nitrogen dioxide corresponds to the quota (standard) accepted in several international documents.

Emissions dispersion calculation of obtained quantities was done with “Raduga” computer program and the results are presented in the table 3.

Table 3.

№	Polluting substances	Residential zones maximum one-time TLV ³ , mg/m ³	Maximum near-ground concentrations	
			mg/m ³	on TLV
1	Carbon monoxide	0.2	0.0232	0.116
2	Nitrogen dioxide	5	0.002	0.0004
3	Hydrocarbons	1	0.0008	0.0008

The significant reduction of the near-ground concentrations is conditioned on the double increase of the emission pipe height. According to the Raduga computer program mathematic model, the pipe height has a great influence.

5 Conclusion

The above-mentioned calculations and grounds show, that in the result of planned YTPP-2 operation, the hazardous substances will not exceed both the Republic of Armenia and international normative requirements, even under the maximum productivity conditions.

The above-mentioned grounds and citations are received from several RA legal acts, of which relevant extracts are presented in the present report annexes part.

“CONSECOARD” LLC director:

Vram Tevosyan

³ European Environment Agency. EMEP/EEA air pollutant emission inventory guidebook 2013

⁴ Table 3-17. Tier 2 emission factors for source category 1.A.1.a, gas turbines using gaseous fuels

⁵ RA GOVERNMENT N 160-N RESOLUTION OF 02.02.2006 “ON THE APPROVAL OF THE NORMATIVES OF ENVIRONMENTAL AIR POLLUTING SUBSTANCES THRESHHOLD LIMIT VALUES (CONCENTRATIONS-TLV) IN SETTLEMENTS”

ANNEX 1.

LAW OF THE REPUBLIC OF ARMENIA

On atmospheric air protection *

Passed on 11.10.1994

ARTICLE 10.

Specifications of Threshold limit values (maximum permissible concentration) of substances polluting atmospheric air and maximum permissible physical harmful influences

Specifications of Threshold limit values (maximum permissible concentration) of substances polluting atmospheric air and maximum permissible physical harmful influences are established for estimation of a state of atmospheric air.

These specifications should answer interests of nature protection and health of people.

ARTICLE 13. The principle of establishing the limit permissible normatives of Threshold limit values (maximum permissible emissions) of substances polluting atmospheric air and maximum permissible harmful physical influences

Specifications of levels of maximum permissible emission of substances polluting atmospheric air and maximum permissible harmful physical influences are established so that taking into account prospects of development of the given region emissions of polluting substances and harmful physical influences from the given territory and from all other sources have not resulted in exceeding of specifications of maximum permissible concentration of polluting substances in atmospheric air and maximum permissible physical harmful influences.

The threshold limit values are established for those emission sources or the groups, the required air use, calculated on which emissions maximum design indicators in one year exceeds two billion cubic meter or in one second exceeds two thousand cubic meter.

All those influences on a state of atmospheric air for which corresponding specifications are not established are forbidden.

The active influences on the atmosphere or atmospheric phenomena are carried out on the procedure, established by the Republic of Armenia.

ARTICLE 14. Regulation of emissions of substances polluting atmospheric air by stationary sources of pollution

Specially authorized state body in the sphere of protection of atmospheric air permits emissions by stationary sources of pollution of substances polluting atmospheric air in each case, on the order,

established by The Government of the Republic of Armenia, within 30 days upon applying by the organizations, having stationary sources of pollution. In case of not giving an answer by the authorized body within the established terms, the normative of the emissions limit values of the air polluting substances should be considered as accepted.

ARTICLE 15. Ensuring of execution of requirements to emissions of substances polluting atmospheric air

The enterprises, establishments and organizations which activity is connected to emission of substances polluting atmospheric air, are obliged to carry out technical, economic, organizational and other actions for ensuring of execution of conditions and requirements stipulated in permissions on emission, to take measures on reduction of emission of polluting substances, to provide a working order of nature protection constructions and equipment, their uninterrupted and effective work, and also in accordance with established procedure carry out the constant account and measurement of amount and contents of substances emitted in atmospheric air.

Realization of actions on atmospheric air protection should not result in pollution of other natural environments.

ARTICLE 16. Restriction, suspension or prohibition of emission of substances polluting atmospheric air

Specially authorized state bodies in the sphere of atmospheric air protection have the right to restrict, suspend or prohibit emission of substances polluting atmospheric air, down to the termination of activity of separate establishments, enterprises, shops and organizations if the conditions and requirements stipulated by permissions are broken, and also a threat to health of the population emerges.

ARTICLE 22. Establishment of sanitary - protective zones

At selection of places for new enterprises, constructions and other objects, reconstruction or expansion of the working enterprises, constructions and other objects influencing a state of atmospheric air, establishment of sanitary - protective zones is provided.

ANNEX 2.

RESOLUTION

OF THE GOVERNMENT OF ARMENIA

27 December 2012, N 1673-N

ON DEFINING THE DEVELOPMENT AND APPROVAL PROCEDURE OF ENVIRONMENTAL AIR POLLUTING SUBSTANCES EMISSION LIMITS NORMATIVES AND ON DECARING THE RESOLUTIONS OF THE GOVERNMENT OF ARMENIA N 192 OF MARCH 30, 1999 AND N953-N OF AUGUST 21, 2008 AS INVALID

Based on the articles 5, 5.1, 12, 13 and 14 of the RA law on “The environmental air protection”, the Government of the Republic of Armenia *decides*:

1. To define the order of development and approval procedure of environmental air polluting substances emission limits normatives, according to the annex.
2. Define that
 - 1) The normatives of hazardous substances emissions in the environment are developed for those hazardous substances for which health, nature protection or other normatives of their content in the environment are established. If in the result of the business entities' activity a substance, for which no health, nature protection or other normatives are established, is emitted, then the business entity applies to the liable authority in order to develop a normative for that substance, according to the established procedure.
 - 2) According to the resolution N259 of April 22, 1999 of the RA Government, for those organizations or private entrepreneurs (hereinafter referred as business entities) under state registration, based on whose emissions maximum design indexes the “required air usage” (hereinafter RAU) is calculated and is from two hundred million up to two billion cubic meter, the emissions limit quantities are the factual emissions, generated in the result of their activity.
 - 3) For those business entities, that have such emission sources, the RAU, calculated based on their emissions maximum design indexes, exceeds two billion cubic meter annual or two thousand cubic meter in a second, the emission quantities are defined based on the emission limits value (ELV) normatives projects, moreover;
 - a. If in the result of dispersion in the ground-level strata – at the edge of the emitting organization territory and(or) in the nearest settlements – the polluting substances emissions cause such concentrations which, together with the given territory pollution background concentration, do not exceed the treshhold limit values (TLV), the ELV normatives are acceptable and are emission limit quantities (emissions permissions),

