Environmental and Social Impact Assessment Final Report

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ARM: Yerevan Gas-Fired Combined-Cycle Power Project

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Final Report
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Yerevan 2 CC Power Plant ArmPower CJSC

Environmental and Social Impact Assessment – Final

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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 SO_2, NO_2 and PM_{10}. 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 ESIAs 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

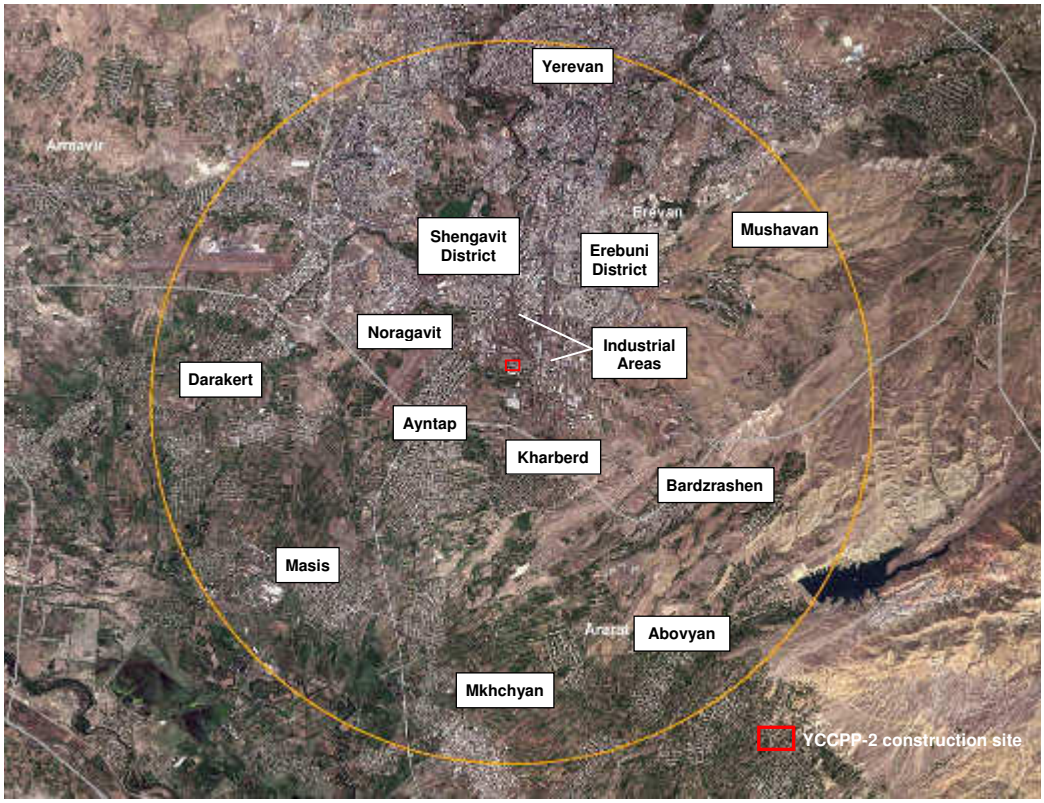
- New connection to the natural gas supply pipeline system from Gazprom Armenia, approx. 1,500 m (under responsibility of Gazprom Armenia)
- New connection to the city water system managed by Veolia (make-up water), approx. 1,000 m
- New connections to the water sewerage of the city, approx. 450 m
- 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 NOx 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 (5^{th} 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 objects[1] 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 Jrants 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 vulenrability 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 PM_{10}, SO_2 and NO_2.

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 objects[2] 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 financers (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 financers (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	o
Soil Use and Soil Erosion	■
Soil Contamination	■
Surface Water	o
Groundwater deviation	(still unknown - see ESAP)
Groundwater contamination	■
Climate and Air Quality	■
Landscape and Visual Aspects	■
Waste	■■
Local Workforce	+
Land Use and Ownership	o
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	o
Soil Contamination	■
Water Courses	■
Groundwater deviation	(still unknown - see ESAP)
Groundwater contamination	■
Climate and Air Quality	■
Landscape and Visual Aspects	o
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	o
Soil Use and Soil Erosion	■
Soil Contamination	■
Surface Water	o
Groundwater contamination	■
Climate and Air Quality	■
Landscape and Visual Aspects	■
Waste	■■
Local Workforce	+
Land Use and Ownership	o
Historical and Cultural Sites	o
Occupational Health and Safety	■
Community Health and Safety	■
Noise	■

Significance of Impact:

■■■	=	high
■■	=	medium
■	=	low
o	=	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 objects[3] 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 vulenrability 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 is 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 outmost 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
- Consecoard 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 SO_2, NO_2 and PM_{10}. For gases (SO_2 and NO_2), 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 NO_2 resulting from the operation of YCCPP-2 are expected. For particulates (PM_{10}), 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.

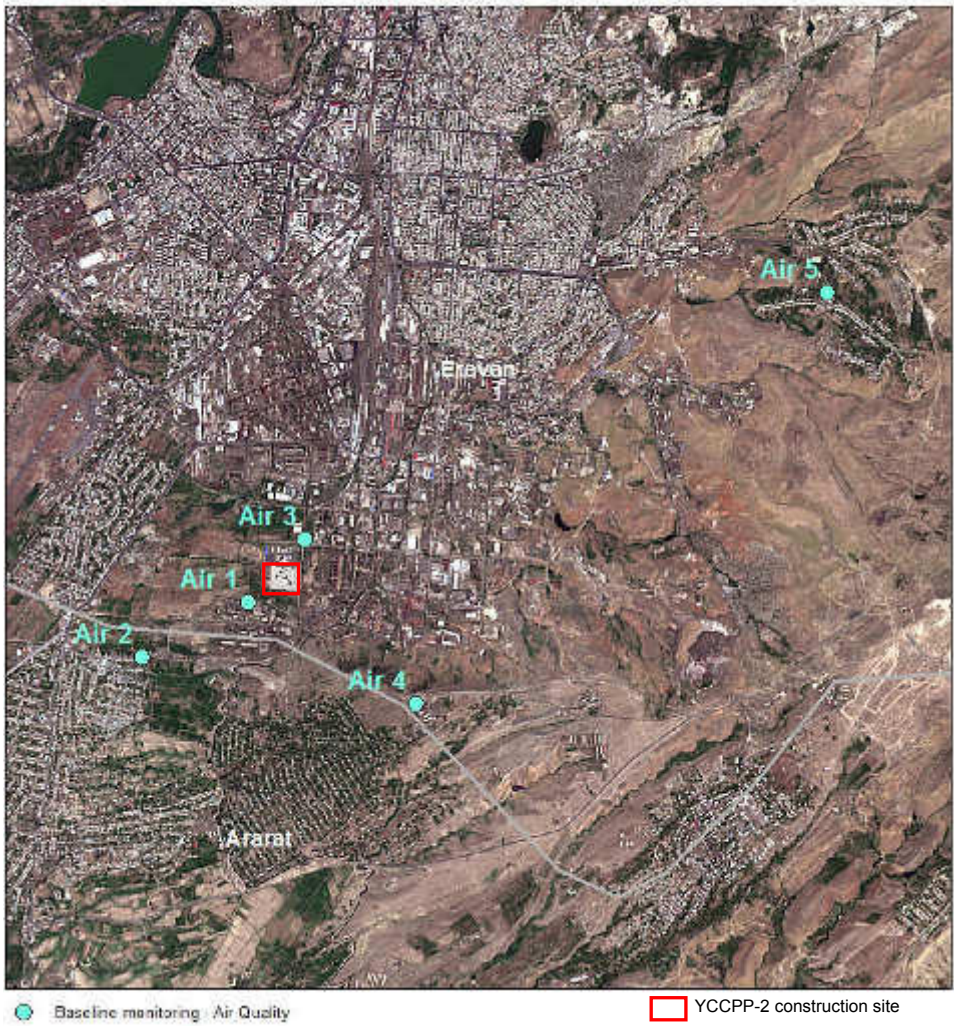


Figure 1-2: Baseline Monitoring Points - Air Quality

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).

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.

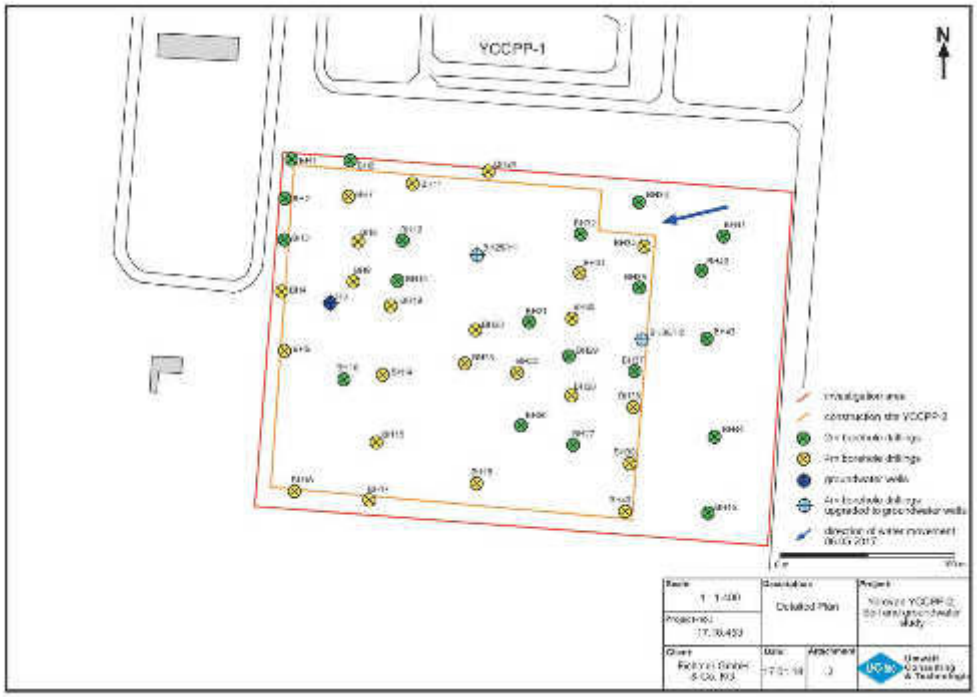


Figure 1-4: Baseline Monitoring Points - Soil and groundwater (November 2017)

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 Impact**s 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	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: - 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	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. Types of environmental protection fees are payments: - 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. Types of environmental usage fees are payments: - 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	The subjects of that law are: - 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	That law provides RA state policy regarding conservation, protection, reproduction and use of species of wild fauna. The subjects of that law are: - 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. Responsibilities of different organizations, including government, ministries, state bodies, local self-governmental bodies are envisaged by that law.	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	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. 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.	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	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. Vital principals of water resources management are: - 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 E**S**IA 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 ESIAs 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 irks 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 or 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

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'.
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).

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/Nm3
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/Nm3
NO_2	51 mg/Nm3
UHC	10 mg/Nm3
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 [µg/m³]	
			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 are not be used in the present ADC, and focus will beis provided on CO and NO2.

Although PM_{10} and SO_2 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 NO_2 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 [µg/l]	Intervention value [µg/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 [µg/l]	GrwV [µg/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
Natrium	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 than16	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):

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

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]
ICNIRP recommends for 50/60 Hz:		
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
Limit values according to the European Directive 2013/35/EC	10,000	500
exposure of workers		

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:

- $T_{[hrs]} = 50/E - 2$
- E = 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		
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. The Impact assessment and the ESMS apply to all the project activities. Corresponding details are given for each applicable Performance Standard.		• 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		
Social risks and impacts are assessed and necessary actions are managed through the ESMS (see Performance Standard 1). The scope of application is direct workers (engaged by the client) as well as contracted workers (engaged by third parties).		• 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.
Provide reasonable working Conditions and Terms of Employment (eventually regarding collective bargaining agreements)	• ILO – Convention On Collective Bargaining	• 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	• EHS - 2.2 Communication and Training	• RA Labor Code Chapter 7, Article 43
If accommodation services are provided, a reasonable policy regarding their quality is provided		• 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	• ILO – Convention on Freedom of Association and Protection of the Right to Organise	• 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	• 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	• 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		• RA Labor Code Chapter 15
Provision of a Grievance Mechanism for workers	• ILO - Convention on Labor Administration	• 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	• ILO - Convention on Worst Forms of Child Labor • ILO – Convention On Minimum Age • UN – Convention on the Rights of the Child	• RA Constitution, Article 32
Not employ forced labor	• ILO - Convention on the Forced Labor • ILO - Convention on Abolition of Forced Labor	• 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	• 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	• 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)		• 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)	• 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)	• 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		
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	• EHS - 1.3 Wastewater and Ambient Water Quality • EHS - 1.4 Water Conservation • EHS Guidelines for Thermal Power Plants: 1.1 Water Consumption, Effluents	• 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"
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	• EHS - 1.6 Waste Management • EHS Guidelines for Thermal Power Plants: 1.1 Solid Wastes	• 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		
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. The production, transportation, handling, storage, and use of hazardous materials for project activities should be assessed	• 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)	• 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)	• EHS Guidelines for Thermal Power Plants: 1.3 Community Health and Safety	• 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	• EHS - 3.2 Structural Safety of Project Infrastructure • EHS - 3.3 Life and Fire Safety (L&FS)	• 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	• EHS - 3.5 Transport of Hazardous Materials	• 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	• EHS - 3.1 Water Quality and Availability	• 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	• EHS - 3.7 Emergency Preparedness and Response	• 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)		• 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	• 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)	• 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.

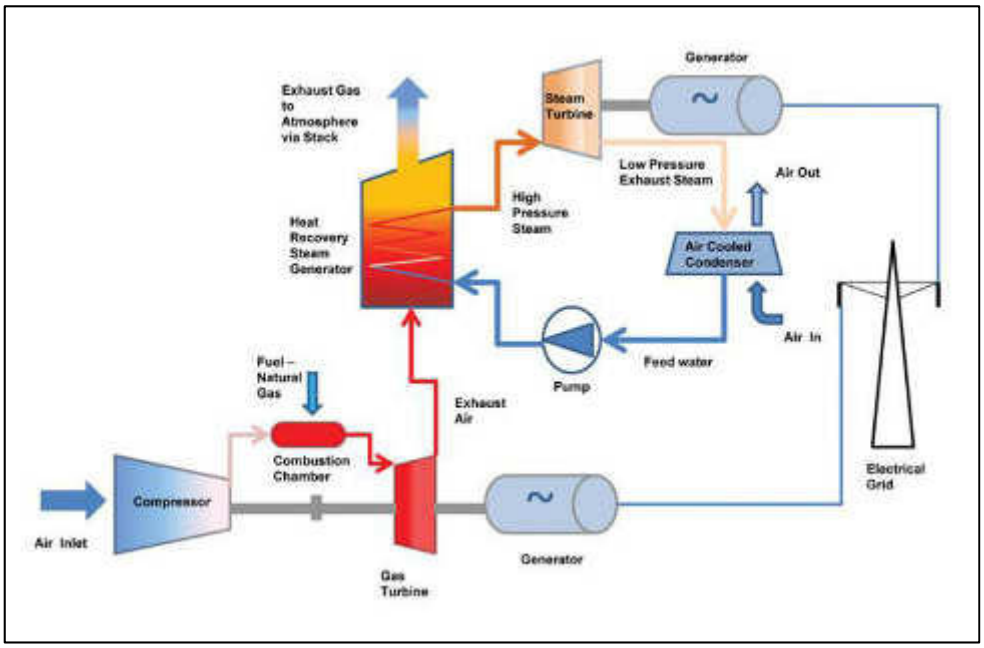


Figure 3-1: **General design of a Combined Cycle Power Plant** [5]