- b. If the ground-level concentrations of polluting substances, formed in the result of the emissions, together with the given territory pollution background concentration, at the edge of the emitting organization territory and(or) in the nearest settlements, exceed the corresponding TLV, and the given substances background pollution does not exceed the TLV, a program of air polluting substances emissions reduction measurements is developed, the realization of which will ensure the TLV normatives formation.
 - c. If for some substances, existing in the business entity's emissions, the background pollution exceeds the corresponding TLV, the ELV normatives are accepted as temporary. The temporary normatives are operating until the new quantities provision, based on the territorial standardization realization in the established procedure in the territories which have hazardous substances background over-pollution.
 3. In the cases, defined in the b) and c) paragraphs of the 3rd sub-clause of the 2nd clause of the present resolution, the emissions quantities are provided to the extent of the ELV normatives.
 4. To define that:
 - 1) The air polluting substances emissions limit normatives for the air polluting immobile sources are developed by the business entities which have such sources.
 - 2) The provided emission quantities remain valid as long as there are no quantitative or qualitative modifications for the polluting immobile sources and polluting substances, as well as there is no background over-normative pollution of those substances. Related to the background over-normative pollution, the emission quantities are being reviewed not earlier than within 5 years upon the provision moment.
 - 3) The information about the territory background pollution is provided by the RA Ministry of Nature Protection, on its official web-site. If the data of that territory background pollution are missing, the background pollution is determined, based on the population quantity of that territory.
 - 4) The emission quantities for the new constructed, expanded and reconstructed buildings are being determined within 7 days upon the day of its commissioning in the established procedure, for one year, based their construction, expansion and reconstruction design solutions. Then, depending on the emissions capacity or quantity, in conformity with the present resolution 2nd clause 2nd or 3rd sub-clauses.
 5. To declare invalid the resolutions of the RA Government N192 of March 30, 1999 "On giving permissions for the normatives of environmental air polluting substances limit emissions and physically hazardous impacts permissible limit levels and for making emissions" and N953-N of August 21, 2008 on "The approval of the procedure of giving permission for the normatives projects examination of the emissions limits of the organizations, having environmental air polluting immobile sources, and for making emissions"

**Annex of the RA Government resolution
N1673-N of December 27, 2012**

ORDER
OF THE DEVELOPMENT AND APPROVAL OF THE NORMATIVES OF ENVIRONMENTAL AIR POLLUTING SUBSTANCES EMISSIONS LIMIT VALUES

1. The designs of the normatives of environmental air polluting substances emissions limit values (hereinafter design) are being developed and submitted to the revision of the Ministry of Nature Protection of the Republic of Armenia (hereinafter Ministry) by the organizations, satisfying the condition, mentioned in the 4th point of the present resolution, in accordance with the guideline of the present order. Required air use (RAU) is being calculated by the formula of the present order 7th clause.
2. The design, together with the attached letter (claim), is submitted via electronic version, by placing it on the Ministry's web-site, notifying the Ministry about it via email: min_ecology@mnp.am.
3. Within 30 days upon the day of the notification about placing the design on the web-site, mentioned in the 2nd clause of the present order, the Ministry informs the organization about the results of the submitted design revision:
 - 1) in case of the absence of the remarks about the design- about the approval of the emissions normatives, represented in the design, which are being considered as emissions quantities, provided to the given organization (emissions permits). Also an excerpt, signed and sealed by the authorized body is being attached to the letter, the table 6 of the design "Normatives/quantities of the emissions limit values (ELV) (QUANTITIES OF POLLUTING SUBSTANCES, EMISSIONED TO THE ENVIRONMENT FROM IMMOBILE SOURCES/ EMISSION PERMITS).
 - 2) In case of any remarks about the design, the remarks and their legal bases are being enumerated, and the design is being returned to reworking.
4. the reworked design again is submitted to revision on the procedure, envisaged by the present order.
5. The provided quantities of emissions remain in force as long as there are no quantitative or qualitative changes regarding the pollution immobile sources and polluting substances, as well as there is no background sub-normative pollution with the given substances. In case of the above mentioned changes the business entity develops a new design and submits it to revision, according to the present order.
6. If within 30 days the Ministry does not give a written answer to the organization, then the emissions normatives, submitted in the design, are considered as approved.

7. The required air use (RAU) in one year or in one second is calculated by the following formula:

$$RAU = \sum_{i=1}^n \frac{E_i}{TLV_i}$$

Where

E_i is the maximum emission of each i -rd substance, relatively in one year or in one second, according to the technological regulations (mg/year or mg/sec),

TLV_i is relatively the average daily or maximum one-time threshold limit value of the i -rd substance (mg/m³).

GUIDELINE

ON THE COMPOSITION AND CONTENTS OF THE NORMATIVES/QUANTITIES DESIGNS OF THE EMISSIONS LIMIT VALUE (ELV)

1. The cover sheet

The cover sheet is the first page of the project and is formed based on the attached exemplary form.

2. Executors' list

The executors' list is written on the 2nd page of the cover sheet. The list represents the organizations and the surnames of all the responsible executors, co-executors, who have participated in the design development activities. On the left side the position, scientific degree are mentioned, while the surname is written on the right side. At each surname, in brackets, the number of the section they have prepared, is mentioned.

3. Summary

The summary should contain the main results of the executed works, the denominations of the polluting substances and the emissions annual quantities, the substances with harmful total impact, the terms of reaching the substances ELV norms and the expenses necessary for them, the amount of the damage on the environment in the result of the emissions by the organization.

4. Contents

The project contents should contain the titles of all the sections and the annexes, with the notes of the relevant pages.

5. General information about the organization

This chapter contains:

- 1) The location of the business entity, the quantity of production areas, information about the industrial area and the bordering objects, settlement, industrial zones, forests, agricultural fields, transport highways disposition.
- 2) The map-scheme of the business entity, mentioning the pollution sources.
- 3) The situational map of the business entity's location, mentioning the settlements, including the resort zones, resorts, kindergartens, schools, hospitals.

6. the characteristics of the business entity as a source of environmental air pollution

This chapter includes:

- 1) The production technology description and the brief characteristics of the used equipment from the environmental pollution point of view as well as information about the product, main raw material, main and reserve fuel.
- 2) The brief description of existing dust-gas-treating equipment, the generalized analysis of their technical condition and efficiency of the activity.
- 3) Information about the used technology, the modernity of the technological and dust-gas-treating equipment and the best available production technologies.
- 4) The perspective development of the business entity.

The decisions about the information of the reconstruction, expansion, technical or technological upgrading, reprofilation, conservation, replacement or liquidation.

It is made a reference to those documents which determine the development perspective: the existence of the project of reconstruction, expansion and new construction, the results or process of their ecological expertise.

5) The list of the polluting substances, emitted to the environment.

Represented in the form of a table, given below.

TABLE 1.

The list of the polluting substances, emitted to the environment

Substance denomination	TLV one-time maximum, mg/m ³	Substance emission, t/year
1	2	3

Under the table the substances with total harmful impact are mentioned, as well.

The quantities of the emissions of the environmental air polluting substances (column 3) are calculated for each substance, based on the business entity operational mode, technological processes and equipment commissioning indexes, consumption quantities of raw material and fuel, on an annual basis.

6) the characteristics of the shock emissions

The brief characteristics of the shock emissions generation conditions are given.

The shock emissions are represented in the form of the below mentioned table, they are not included in the table 1. The shock emissions are considered only in the emissions quantities on an annual basis. No dispersion calculation is carried out for them and they cannot be included in the quantity of the given substance maximum one-time (g/sec) emission.

ANNEX 3.