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%

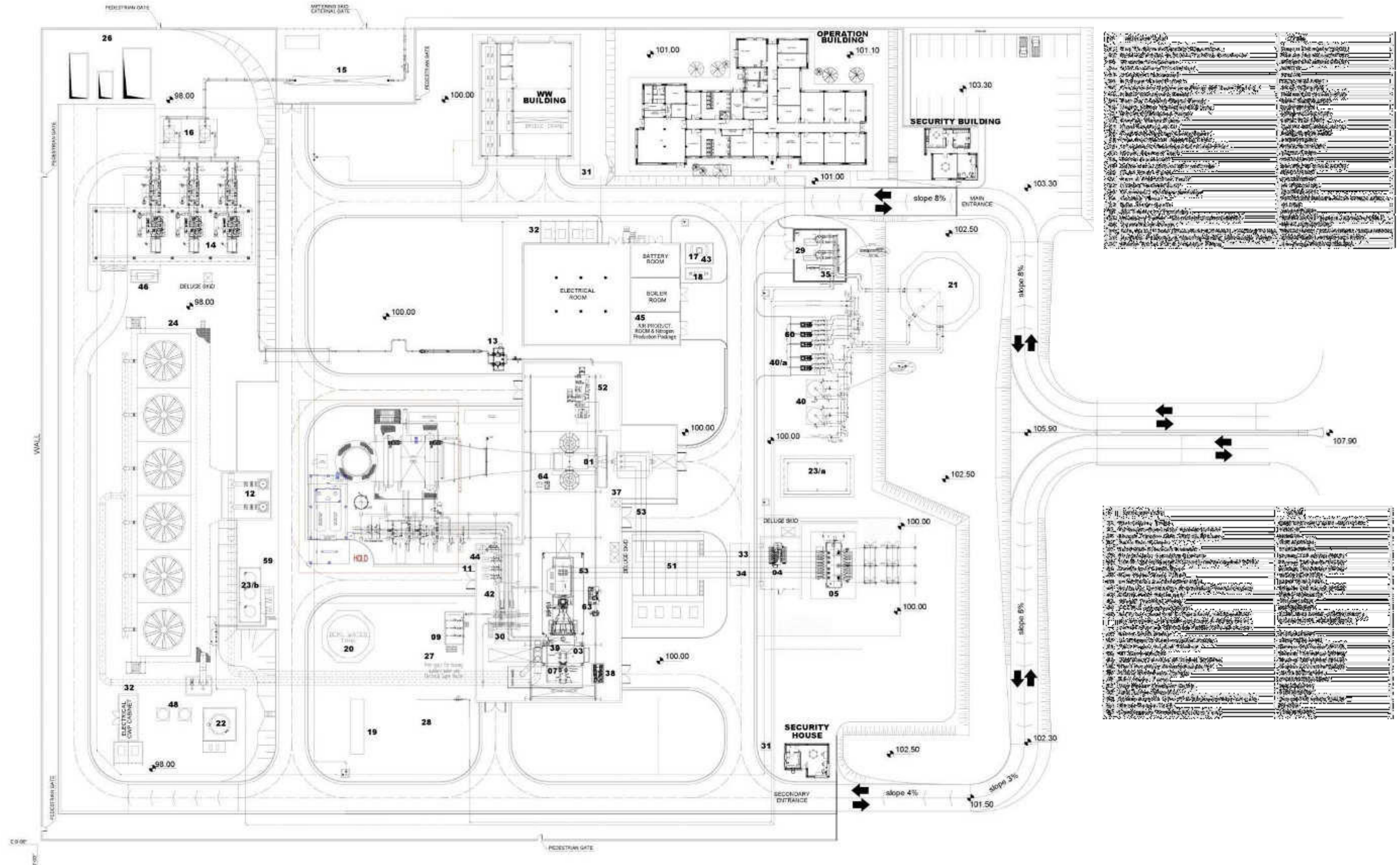


Figure 3-2: YCCPP-2 Key Plan (Source: RENCO SPA)

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 NOx 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 NOx type to keep NOx 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 mgO_2/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 O_2 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

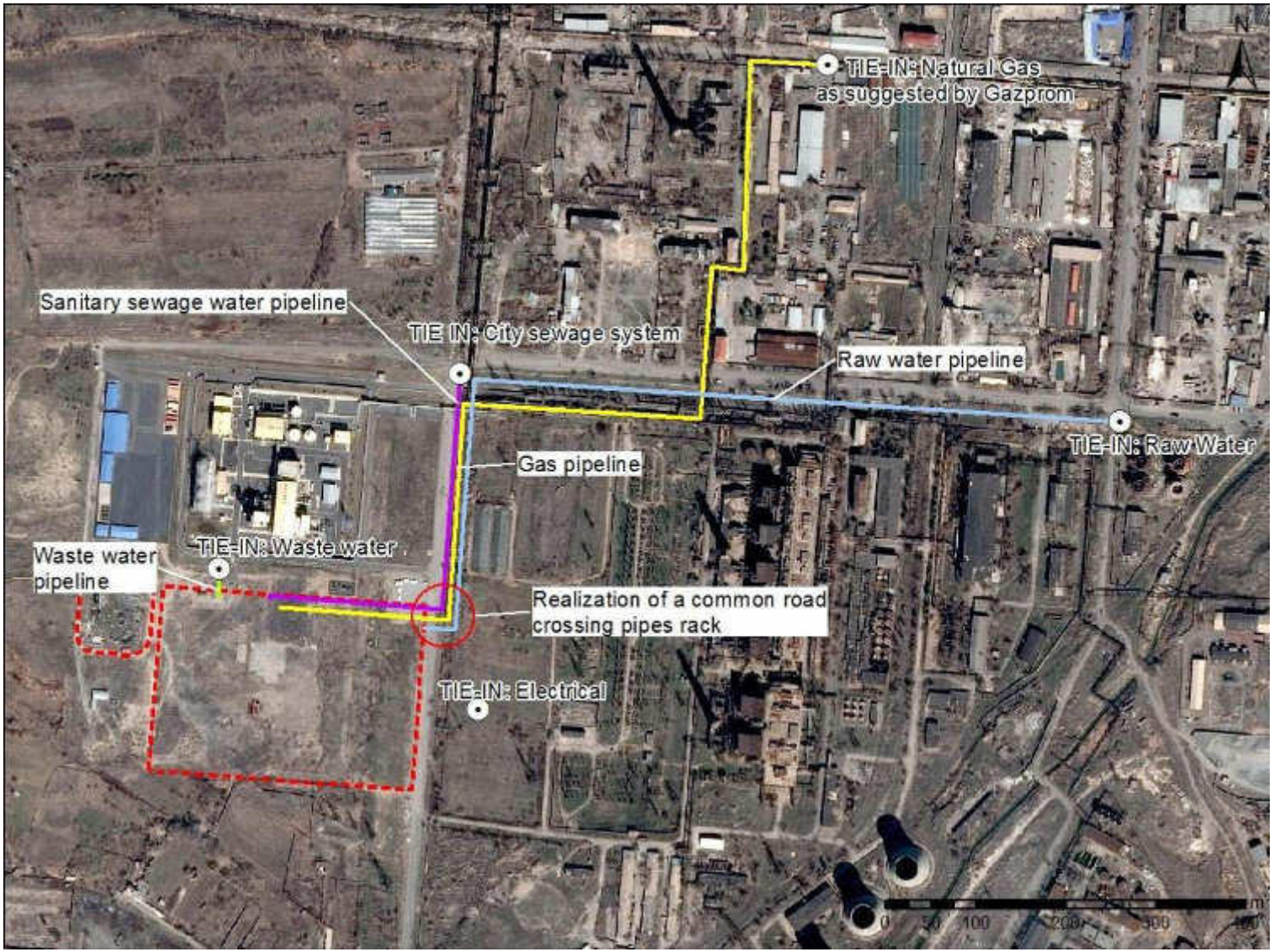


Figure 3-3: Overview plan showing the new interconnections of YCCPP-2

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).

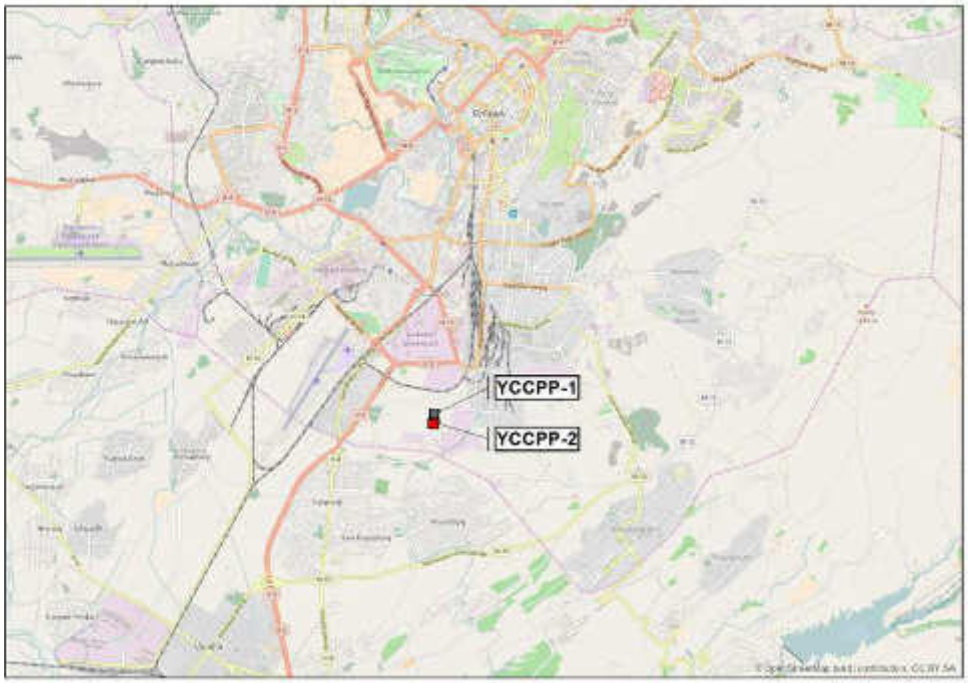


Figure 3-4: Location of existing YCCPP-1and future YCCPP-2 in the south of Yerevan

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.

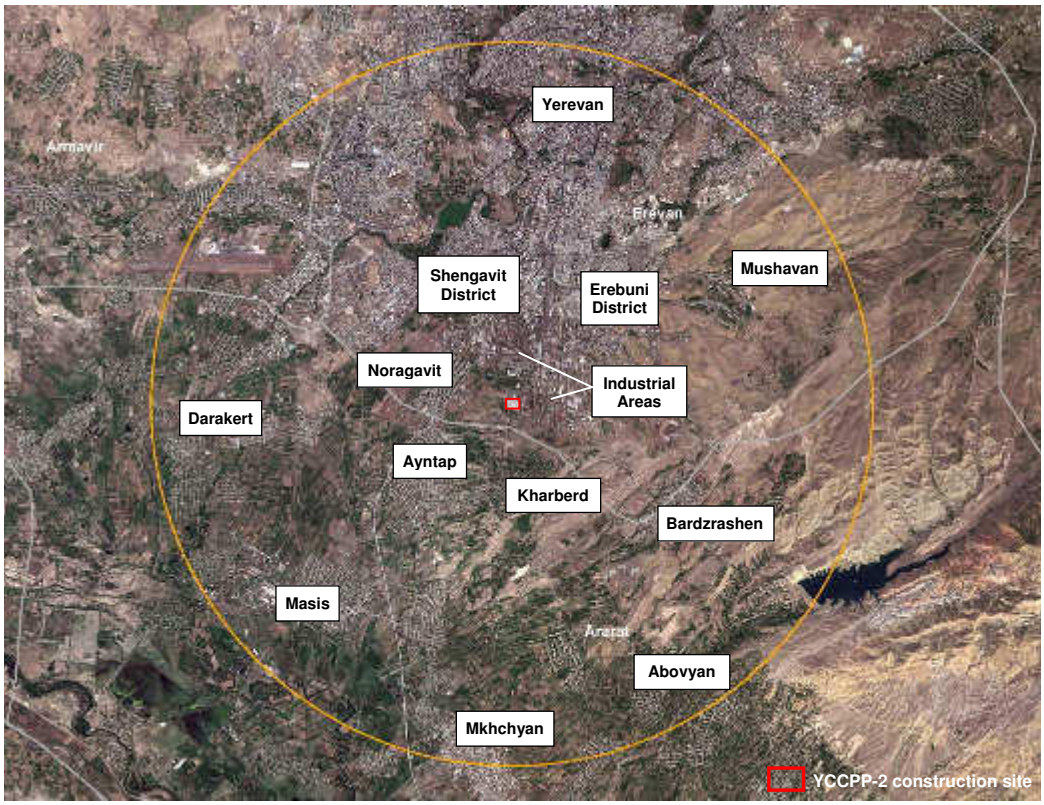


Figure 3-6: Project Area of Influence with residential areas in a distance of 10 km from the YCCPP-2 that might be impacted by the Project

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.