GOVERNMENT OF THE REPUBLIC OF ARMENIA

RESOLUTION

N 160-N of 2 February 2006

ON APPROVAL OF THE NORMATIVES OF THE THRESHOLD LIMIT VALUES (CONCENTRATIONS-TLV) OF THE SUBSTANCES POLLUTING THE ENVIRONMENTAL AIR IN SETTLEMENTS

(title modified on 05.04.07 N 403-N)

In conformity with the clauses 5, 10, 11 and 18¹ of the Republic of Armenia's law "On the environmental air protection", the Government of the Republic of Armenia *decides*:

1. To approve the normatives of environmental air polluting substances threshold limit values (concentrations-TLV) in settlements, in conformity with the Annex N1.
2. *(the clause has lost validity on 05.04.07 N403-N)*
3. To define that in sanatoriums, specially protected areas and touristic regions and (or) centers the threshold limit values of the hazardous substances, included in the Annex N1 of the present resolution, are accepted to the extent of the 0.8 threshold limit value of the given substance.
4. The present resolution enters into force the tenth day, successive to the official publication day.
5. THE NORMATIVES OF ENVIRONMENTAL AIR POLLUTING SUBSTANCES THRESHHOLD LIMIT VALUES (CONCENTRATIONS-TLV) IN SETTLEMENTS

NN	Hazardous substance denomination	TLV (mg/m ³)		Danger class
		one-time maximum	Average daily	
1	2	3	4	5
1.	Nitrogenic acid (by HNO ₃ molecule)	0.4	0.15	2
2.	Nitrogen dioxide	0.2	0.04	3
3.	Nitrogen oxide	0.4	0.06	3

ANNEX 4.

MINISTER OF HEALTHCARE
OF THE REPUBLIC OF ARMENIA

December 6, 2010

N 27-N

ORDER

ON DETERMINING “THE CHEMICALS THRESHOLD LIMIT VALUES IN THE WORK ZONE AIR OF
WORKPLACES OF ORGANIZATIONS” N 2.2.5-004-10 SANITARY RULES AND NORMS

Taking as a base the sub-clause d) of the clause 12 of the RA Ministry of Healthcare statute, defined by the resolution N1300-N of 15 August 2002 of the RA Government “On creating a state governmental institution “Staff of RA Ministry of Healthcare ”, establishing the Republic of Armenia’s Ministry of Healthcare statute and staff structure”, as well as the proposals of the World Health Organization for the development of the regions of Eastern Europe, Caucasus and Central Asia, based on the population’s health care interests,

I order

To approve the sanitary rules and norms N 2.2.5-004-10 “The chemicals threshold limit values in the work zone air of workplaces of organizations”, according to the annex.

Minister

H. Kushkyan

Annex
Of the resolution N27-N of 6 December 2010
Of the RA minister of Healthcare

SANITARY RULES AND NORMS

THE CHEMICALS THRESHOLD LIMIT VALUES IN THE WORK ZONE AIR OF WORKPLACES OF ORGANIZATIONS

N 2.2.5-004-10

THE HAZARDOUS SUBSTANCES OF ACCUTE IMPACT THRESHOLD LIMIT VALUES (TLV) IN THE WORK ZONE
AIR

N	Substance denomination	Threshold limit value (TLV) mg/m ³	The prevailing aggregate state of the substance in production conditions	Danger class
1	2	3	4	5
1.	Nitrogen dioxide	2	g	3
2.	Nitrogen oxides (recalculated on NO ₂)	5	G	3

ANNEX 5.

SANITARY NORMS OF DESIGNING INDUSTRIAL ENTERPRISES

Approved by
The State Committee of
Council of Ministers of the USSR
for construction
November 5, 1971

in accordance with the sanitary classification of enterprises, industries and facilities, the following sizes of sanitary protection zones for enterprises are established:

- class I – 1000 m;
- « II - 500 m;
- « III - 300 m;
- « IV - 100 m;
- « V - 50 m.

8. SANITARY CLASSIFICATION OF ENTERPRISES AND PRODUCTION, THERMAL POWER STATIONS, WAREHOUSE BUILDINGS AND STRUCTURES AND DIMENSIONS OF SANITARY - PROTECTION ZONES FOR THEM

8.1. For enterprises, buildings and structures with technological processes that are sources of production hazard emissions into the environment, sanitary-protection zones should be provided in accordance with [section 2](#) of these standards, depending on the sanitary classification.

Note. When organizing new productions and technological processes not included in this classification, the size of the sanitary-protection zone should be established in each specific case on agreement with the Chief Sanitary-Epidemiological Administration of the Ministry of Health of the USSR and the USSR Gosstroy.

INDUSTRIAL ENTERPRISES

8.2. For industrial enterprises, depending on the nature of production and capacity, the following sanitary protection zones should be envisaged.

THERMAL POWER STATIONS AND BOILERS

8.3. Sanitary-protection zones for thermal power plants and boilers should be determined by calculating by the dispersion in the atmosphere of harmful substances contained in the emissions, on the basis of normative documents approved in accordance with the established procedure.

ANNEX 6.

OFFICIAL COMMUNICATION FROM THE HEAD OF WASTE AND ATMOSPHERE EMISSIONS MANAGEMENT
AGENCY



ՀԱՅԱՍՏԱՆԻ ՀԱՆՐԱՊԵՏՈՒԹՅԱՆ ԲՆԱՊԱՀՊԱՆՈՒԹՅԱՆ ՆԱԽԱՐԱՐՈՒԹՅԱՆ
ԱՇԽԱՏԱԿԱԶՄԻ ԹԱՓՈՆՆԵՐԻ և ՄԹՆՈԼՈՐՑ ԱՐՏԱՆԵՏՈՒՄՆԵՐԻ
ԿԱՌԱՎԱՐՄԱՆ ԳՈՐԾԱԿԱԼՈՒԹՅԱՆ ՊԵՏ

MINISTRY OF NATURE PROTECTION OF THE REPUBLIC OF ARMENIA
HEAD OF WASTE AND ATMOSPHERE EMISSIONS MANAGEMENT AGENCY

ՀՀ, 0010 Երևան, Հանրապետության
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№ 5/19.3/1900223

«15» 03 2018թ.

«Ռենկո Արմէստեյտ» ՍՊԸ
գործադիր տնօրեն պարոն Քրիստիան Կուկուտակիին

Հարգելի պարոն Կուկուտակի

Ի պատասխան Ձեր 2018 թվականի փետրվարի 5-ի N42/18 գրության, հայտնում եմ.
Հայաստանի Հանրապետությունում վնասակար նյութերի արտանետումների նորմավորումը կատարվում է համաձայն ՀՀ կառավարության 2012 թվականի դեկտեմբերի 27-ի «Մթնոլորտային օդն աղտոտող նյութերի սահմանային թույլատրելի արտանետումների նորմատիվների մշակման ու հաստատման կարգը սահմանելու և Հայաստանի Հանրապետության Կառավարության 1999 թվականի մարտի 30-ի N 192 և 2008 թվականի օգոստոսի 21-ի N 953-Ն որոշումները ուժը կորցրած ճանաչելու մասին» N 1673-Ն որոշման պահանջների:

Շրջակա միջավայրի վրա ազդեցության գնահատման (ՇՄԱԳ) հաշվետվություններում վնասակար նյութերի մթնոլորտային արտանետումների ազդեցության գնահատումը նույնպես կատարվում է վերը նշված կարգով:

Ըստ այդ կարգի ձեռնարկություններն, որոնց արտանետումներն ենթակա են նորմավորման, հաշվարկում են իրենց տարեկան (տ/տարի) և կարճաժամկետ (գ/վրկ) արտանետումների քանակները և ներկայացնում ՀՀ բնապահպանության նախարարություն անշարժ աղբյուրներից աղտոտող նյութեր մթնոլորտ արտանետելու չափաքանակներ/արտանետման թույլտվություններ ստանալու համար:



Տարեկան արտանետումները հաշվարկվում են պլանային կամ նախագծային հզորությունների կամ արտադրողականության հիման վրա, իսկ կարճաժամկետ արտանետումները՝ վատագույն պայմանների համար, որոնք են՝ առավելագույն արտադրողականությունը, նույն նյութերը արտանետող աղբյուրների միաժամանակ աշխատանքը և այլն:

Արտանետումների քանակների թույլատրելիությունն որոշվում է վատագույն պայմանների համար, համեմատելով արտանետումների ցրման արդյունքում սպասվող գետնամերձ կոնցենտրացիաները սանիտարական նորմերի հետ:

Գետնամերձ կոնցենտրացիաների հաշվարկները կատարվում են ըստ «Ձեռնարկությունների արտանետումներում պարունակվող վնասակար նյութերի կոնցենտրացիաների հաշվարկի մեթոդակարգի» (ՕՆԴ 86), կամ դրա հիման վրա մշակված «Ռադուգա» համակարգչային ծրագրի միջոցով:

Հաշվարկների համար մուտքագրվում են վերը թվարկված վատագույն պայմաններով հաշվարկված կարճաժամկետ արտանետումները, ինչպես նաև կլիմայական պայմանների ցուցանիշները:

Հաշվարկի արդյունքում ստացվում են մի քանի հարյուր կամ հազար կետերում գետնամերձ կոնցենտրացիաներ, որոնցից ամենաբարձրը համեմատվում է նույն նյութերի առավելագույն միանվագ սահմանային թույլատրելի խտության՝ կոնցենտրացիաների (ՍԹԿ) հետ:

Դրա հիմքերը նշված են «ՕՆԴ 86» մեթոդակարգի՝ «1. Ընդհանուր դրույթներ» գլխի 1.4 ենթակետի 1.1. բանաձևի բացատրությունում, ՀՀ կառավարության 2012 թվականի դեկտեմբերի 27-ի N1673-Ն որոշման Հավելվածի Ուղեցույցի աղյուսակ 1-ում, որտեղ տեղադրվում են վնասակար նյութերի բնութագրերը և պարամետրերը, ինչպես նաև՝ «Մթնոլորտի պահպանության միջոցառումների փորձաքննության համար օրենսդրական և նորմատիվամեթոդական փաստաթղթերի ժողովածու»-ի 5 գլուխի 5.2 ենթագլխի 2-րդ կետի 2.1 ենթակետում:

Հարգանքով՝



Մ. Ղազարյան

MINISTRY OF NATURE PROTECTION OF THE REPUBLIC OF ARMENIA
HEAD OF WASTE AND ATMOSPHERE EMISSIONS MANAGEMENT AGENCY

N 5/19.3/1900223

“15”.03.2018

To the chief executive director

Of “Renco Armestate” LLC

Cristian Cucurachi

Dear Mr. Cucurachi,

In response to your N 42/18 letter of 05.02.2018, I inform that,

In the Republic of Armenia, the normalization of hazardous substances emissions is done according to the RA Government N 1673-N resolution requirements of 27.12.2012 on “Establishment of threshold limit values emissions normatives development and approval procedure of the substances polluting the atmospheric air and on consider invalid the N 192 of 30.05.1999 and N 953-N of 21.08.2008 resolutions of the RA Government.

In the environmental impact assessment (EIA) reports the assessment of hazardous substances atmosphere emissions impact is also carried out in the above-mentions procedure.

According to this procedure, the enterprises, of which emissions are subject to normalization, calculate their annual (t/year) and short-term (g/s) emissions quantities and submit to the RA Ministry of Nature Protection for obtaining polluting substances quantities/emission permissions to emit into atmosphere from immobile sources.

The annual emissions are calculated on the basis of plan or project powers or productivity, and the short-term emissions for the worst conditions, which are the maximum productivity, the simultaneous work of sources emitting the same substances etc..

The emissions quantities permit is determined for the worst conditions, by comparing the near-ground concentrations originating from emissions dispersion with the sanitation norms.

The near-ground concentrations calculations are determined according to the “Methodology of calculation of hazardous substances concentrations being in the enterprises emissions” (ОНД 86), or through “Raduga” computer program developed on its basis.

The short-term emissions calculated by the worst conditions listed above are entered for the calculations, as well as climate conditions indicators.

In the result of calculation, in the several hundred or thousand points near-ground concentrations are obtained, the highest one of which is compared with the same substances maximum one-time threshold limit values (TLV).

Its bases are mentioned in the "1.General provisions" chapter 1.4. sub-point 1.1. formula explanation of "ОНД 86" methodology, in the Guideline Annex table 1 of RA Government N 1673-N resolution of 27.12.2012, where the hazardous substance characteristics and parameters are added, as well as in the 5 chapter 5.2 subchapter 2nd point 2.1 sub-point of the "Legislative and normative-methodological documents collection for the atmosphere protection measures expertise".

Best regards,

M. Ghazaryan

Public Consultation Meeting at Yerevan 10th February 2018

1. Invitation letters and newspaper advertisements

Invitation letters for participation at the Public Consultation Meeting were sent to the following institutions/ agencies:

Armenia, 0025 Yerevan, 46 Charents st.
RA Ministry of Nature Protection, 2
Tel: (37411) 81 85 93; /374 91/81-60-55
Silva Ayvazyan (coordinator of Aarhus Center of Yerevan)

Armenia, 0803, Ararat province, Ayntap village
6th street, 47 building
Tel: +374-236-60506
Karen Sargsyan (executive of Ayntap Municipality)

Armenia, 0817, Ararat province, Nor Kharberd village,
Tel: +374-236-60030, +374-93-400122 (cell.)
Kamo Kakoyan (executive of Nor Kharberd Municipality)

Armenia, 0026, Yerevan
26 Garegin Nzhdeh st.,
(Shengavit administrative district)
Tel: +374-11-518808, +374-11-518811
Armen Sargsyan (head of Shengavit administrative district of Yerevan)

Armenia, 0008, Yerevan
87 Sasuntsi Davit st.,
(Erebuni administrative district)
Tel: +374-11-518331, +374-11-518333
Davit Grigoryan (head of Erebuni administrative district)

Armenia, 0015, Yerevan,
1 Argishti st.,
(Kentron administrative district)
Tel: +374-11-514264
Avet Martirosyan (chief of department of Nature Protection of Staff of Yerevan Municipality)

Armenia, 0012, Yerevan,
29 Komitas, 3rd and 4th floors
(Arabkir administrative district)
Tel: +374-10-272007
Sasun Sahakyan (director of Environmental impact monitoring center (Ministry of Nature Protection of the Republic of Armenia))

Armenia, 0010, Yerevan
Republic square, Government House 3,
(Kentron administrative center)
Tel: +374-11-818506, +374-11-818520
Artsvik Minasyan (RA minister of Nature Protection)

These invitation letters had the following content:

Public Consultation Invitation

Dear Mr./Mrs. ...

We inform, that the Ministry of Energy (MOE) of the Republic of Armenia plans to improve the total output capacity of its electric energy production, complementing the power units of the existing Yerevan Combined Cycle Power Plant (YCCPP-1) with a most modern and efficient power plant. For this reason a new gas fired Combined Cycle Power Plant of 254 MW (YCCPP-2) is planned to be built at the site next to the existing YCCPP-1. The MOE wants to provide reliable national power supply, allow Armenia to become a major exporter of electricity, and shift the burden of electricity production from the public to the private sector.

RENCO SPA will be the Engineering, Procurement and Construction Contractor for this Project. The operation of the power plant will be made by ArmPower CJSC, a subsidiary company of RENCO SPA.

The Project has already obtained the national environmental approval from the Ministry of Nature Protection in January 2017. However, the project developer aims to obtain financing from the International Financing Corporation (IFC) and the Asian Development Bank (ADB). Because of this, an Environmental and Social Impact Assessment (ESIA) has been prepared for the YCCPP-2 Project in December 2017 following international best practices.

ArmPower CJSC/RENCO SPA would like to inform all interested authorities and NGO's about the construction of the new YCCPP-2 and the ESIA. Therefore, you are invited to come and join the Public Consultation Meeting at "DoubleTree by Hilton Yerevan City Centre" hotel "Milano" hall, 4/2 Grigor Lusavorich str., on February 10, 2018, at 10:00.

In a short presentation we will introduce the project to you and the general public, talk about possible environmental and social impacts and mitigation measures, and inform you about the grievance mechanism we implemented for the project. After that, in an open questions & answers session, you will have the chance to ask everything you want to know about the project.

Several experts on all different fields will be available to discuss the project and would welcome your comments and feedback.

Comments can also be emailed to: info@armpower.am

or posted to: Yerevan 0010, 10 Vazgen Sargsyan str., 105 office

We would also like to request your support for disclosing the ESIA documents that were prepared for the project, which we attach to this letter. We would like to request you to please post these documents on your official website, and to make the hard copies available at your installations, together with a sign informing people about the existence of these documents.

Thank you in advance for your cooperation and we are looking forward to seeing you at the public consultations.

Best regards,

“ArmPower” CJSC (a subsidiary company of RENCO SPA)

An **advertisement** was published on 17th January 2018 in the Armenian local **newspaper** regarding the invitation to the Public Consultation Meeting with the following content:

Public notice

We inform, that the ArmPower CJSC (an Italian RENCO SPA group company) will begin to build a new gas fired Combined Cycle Power Plant of 254 MW (YCCPP-2) near the existing “Yerevan TPC”, in regard of which the ArmPower CJSC wants to inform all interested citizens about the new plant construction and Environmental and Social Impact Assessment (ESIA). Therefore, you are invited to come and join the Public Consultation Meeting at “DoubleTree by Hilton Yerevan City Centre” hotel “Milano” hall, 4/2 Grigor Lusavorich str., on February 10, 2018, at 10:00. For participating in consultations, free transportation is available from the following locations:

From the front of Ayntap Municipality – at 09:30

From the front of Barekamutyun Metro station of “Hayastan” supermarket (exit)- at 09:30

From the front of Shengavit administrative district – at 09:30

From the front of Erebuni administrative district – at 09:30

2. List of Participants

	Name	Surname	Occupation
1	Boris	Ohanyan	
2	Qnarik	Hovhannisyan	Independent expert in water resources
3	Lala	Tevosyan	Social and technology academy
4	Emil	Sahakyan	Energy expert
5	Aram	Grigoryan	"Arsar" center
6	Suren	Sargsyan	"Golos Armenia" newspaper
7	Kristy	Harrison	ADB
8	Ashot	Mirzoyan	"Consumers Support Center"
9	Zoya	Beniamonovaya	"Consumers Support Center"
10	Karen	Chilingaryan	"Consumers Support Center"
11	Arsen	Hazarapetyan	Yerevan municipality
12	Silva	Ayvazyan	"Aarhus Center Yerevan"
13	Ruzanna	Ghazaryan	
14	Vram	Tevosyan	"Consecoard"
15	Eduard	Arzumanyan	"Consumers Support Center"
16	Samvel	Khachatryan	

3. Minutes of the meeting

MINUTES

OF PUBLIC CONSULTATIONS

ON ESIA REPORT REGARDING YCCPP-2

OPENING REMARKS:

Mr. Sargis Grigoryan:

I welcome you all at this Public Consultations. Thank you for attending it. I wish all of us a fruitful meeting.

Ladies and gentlemen, the purpose why we have gathered is to conduct public consultations on the activities we have so far carried out in relation to the Environmental and Social Impact Assessment for Yerevan Combined Cycle Power Plant 2. I would like to emphasize the importance of the project for the Republic of Armenia, as it will ensure very efficient cooperation among the Asian Development Bank, the International Finance Corporation and the Government of the Republic of Armenia. The Renco Group in cooperation with Fichtner, German company, has conducted an Impact Assessment which will be presented to you today. It will be our pleasure to address your recommendations and remarks. First I would like to give the floor to Mr. Michele Arcangeletti, the Industrial Plants

Division Director at Renco S.p.A., to address an opening for this event. Afterwards, Mr. Detlev Paulsch, Fichtner representative, will present the Impact Assessment. A Q&A session will follow the presentation, and you will be welcome to provide us with your remarks and opinion. This is our agenda. Please feel free to ask any question on the agenda. If there is no question, we should start.

Mr. Michele Arcangeletti:

Buongiorno a tutti! First of all, I thank you all for attending this event, which relates to a stage of enormous importance to our project. I would not like to get into much technical detail regarding the project, as such detail will be presented by our colleagues. I will also skip the contractual matters surrounding the project, as it is long time you have the opportunity to get the respective information through various websites. I will address all your questions answers to which you have probably not found in the information published so far. The points I am going to make will help appropriately present the philosophy and vision of the project. If I were sitting among you, on that side, I would probably be interested in getting the answers to the following four main questions. First, it would be the question: "Who will implement this project?"; second, it would be "Why this is being implemented? What is the aim pursued by the one who has assumed the implementation?"; third: "How well or how bad will the project be implemented?"; And the fourth question I would address if I were you would be: "What will be the benefits of the project for the society at large, for the surrounding people?"

Let me start with the first question about Renco and its activities. I will try to be short to save our time for the discussions. Renco is an Italian company, born in Italy and with its headquarter in Italy, namely in Pesaro. About one hundred percent of Renco's activities are carried out abroad Italy. Now about the philosophy of what we do. Renco is not the company which enters a country for specifically one project and quits it after implementation of the project, nor is it the company which enters a country as a tourist. Wherever Renco operates, it makes that particular country its home. That is to say, Renco brings its huge expertise to that country and takes from there some of the country's experience, skills, and culture. This is the same philosophy of when a person makes its home bigger or when he builds a new home elsewhere. And this very philosophy is proved by the fact that twenty years ago Renco came to Armenia for its first project and stayed here for all these twenty years. Renco still operates here, implementing various projects, makes investments, and feeling home. Renco has become, so to say, an Armenian company, operating under the name RENCO ARMESTATE. Thus, I would like specifically highlight that we have extended the idea of what is our home. This concept leads to an answer to the second question, which, as you might recall, refers to the reason why we have undertaken the implementation of this project. Because when one extends the area of its home or when he builds home elsewhere, he has to consider two aspects, technical and moral. The technical considerations relate to the durability of what one builds, as he wants to live for a long period. So, one has to exert maximum of his efforts to build it in a perfect manner. After, one has to be considerate and to build good relations with the neighbors on a mutuality