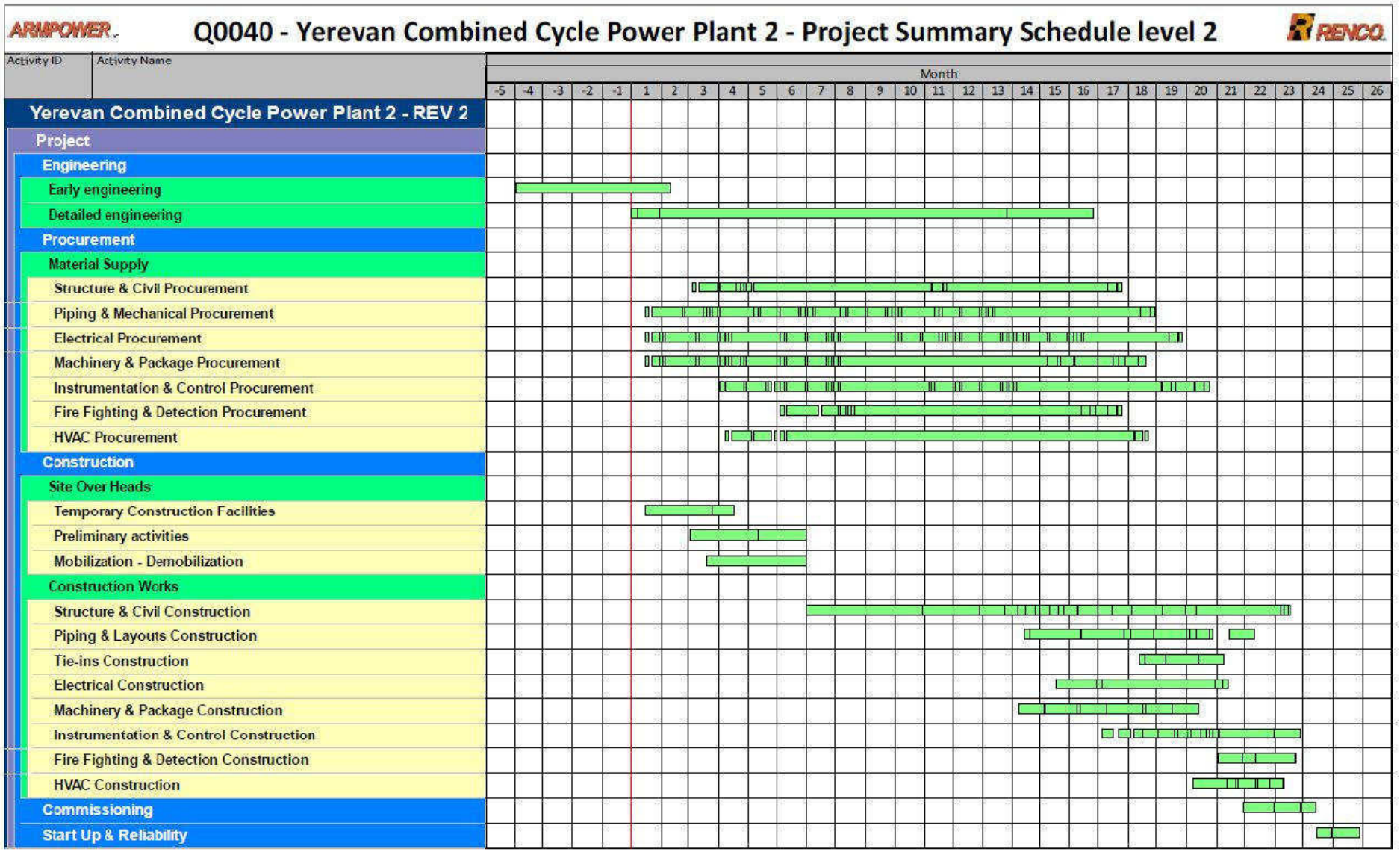


Figure 3-7: Preliminary Project Schedule

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 Armenia[7] 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 outmost 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				
Alternati-ves / 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				
Alternati-ves / 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, inhabitated sites	Low - the site is not inhabitated
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
SUMMARY	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			
Alternati-ves / 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
SUMMARY	**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 NOx 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		
Alternati-ves / E&S impacts	**No air or water emissions mitigation equipment**	**Installation of low NOx burners, drift eliminators and an own WWTP (the Project)**
Community H&S	**High** - without low NOx 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
SUMMARY	**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. Therefore, potential contamination of groundwater, soil and surface waters cannot be excluded.	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)		
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
SUMMARY	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 is 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 RA[8]) 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 Somkheti-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, ophyolite, volcanic and sedimentary formation stratums, 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 1988[9]. In 2011 an earthquake with a magnitude of 3.2 occurred 37 km north of Gyumri[10].

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/istanbul03/09melkumyan3-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 performed[12]. 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-hydraulical characteristics of the underground, as well as groundwater levels and the location of rock surfaces, if any.

Another geological study[13] 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 measured 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-N[14] 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 objects**[15] 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 vulenrability 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 km^2 (Debed, Pambak, Aghstev, Tavush Rivers, etc.), and basins of the tributaries of Arax River an area of 22,790 km^2 (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 km^2. 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 city[16]. Water quality of the Hrazdan River is categorized as bad (5th class of the surface water quality assessment system of RA[17]) in the area south of Yerevan[18]. 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-1finally 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)

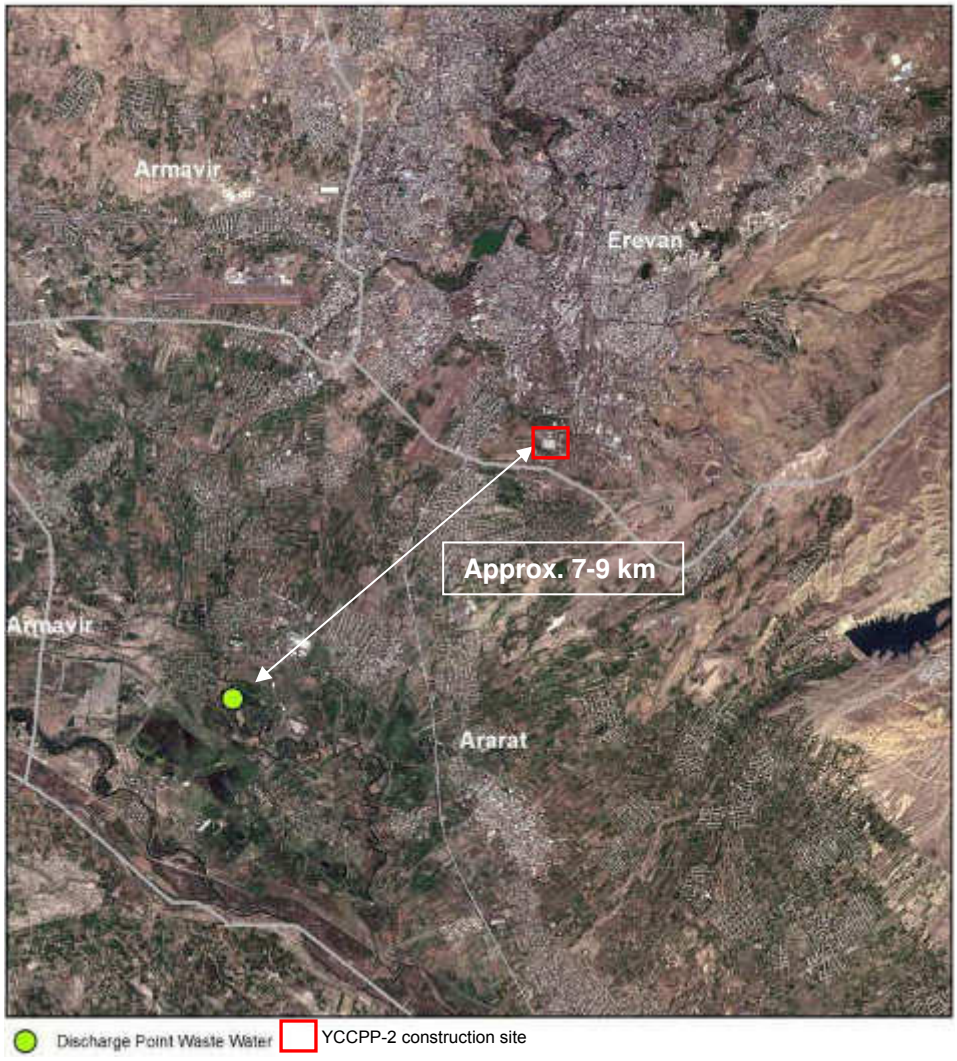


Figure 5-7: Final discharge for the treated waste water from YCCPP-1 (and for the future for YCCPP-2 as well)

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 studies[19] 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 study[20], 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 2017[21] 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] Consecoard 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 Standards[22] 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 Consecoard (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.