principle, trying to have good impact on the neighborhood. And if one wants to live well and to feel good where he lives, he cannot do it alone, but he can achieve it when the neighbors also live in tranquility and happily. Last but not least, one has to preserve and have good impact on the environment as much as possible. All these considerations lead to answering to the third question. How well will we implement this project? Is it environmentally safe? Let me give you some background to help you better understand these matters. First, one of the most important guarantees for quality is that our project must be viable for quite a long period, meaning that the project must operate well, be implemented with high quality and flawlessly, at least for twenty years, so that we can enjoy the fruits of our investments. This is why our choice of the technological partner was Siemens, a world technology giant having the experience of generating numerous gigawatts of energy all over the world. Our choice has also been conditioned by that Siemens agreed to enter into the project as a partner, as a shareholder, which fact is an additional guarantee for the minimum twenty years of viability of our project. The engagement of Siemens in the project is itself a guarantee for us, for the project. Second, as to the issue whether the project is environmentally-friendly, whether all relevant studies and expert examinations have been carried out, we have carried out double examinations to be sure that everything is appropriate in that regard. The first ESIA has been carried out by an Armenian organization, so that we also comply with the Armenian laws and regulations regarding the expert examinations. Afterwards, we also undertook the second impact assessment, not because we did not trust the assessment of the Armenian company, but because we also have international investors and we needed to comply with the international standards required by them. Mr. Detlev Paulsch will present in detail how that assessment has been carried out. The reason why we undertook the second assessment is also that, apart from the international standards, we wanted to double check for our comfort that everything goes as it should. Almost every day, and even yesterday, we visited the site to make sure that we did not overlook or miss any detail. Whenever we took samples, even if the laboratories issued positive opinions, we conducted double examinations, not economizing on any resources for that purpose. The logical continuation of these environmental principles I was presenting is the answer to the last questions, which I would like to have addressed if I were sitting there among you. What is the positive impact that the project will have on the community and the surrounding environment? First of all, the project will create 400 new jobs throughout its construction and operation periods. To note, this is not a short project, and following the construction, the project will operate for another 20 years. This means that throughout the whole period of operation, the project will guarantee over 100 jobs. An added value is that these employees will acquire new skills and expertise, not only in Armenia, but also abroad, with the help of Siemens' specialists. Last but not least, during the construction period, millions of dollars will be circulated through transactions for provision of services, acquisition of materials and goods. I hope the answers to these four questions have provided with some introduction to the project. Now I am pleased to give the floor to Mr. Detlev Paulsch, who represents the German company Fichtner having conducted the assessment.

PRESENTATION ON THE ESIA:

Dr. Detlev Paulsch presents the overview and main details of the Environmental and Social Impact Assessment for the project, including main possible impacts and respective mitigation and monitoring measures as well as different aspects of future public participation during the Project, including the Grievance Redress Mechanism.

Q&A SESSION:

Mr. Sargis Grigoryan:

Thank you Mr. Detlev Paulsch for the detailed presentation. I also want to thank for the enormous work that has been done. Particularly, I would like to highlight the introduced dispute settlement mechanism for addressing the complaints. This is highly important in the Republic of Armenia. I also want to refer back to Mr. Michele's opinion, which I share, regarding neighbors and home. The approaches of the Italians and the Armenians towards this matter coincide, with no doubt, so there can be some synergy in terms of style of working and the implementation of the project. I also want to emphasize the degree of Renco's social and other responsibility, which is another important quality for an investor who will make investments and implement a project in Armenia. Now, let's commence the final section, the Q&A. I am sure you all have questions, but please take into account that everyone should be provided with the opportunity to address questions and to have these questions answered; therefore, please consider that we have time limitations and address short questions, and we in our turn will try to give short and precise answers to them. I assure you in case of further questions which will not be addressed now, the whole time will be ready to attend any matter you will later raise. Using my privilege of the moderator, I would like to start with the question of Mr. Aram Grigoryan, as he has raised some matters during the coffee break.

Question 1:

Mr. Aram Grigoryan, representative of the Armenian Technological Academy:

- Thank you for this opportunity and for the detailed presentation, which enabled us to have some understanding of the preparatory works and of the further steps. I have several questions.

Mr. Sargis Grigoryan:

- Please, mind the time constraints. Please, stick to the "one question" principle. Each person addresses one question, then at the end we will come back to the questions which remained unaddressed.

Mr. Aram Grigoryan:

- OK! But I want to note, this is not my question, that we have gathered today for consultations, but why we do not have here the representatives of our Government so that to address some of the questions to them. All what you have told us today has been rather clear, but an important matter that has been and is still unaddressed: “Was there a true necessity for commencing such a transaction, for the construction of a new thermal power plant?” But this is a question which I believe should not be asked to the speakers. Anyway, I will address one question to the speakers: “What standards, e.g. European or some other standards, have been applied for project in general?”

Mr. Sargis Grigoryan:

- Since the main topic of our today’s event is the environmental aspects, I am sure you mean the ESIA. If we talk about the project in general, then it would be outside the scope of the subject of today’s meeting. Therefore, I will ask Mr. Detlev Paulsch to answer this question.

Dr. Detlev Paulsch:

- We have used two types of standards. First, the national standards, which are defined in different decrees and regulations of Armenian Government. Second, we have used international standards, which are defined for example by IFC, ADB or the World Bank. The strategy is that always the stricter one of these standards has been included in our assessment.

[One of the participants attempts to correct the interpreter’s comment in relation to the translation of the word “stricter of the standards”; Mr. Sargis Grigoryan asks the participants not to make additional comment so that each question receives its proper answer; Then, Mr. Detlev Paulsch continues]:

- And where, for example, no national standard exists, international standards are used.

Question 2:

Mr. Ashot Mirzoyan, president of the Consumers Support Center:

- Welcoming your style of working, not trusting our Government, I would like to touch upon one point. Among the objectives, you have mentioned shifting of the financial burden for power generation from the government to the private sector. Please specify how you plan to do this, as the years of practice shows that at the end everything rests on the shoulders of the end-users, through an increase in the tariffs. What is the mechanism?

Mr. Sargis Grigoryan:

- I have just noted that the subject of today's public consultations is Environmental and Social Impact Assessment; therefore, please ask questions related to this topic, and we might later discuss some global strategical questions for example during a coffee break or maybe we will provide additional clarifications later. So, please stick to the objective and format of today's event.

Mr. Ashot Mirzoyan:

- I am sorry but you have mentioned this among your objectives.

Mr. Sargis Grigoryan:

- The objective of today's meeting is the environmental impact, and the whole presentation made by Mr. Detlev Paulsch was aimed at this very topic. So, please stick to the format.

Question 3:

Mrs. Qnarik Hovhannisyan, independent expert in water resources:

- My question relates to water resources. From these reports, I could not finally understand what resources will be used to have the monthly water quantity of 300 000 m³. Surface water or groundwater? What you mean by potable water is the water supply system? Then why you mention underground water? In short, what water is used for water supply?

Mr. Sargis Grigoryan:

- Mr. Michele has just pointed to me that we have received confirmation that water use will not have any negative impact on the consumers. Now, as to your question, I will translate and ask Detlev to answer it quickly.

Dr. Detlev Paulsch:

- The water to be used for the operation of this power plant is taken from the Yerevan Water Grid/ Network. And there are agreements already in place with the water provider that this amount of water can be taken, and this will be no problems for other water users.