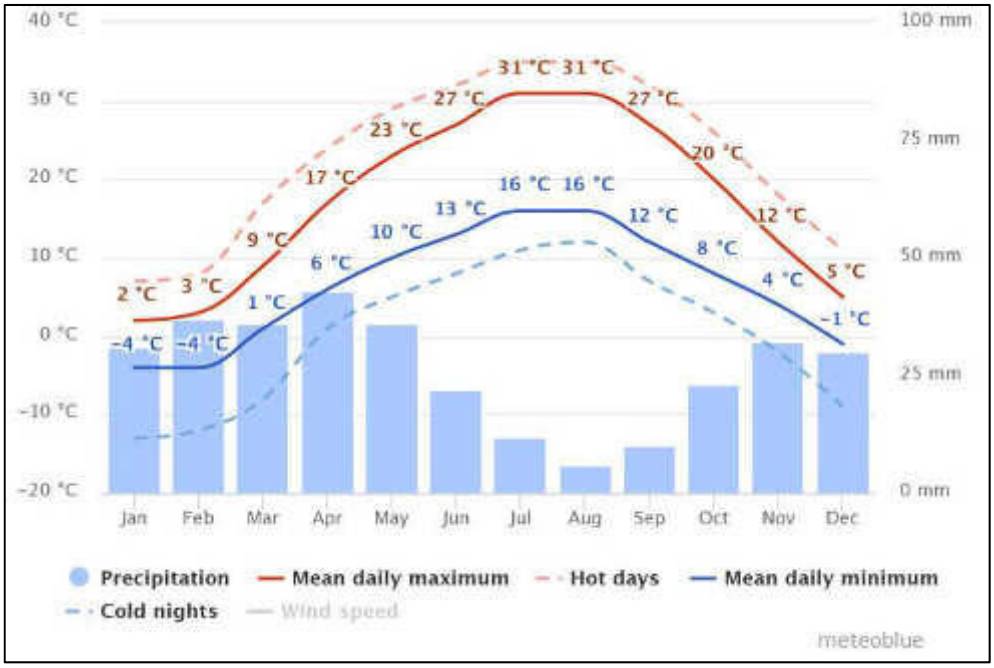


Figure 5-8: Average temperatures (min. and max.) and precipitation (mm) in Yerevan (30-year global history with hourly weather data).[23]

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).

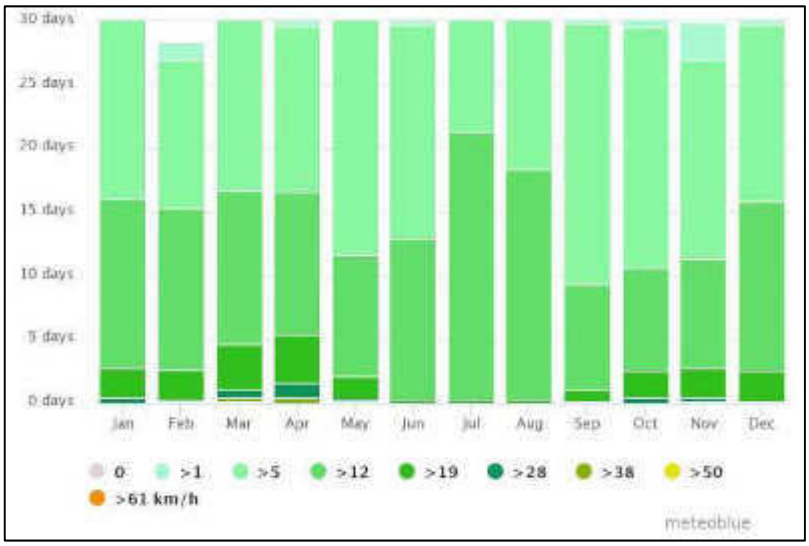


Figure 5-9: The diagram for Yerevan shows how many days within one month can be expected to reach certain wind speeds

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.

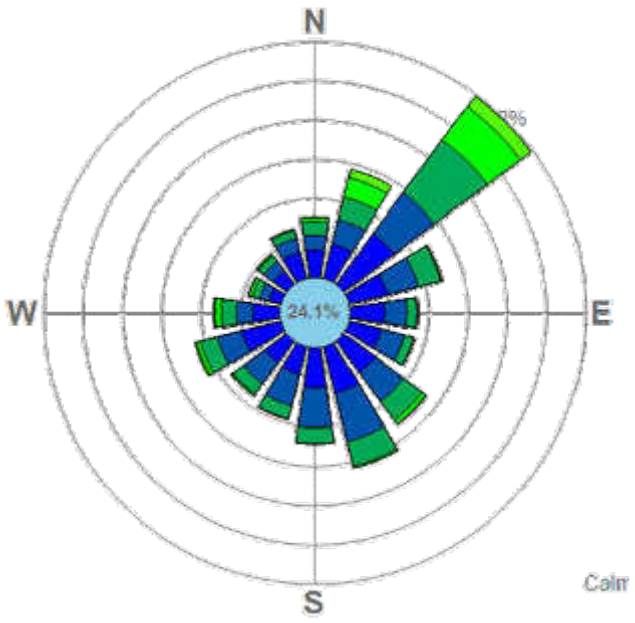


Figure 5-10: Wind rose for the years 2014-2016 (wind blowing from)

5.1.6.2 Air Quality

Air pollution has always been a sensitive issue in Armenia. According to a recent report of the WHO[24] 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 (PM_{10}) 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, SO_2, NOx and near-ground O_3 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, SO_2 and NOx 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 SO_2 and NOx 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 SO_2, NO_2 and PM_{10} 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 (SO_2 and NO_2), 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 (PM_{10}), 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 PM_{10}, SO_2 and NO_2. 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.

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 2016[26] 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	O

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 objects[27] 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 vulenrability 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	o

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 Note[28]. 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 SO_2, NO_X, CO, CO_2, 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	o

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 m^3/h). The maximum power plant water flow rate (referred to normal operation) will be 450 m^3/h (annual average). The necessary average monthly water quantity will be around 300,000 m^3. 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.

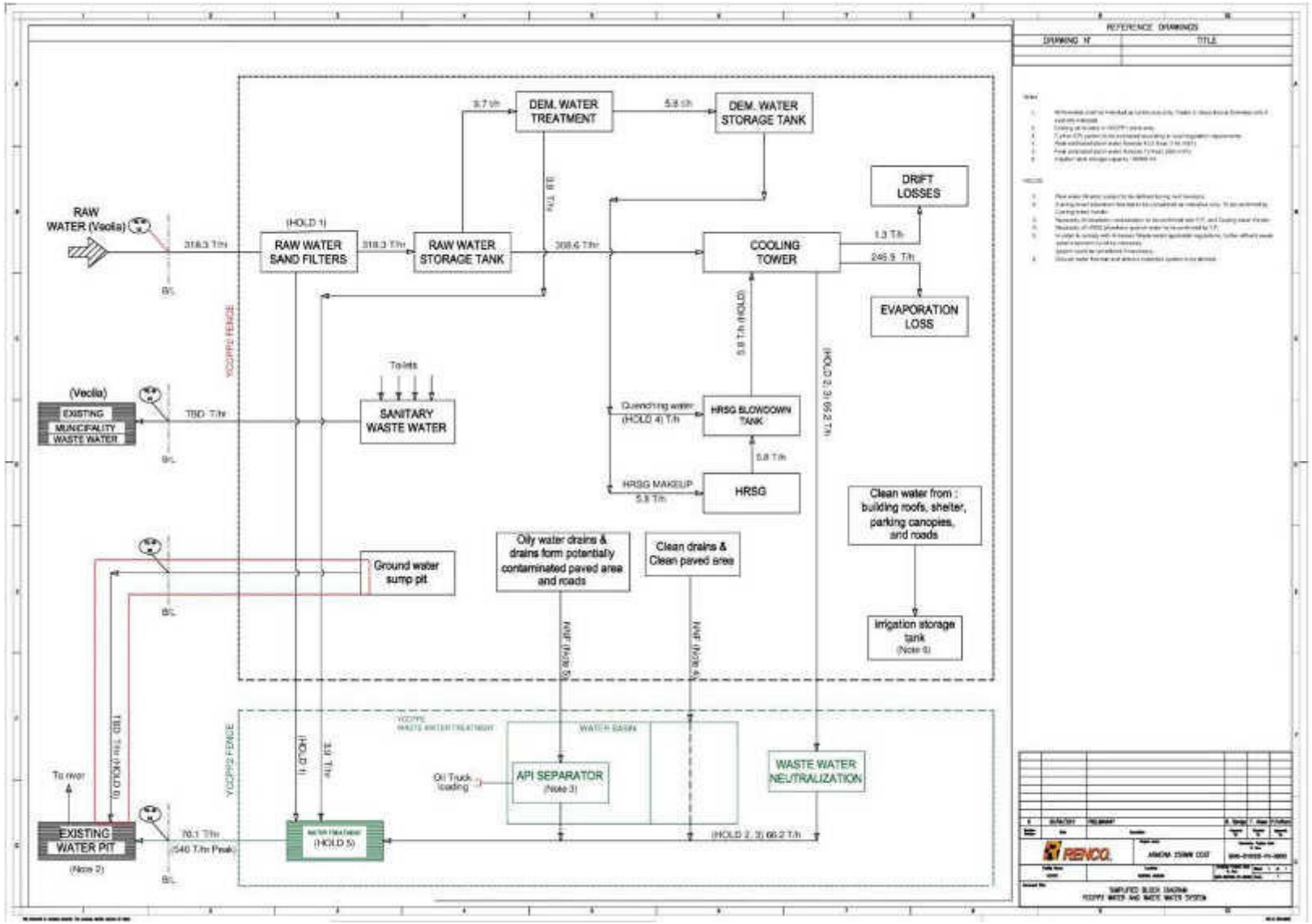


Figure 6-9: Preliminary Water Balance of YCCPP-2 (Source: RENCO)

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 m^3/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 m^3/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 NOx emissions shall be less than 51 mg/Nm³ (referring to dry exhaust and 15% O_2). In order to comply with this limit value, a low-NOx 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): NOx 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% O_2).

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 NO_2 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 NO_2 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 CO_2/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 CO_2/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 CO_2/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 indirect[29]). 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 2015 [30], 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 person [31].

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 (CO_2) 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 (CH_4 and N_2O), as well as the indirect emissions of GHG shall be calculated based on internationally recognized guidelines (for example, the guidelines from the IPCC[32] or the US EPA[33]).

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 (PM_{10} / $PM_{2.5}$) 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 PM_{10}. Results show that PM_{10} 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 PM_{10} 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 an positive impact to the area.

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

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.

RENCO 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)**

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	o

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 practice[34] 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)

[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.

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).

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).

RENCO'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 (PM_{10} / $PM_{2.5}$) 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 practice[35] 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 - *residential areas*	"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)

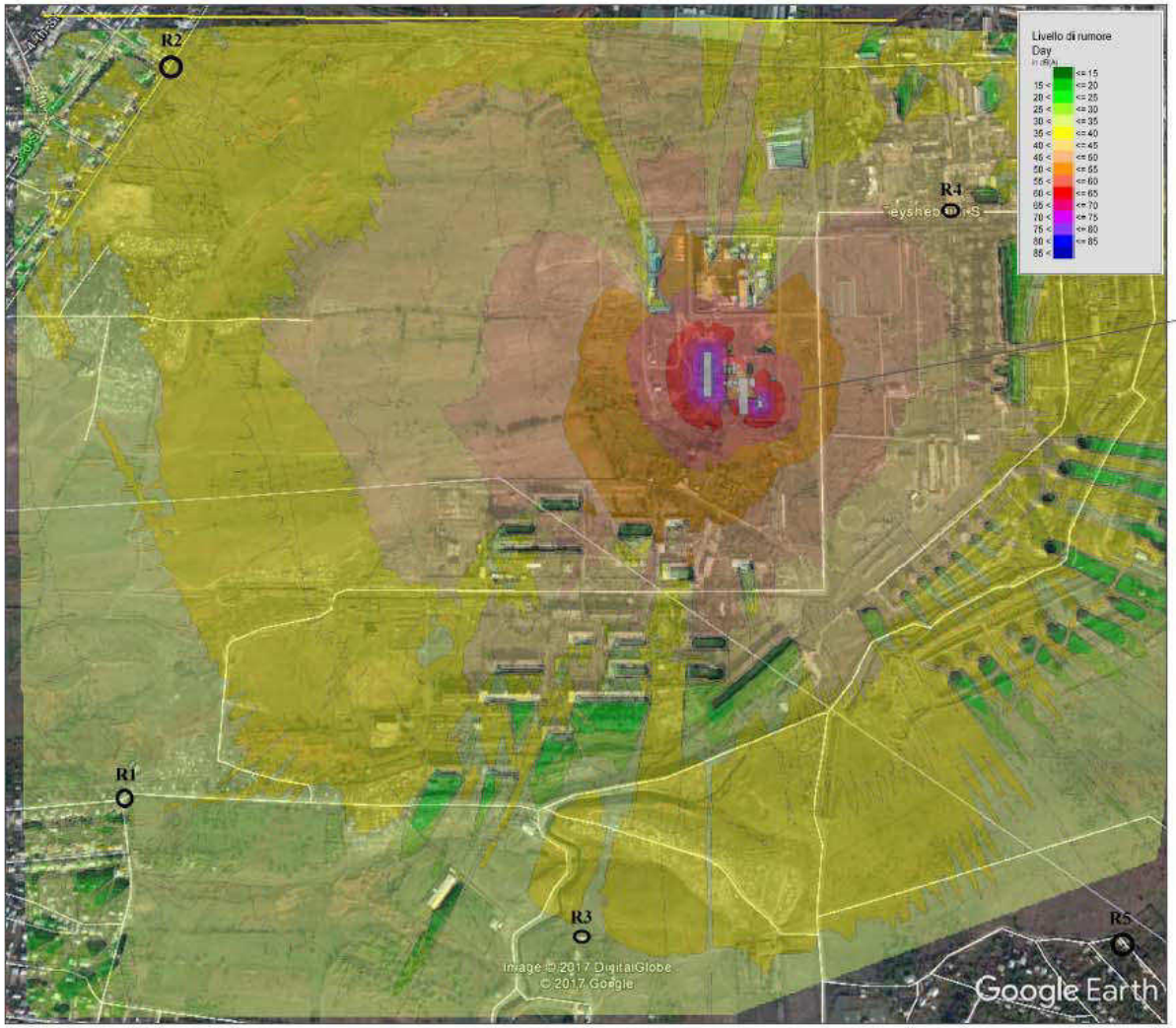
The calculation outcomes of the model for YCCPP-2 have shown that the operation of **the new plant will not produce any significant increase of the noise pressure at the sensitive receptors**. In particular:

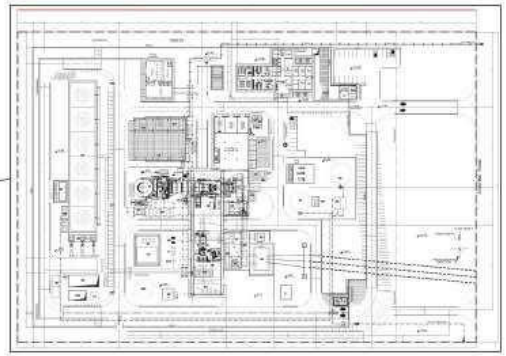
- where the current noise pressure is under the applicable limits, the YCCPP-2 operation will not produce any exceedance of the said limit either during the daytime or during the night time;
- where the current noise pressure is already over the applicable limits, the YCCPP-2 will produce a negligible 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, 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

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	O
Soil Use and Soil Erosion	■
Soil Contamination	■
Surface Water	O
Groundwater deviation	(still unknown - see ESAP)
Groundwater contamination	■
Climate and Air Quality	■
Landscape and Visual Aspects	■
Waste	■■
Local Workforce	+
Land Use and Ownership	O
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	O

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	o
Soil Use and Soil Erosion	■
Soil Contamination	■
Surface Water	o
Groundwater contamination	■
Climate and Air Quality	■
Landscape and Visual Aspects	o
Waste	■■
Local Workforce	+
Land Use and Ownership	o
Historical and Cultural Sites	o
Occupational Health and Safety	■
Community Health and Safety	■
Noise	■

Significance of Impact:

■■■	=	high
■■	=	medium
■	=	low
o	=	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] Aahrus 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 though 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.

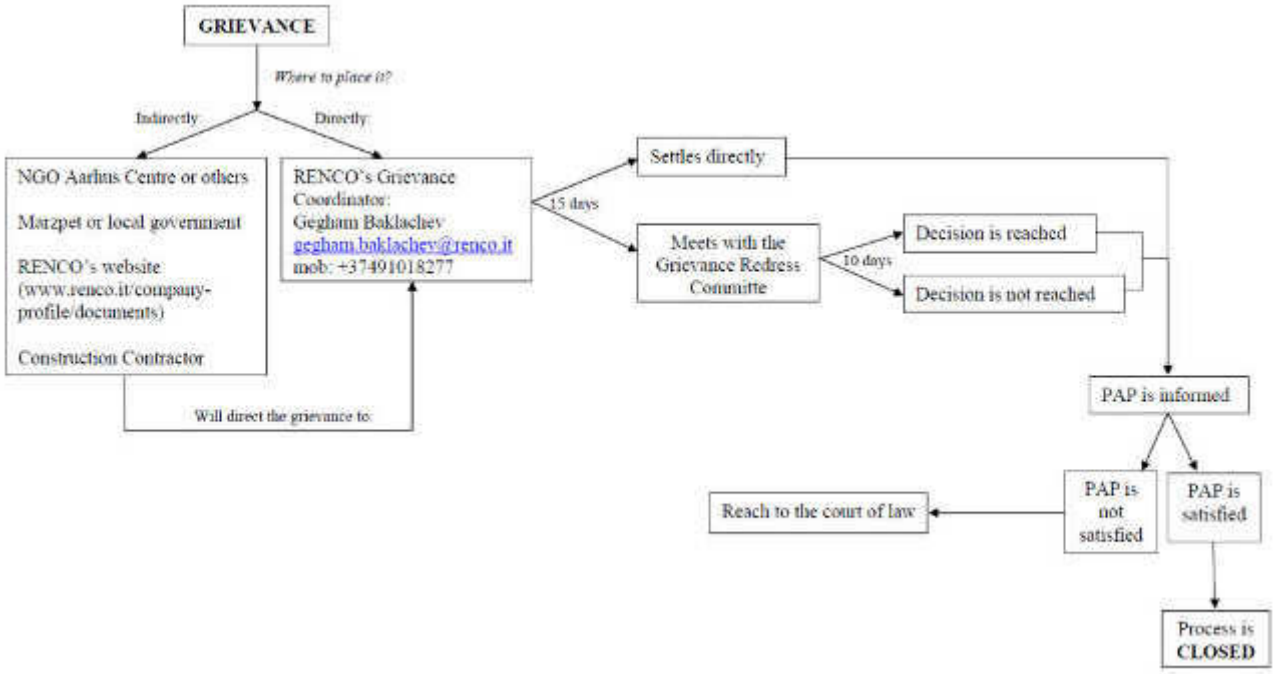


Figure 8-1: Flowchart of Grievance Redress Mechanism

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
HRSG 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
HRSG 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 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.	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 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.

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** *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	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** *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 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 sin 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 Office of EPC Contractor	Control of Waste Management Plan	Waste Management Plan developed	In advance of construction	ArmPower External auditor
	Implementation of Waste Management System		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 H&S Manager employed	Regularly during construction	ArmPower External auditor
	HSEMP and HSEMS shall also be valid for any third parties or subcontractors in the supply chain			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** *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	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** *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**		
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** *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**		
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	Construction Site Office of EPC Contractor	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		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** *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**		
Community Health and Safety	Provide adequate security measures to prevent accidents and injury (e.g. keeping speed limits)	Construction Site Office of EPC Contractor	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					
	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** *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**		
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 Office of EPC Contractor	Inspection of employment contracts (also of subcontractors) Inspection of complaints Interviews with employees	Employment contracts according to international labor standards No complaints		
	Prosecute offenses related to payment of wages by sub-contractors strictly			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** *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**		
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 NO_2 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 NO_2 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** *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	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 Inspection of monitoring reports	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)
	HRSG 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** *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	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)
	HRSG 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** *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**		
	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 bunded 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 NO2, 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 (NOx: < 50; CO < 30; UHC < 10 mg/Nm³)	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 NO2, 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 (NOx: < 50; CO < 30; UHC < 10 mg/Nm³)	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 CO2 emissions shall be monitored with the CEMS; direct emissions of CH4 and N2O 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 be 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 *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**		
	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)	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		
	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** *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**		
	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 *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**		
	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** *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**		
	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 (RENCO 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
SUB- TOTAL				*145,000 USD*
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
SUB- TOTAL				*110,000 USD*
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: • 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?	
Where accommodation services are provided, is it ensured that: • 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?	Yes; Skilled workers (partly from abroad) will be accommodated in RENCO's guesthouse or in hotels in Yerevan; Unskilled workers will be employed in adjacent villages and Yerevan, thus no workers' camps are necessary, as workers can get back to their homes after work
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	
Is a grievance mechanism for workers provided to raise workplace concerns that: • 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
Where national laws allow the employment of minors: • 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 bunded 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 measured 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	IFC PS 1, 4 IFC (2017): Good Practice Handbook on Use of Security Forces - Assessing and Managing Risks and Impacts.	RENCO as EPC Contractor ArmPower as Operator	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	IFC PS 2, 3 IFC/ WB General EHS-Guidelines IFC/ WB EHS Guidelines for Thermal Power Plants IFC/ WB EHS Guidelines for Electric Power Transmission and Distribution	RENCO as EPC Contractor ArmPower as Operator	In advance of construction, valid during construction, operation and decommissioning phases	Site-specific HSEMP and HSEMS for construction, operation and decommissioning periods; Grievance log book and reports on successful handling the grievances; HSE officers established at RENCO and ArmPower
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	IFC PS 3 EU Directive 2008/98/EC (Waste Framework Directive)	RENCO as EPC Contractor ArmPower as Operator	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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