Mr. Michele Arcangeletti:

- You have asked a question very much to the point, relating to our concerns with the decrease in the levels of underground water. There has been a recommendation to decrease the levels of underground water. The guidelines for the international standards require that when digging is done during construction works, it should be verified and made sure that

there is no negative impact on the level of underground water. But at this point, there is not such a plan. This is just, as you said, a hypothesis that if we choose that option, we will conduct additional studies to mitigate the impacts.

Mr. Michele Arcangeletti:

- I would like also to come back and answer to the previous question about Tariff, remembering anyhow that the Frame Work Agreement between Government of Armenia and ArmPower is a public document. As to the previous question on financing, as you know, we do not have any mechanism of influence on the tariffs. There is special authority, which regulates the tariffs, and as you know, this authority is the Public Services Regulatory Commission. Nor we have any say in the energy balance for the upcoming twenty years, in the quantity of energy that will be required to be generated. The thing that is indeed within the scope of our competence and that is the primary objective of our company is to invest our reputation and our expertise to be able to introduce respective technology and to attract respective financial resources, in addition to our resources, to attract respective loans due to our reputation, to be able to build this very efficient power plant.

Mr. Gegham Baklachev:

- Answering to Mr. Ashot Mirzoyan about question on Tariff: Sorry, why do you address this question to us? You should address this question to the Public Services Regulatory Commission; you are a member of that Commission!

Mr. Edward Arzumanyan:

- You just tell me whether what the [tariff] will be in the first year, fifth year when the plant operates. I have addressed a question in writing, but have not received an answer.

Mr. Sargis Grigoryan:

- I ask you to stick to the format of our meeting and respect each other. As to the tariffs, I should repeat that it is outside the scope of our today's meeting. Anyway, we always there ready to fully answer questions. Please, next question, Mr. Arzumanyan. One question, one answer. There are time constraints.

Question 4:

Mr. Edward Arzumanyan, energy sector expert, Consumers Support Center NGO:

- Since the questions on use of underground water have already been addressed, but the answers were not satisfactory, I now ask another question which is the most topical one for me at this point. We already have the bad experience. Since 2010, when the first Yerevan Combined Cycle Power Plant's 1st block, which is now next to your territory, was commissioned, we have received alarms that the temperatures of gas emitted by the plant exceed 200°C. Please answer whether in the normal operational mode or in case of 100% or 50-60% load, which is quite a possible scenario for the Armenian energy system, what will be the temperature of the emitted gas? I have more questions, but if I am to ask just one question, then this is my only question for now.

[Following the question, there starts a conversation regarding the questions of Mr. Arzumanyan which have allegedly been sent but remained unaddressed. Mr. Grigoryan says the responses have already been sent, but they will be resent if needed. Mr. Arzumanyan says he had received the response, but it referred to some websites. He says there is a question the answer to which has been left blank. Mr. Grigoryan says this is a technical matter, which will be clarified with Mr. Arzumanyan after the meeting, and clarification will be refurbished, if necessary.]

Dr. Detlev Paulsch:

- The temperatures of emissions at the stack will be 97° C. This temperature and also the emissions will be monitored during the operation. They are below the national and international limits. This is also the case, for example, for the emission of CO₂. This will be also within the range of typical CO₂ emissions which are provided by the IFC international guidelines.

Question 5:

Mrs. Qnarik Hovhannisyan:

- I am concerned with the issue of contamination. You have written here that wastewater treatment plants will be built. What type of plants are these: mechanical or biological? Do we comply with the required norms or not?

Dr. Detlev Paulsch:

- There will be a wastewater treatment plant constructed on site. This will be part of the new power plant. And all this industrial wastewater will be led to this treatment plant. The water that leaves this plant will be

monitored in order to adhere to all limit values. And then this wastewater will be led to the existing discharge structure of YCCPP-1.

Mrs. Qnarik Hovhannisyan:

- So, is this a mechanical or biological plant?

Dr. Detlev Paulsch:

- It will be both. There will be mechanical clearing, for example, for some oil contents. And there will also be biological clearing.

Question 6:

Mr. Tevosyan Vram, Consecord LLC:

- Please specify how you are going to calculate the quantities of outflowing water. Will there be calculation or some metering device for clarifying the quantities?

Mr. Michele Arcangeletti:

- Usually the outflowing water quantity cannot be more than the 300 000 m³ of water that will flow to the power plant. Anyway, usually when designing such power plants, the preliminary data calculations are very precise, very close to the reality.

Dr. Detlev Paulsch:

- This blowdown water will also be led to the wastewater treatment plant.

Question 7:

Mrs. Silva Ayvazyan, representative of Aarhus Center Yerevan:

- I would like to make some slight clarification. It has been mentioned that you cooperate with Aarhus Center Yerevan, but I do not know why it has been mentioned as NGO. To note, our organization is not a non-governmental organization, but is a public environmental information center. Yes we have met with representatives of Fichtner and we have promised that we will support in this public participation process. We have posted the draft on our website and have disseminated it among the public as much as possible. The interested parties are present today. This is all for the clarification part, and I also want to address a question to the representatives of Renco. The draft here mentions that the monitoring data will be coordinated with the Monitoring Center of the Ministry of Nature Protection, and thus the contamination data will be made publicly available. However, there are numerous modern technologies, innovative

mechanisms, which particularly make the information transparent. For example, the company might create its self-regulation mechanism and introduce devices for making the data available to the public online. I mean, can we expect the availability of such data on your website?

Dr. Detlev Paulsch:

- This will be an ongoing process throughout the construction and also the operation of the plant. So, there are different aspects. For example, the Emergency Preparedness and Response Plan will have to be developed/ sent also with/ to the communities. Furthermore, there will be information done by Renco, probably on their website, showing the ongoing process and showing the adherence to limit values and the implementation of the mitigation measures. This is all part of the Stakeholder Engagement Plan, which is also one part of our study. And also another aspect is the grievance redress mechanism, where during the construction and also during the operation people can send their concerns or their questions to the companies.

One of the participants makes a clarification with regard to Mrs. Silva Ayvazyan's question:

- "Sorry, I think she was wanting to know if the monitoring data that will be collected will be collected automatically, and then put on the website at the same time. So, automated monitoring. I think she means gas and water discharges.

Dr. Detlev Paulsch:

- To have these data also online is a good suggestion, which will be taken into account by Renco. And the monitoring data will be sent, in form of quarterly reports, to the Ministry of Nature Protection and to the other stakeholders.

Question 8:

Mr. Ashot Mirzoyan:

- "A Waste Management Plan which shall include a risk assessment..." etc. The world is progressing. Why do we store the waste? Let's just handle this waste. I want to make a recommendation to Fichtner. There are numerous technologies in the world for waste disposal. Why do we store and thus contaminate? There are technologies for disposal, if you are interested, we can send, if you do not know of them.

Dr. Detlev Paulsch:

- This Waste Management Plan I was talking about will, of course, follow some suggestions. This will follow waste management hierarchy, which is first to avoid any waste. If this is not possible, try to reuse or recycle. If all this is not possible, this will probably be disposed [*here the interpreter translates as "properly stored"*]. We will not have any contaminated waste.

Mr. Sargis Grigoryan:

- Let me sum up. What Mr. Detlev said, is that there will be a Waste Management Plan, which will generate solutions depending on the different types of waste.

Question 9:

Mr. Edward Arzumanyan:

- You have mentioned that there will be no contaminated waste in the plant. Does this mean that the plant will not have a chemical plant for water treatment? If there is a chemical treatment plant, then contaminated water or wastewater will be discharged from there. This is a point with regard to the previous question which needs clarification. Now, my question. You have a heat recovery steam generator. How many sections does it have: one, two, or three?

Mr. Gegham Baklachev:

- We kindly ask you to address these questions in writing, so that we give you a detailed and precise answer.

Question 10:

Mrs. Ruzanna Ghazaryan, "Dalma-Sona" Cultural and Educational, Social and Ecological Foundation:

- I wish all the success to the project. The project area, as I can judge at first sight, is located within the Erebuni-Arin Berd line. We all know that the Armenian land is really old, unpredictable. Maybe, no historical and cultural sight has been discovered at the area during the Soviet period, but I believe there is huge probability that something might be discovered there. It has been mentioned that a proof of occurrence/absence of any cultural or historical goods will be requested from the Ministry; however, if for example some 3000-year-old cultural monument is discovered, are you ready to abandon the project at all?

Mr. Gegham Baklachev:

- Such matters are always our focus. In our case, there will be no deep digging, but if anything valuable or unusual for the soil structure is discovered, we will inform both you and the Ministry of Culture. It will be our great pleasure to cooperate with you.

Dr. Detlev Paulsch:

- First of all, the area we are talking about, there has been some kind of earth work in the past. So probably there will be no cultural goods found anymore. But the Ministry of Culture shall be informed before the project, in order to give them the possibility to have a look at this area. And during the construction, as I said before, there will be a Chance Find Procedure. This means that if any cultural goods will be found during the construction works, during earth works, then the Ministry of Culture has to be informed about it and they have to decide on the future steps.

Mr. Sargis Grigoryan:

- Mr. Detlev Paulsch's statements are fact-based. Let's stick to the facts. The fact is that currently there are no cultural and historical goods, but if there will be such, a proper plan will be in place. As to the termination or abandonment or continuation of the project, it depends on the particular event that will occur, the goods that will be found, and on the possibility to further implement the project. Answering your question now and saying that we will or will not terminate the project, I think will be an unprofessional attitude on our part. Thank you.

Mr. Michele Arcangeletti:

- These engineering and geological studies carried out so far, do not give room for assuming that there will be any chance finding. But if we have the chance to detect anything of true historical and cultural value, we will be really happy and we will not make any decision independently, but will engage the respective authorities and the civil society. Let's hope that the big treasure, as you said, will be found not in the project site but in the vicinity. In that case we all will be happy.

Question 11:

Mr. Ashot Mirzoyan:

- The question relates to the gases. Based on what you said, the technology is quite clean and environmentally-friendly; however, please explain how it happens that the gases are so clean. Is this due to special filters or a well-developed deep combustion process?

Dr. Detlev Paulsch:

- Of course, this will be state-of-the-art equipment that will be installed there, including filters and, for example, low NOx burner to reduce the emissions. As you know, the stack will be 66 meters high. We calculated different scenarios for different stack heights, showing that this 66-meter stack height will have least impact on the residential areas and also showing that all national limits and all the international limits are adhered to and are not exceeded. And of course, there will be a monitoring system installed to monitor continuously the emissions.

Mr. Michele Arcangeletti

- The technology to be used will be supplied by Siemens, and their technology is internationally approved. Siemens plays a primary role in the world in this regard. There are just a few companies in the world competing with Siemens. This competition makes these companies to invest enormously in minimizing the hazardous emissions. And there is no wonder that by the time the emissions are less risky, less hazardous. These companies are global players, and they know that in order to sell their equipment on a worldwide basis they have to pay ever more attention to environmental aspects, to lower the emission levels, and to make their equipment more efficient. Knowing well that the environmental awareness of people is continuously raising, these global producers do not simply focus on profits, but on making their equipment more efficient and more environmentally friendly. As you know, Siemens is a German company. The Italians, whenever they learn that the used technology is German, they get the ultimate trust. When we were to choose the technology, we again relied on Siemens, relying also on the information provided by Siemens with regard to the parameters of the equipment.

Question 12:

Mr. Emil Sahakyan, energy and nature protection sector expert:

- I think the work you have done is extensive, useful and exhaustive. I have just one question. Will the main equipment in the newly built thermal power plant be different from the existing ones? And also, will their impact in terms of the water discharges be different, given that the two blocks will use the same system, which discharge the waters into Hrazdan River?

Dr. Detlev Paulsch:

- It is planned to use the existing discharge structure of the YCCPP-1, and the treated wastewater from the new power plant will be led to this discharge structure with pipelines and channels leading finally to Hrazdan

River. But it is important to mention that we will have our own wastewater treatment system in this new plant.

Mr. Michele Arcangeletti:

- The Monitoring Plan will be applied to our own wastewater system. Though the infrastructure is shared, but the monitoring plan will help clearly distinguish how wastewater from our plant is treated. As to the equipment, the existing power plant uses the main equipment produced by General Electric, whereas we will use the equipment produced by Siemens. So they will be different.

Question/recommendation 13:

Mrs. Yepremyan, interpreter at ADB:

- Actually I live in Shengavit District, so this issue is quite relevant for my family. My recommendation or question will be as follows. As part of the mitigation plan, do you envisage any type of landscaping for particularly Shengavit and Erebuni Districts, like tree planting or maybe establishing some small green oasis within these two districts, because the districts are also very poor in vegetation?

Dr. Detlev Paulsch:

- It is foreseen to have a landscape management plane at least near to the power plant. But it is a good idea to also include your recommendation in this plan.

Mr. Gegham Baklachev:

- I would add that we cooperate with the landscaping department of Yerevan Municipality, and we participate in Community Cleanup Days and tree planting events in different parts of the city. This is a good recommendation. We will further focus our attention on the cooperation with the district administration offices. We are already in direct contact with them. For sure, we will implement landscaping activities.

Question/recommendation 14:

Mr. Ashot Mirzoyan:

- I just suggest that Renco to engage the Consumers Support Center as much as possible in relation to the grievance redress mechanism. We are receiving numerous complaints with regard to the road construction project with the Asian Development Bank. The practice shows that if we work in collaboration, the results are more efficient for you and for us. As

to the landscaping projects, we are always ready to help with our volunteers, etc. Thanks.

Dr. Detlev Paulsch:

- As I showed before in the grievance mechanism scheme, there is always the chance to place the grievance indirectly, e.g. with the support of NGOs, who will then direct the grievance to the risk manager at Renco.

Mr. Gegham Baklachev:

- I would like to add that it will be our pleasure to collaborate. Maybe after the event, we can exchange ideas on an additional mechanism.

CLOSING REMARK:

Mr. Sargis Grigoryan:

- Ladies and gentlemen, thank you all for your presence, your participation and for your recommendations, which are really important to us. I am sure this will not be the only such event. We are always ready to cooperate with you on different matters. We highly estimate your opinion and your recommendations. Please always feel free to approach our team, should you raise any matter. We are always here to help.

Mr. Gegham Baklachev:

- One more point regarding the earlier questions on tariffs. There is the Framework Agreement with the Government, which is publicly available, and is posted on the website of the Ministry of Energy. If you wish, we can supply it to you. There you will find the tariffs and all the relevant provisions of the agreement.

Mr. Michele Arcangeletti / Dr. Detlev Paulsch:

Thank you to everyone.

COFFEE BREAK:

During the coffee break, Mr. Edward Arzumanyan received answers to some of his questions and was informed that additional response had been sent to him the day before. Hard copy of the responses has been supplied to him.

Public Consultation Session - 10.02.2018 - Photo documentation





