Environmental and Social Impact Assessment Final Report: Annexes (Part 3)

Project Number: 51090-001
March 2018

ARM: Yerevan Gas-Fired Combined-Cycle Power Project

Prepared by Fichtner, Stuttgart, Germany

7. Գործընթացի մասնակիցները համաձայն Օրենքի 4-րդ հոդվածի 1-ին մասի 22-րդ կետի	Երևանի քաղաքապետարան, հանրություն:
8. Հանրության ծանուցումը և քննարկումների իրականացումը կատարել համաձայն Օրենքի 26-րդ հոդվածի 2-րդ մասի 2-րդ, 3-րդ կետերի, 3-րդ մասի, 5-րդ մասի 1-ին, 2-րդ կետերի, 7-րդ և 8-րդ մասերի և <Հանրային ծանուցման և քննարկումների իրականացման կարգը սահմանելու մասին>> ՀՀ կառավարության 19.11.2014թ N1325-Ն, որոշման	Գնահատման ընթացքում քաղաքապետարանը ձեռնարկողի հետ համատեղ պետք է իրականացնի հանրության ծանուցում և հանրային քննարկումներ: Արձանագրությունները, տեսաձայնագրության կրիչը, հանրության դիտողությունների հիմնավորված պատասխանների ամփոփաթերթը պետք է ներառել շրջակա միջավայրի վրա ազդեցության գնահատման հաշվետվությունում և ներկայացնել ՀՀ բնապահպանության նախարարություն՝ փորձաքննության:
9. Պետական տուրքի չափը՝	500.000 (հինգ հարյուր հազար) դրամ՝ Ա կատեգորիայի համար
10. Ստացողը և հաշվի համարը՝	ՀՀ ֆինանսների նախարարության գանձապետարան՝ 900005000196
11. Վճարման նպատակը՝	Նախատեսվող գործունեության փորձաքննության գործընթացի իրականացման համար
12. Փորձաքննության հիմնական փուլի սկիզբը համաձայն Օրենքի 19-րդ հոդվածի և <<Շրջակա միջավայրի վրա ազդեցության փորձաքննության իրականացման կարգը սահմանելու մասին>> ՀՀ կառավարության որոշման	Տեխնիկական առաջադրանքի համապատասխան կազմված ՇՄԱԳ հաշվետվությունը՝ ՀՀ բնապահպանության նախարարություն՝ շրջակա միջավայրի վրա ազդեցության փորձաքննություն ներկայացնելը:

<<Շրջակա միջավայրի վրա ազդեցության փորձաքննական կենտրոն>> ՊՈԱԿ-ի տնօրեն Վ.Սահակյան

<<Շրջակա միջավայրի վրա ազդեցության փորձաքննական կենտրոն>> ՊՈԱԿ-ի փոխտնօրեն Ս.Փահլևանյան

<<Շրջակա միջավայրի վրա ազդեցության փորձաքննական կենտրոն>> ՊՈԱԿ-ի մասնագետ Ա.Մինասյան

Annex N2 of the

N 347-N order of 18.11.2014

of RA Minister of Nature Protection

TECHNICAL SPECIFICATION

/of the planned activity/

TS 37

23.06.2016

The present specification is made according to the RA law clauses on the "Assessment and expertise environmental impact" (hereinafter referred to as Law) and is taken as a base for the planned A or B category activity for the processing of the report of main assessment of environmental impact being submitted to the expertise general phase, according to the following specifications:

1. The name and address of undertaker:	"RencoArmestate" LLC / 8 M. Khorenatsi St., 1st Blind Alley, Yerevan/
2. The planned activity and its category:	Primary assessment application, "A" category for the "Combined cycle power plant"
3. The affected community (communities):	Yerevan city
4. To foresee the objects and characteristics being observed during the process of the Environmental impact assessment according to the Law 1-13 points of the 1st part of the 7th article:	It is necessary to observe all the objects and characteristics indicated in the points.
5. To foresee the content of report of the human health and environmental impact assessment and the attached documents according to the Las 2-6 points of the 3th part and 1-15 points of the 2nd part of 18th article:	In the reports of the environmental impact assessment is necessary to include all the indicated documents and indicators of the points.

6. The requirement on the opinion or conclusion of state licensed body of the relevant field:	
7. The participants of the process according to the Las 22nd point of the 1st part of the 4th article:	Yerevan municipality, society
8. To execute the public notice and the implementation of discussions according to the 7th and 8th parts, 1st and 2nd points of the 5th part, 3th part, 2nd and 3th points of the 2nd part of the Law 26th article and according to the N1325-N decision of 19.11.2014 on the "Establishment of the public notice and discussions implementation procedure":	During the assessment the municipality should realize public notice and public discussions with the undertaker. The minutes of meeting, the video flash, the answers summary sheet based on public remarks should be included in the report of the environmental impact assessment and should be submitted to the expertise of the RA Ministry of Nature Protection.
9. The amount of state fee:	500.000 (five hundred thousand) AMD for A category
10. The recipient and the account:	treasury of RA Ministry of Finance – 900005000196
11. Payment purpose:	For the implementation of the planned activity expertise
12. The beginning of the expertise general phase according to the Law 19th article and to the decision of the Government of the Republic of Armenia on the "Establishment of procedure of the implementation of the environmental impact expertise":	The submission of the environmental impact assessment report made according to the technical specification to the expertise of environmental impact – to the RA Ministry of Nature Protection .

Director of "Center of expertise for

Environmental impact assessment"

State Non-Commercial Organization V. Sahakyan

Deputy director of "Center of expertise for

Environmental impact assessment"

State Non-Commercial Organization S. Pahlevanyan

Specialist of "Center of expertise for

Environmental impact assessment"

State Non-Commercial Organization A. Minasyan

11.2 Annex 2 - Form for comments

Comments to the Draft Final ESIA Report				
Do you wish to receive an answer to your comments?			☐ Yes	☐ No
If yes, please mark how you wish to be contacted	☐ Post	☐ Telephone	☐ E-mail	☐ Others
	Address:	Contact number:	E-mail address:	Please specify:
Preferred language for communication	☐ Armenian	☐ Russian	☐ English	☐ Others Please specify:
☐ I prefer to remain anonymous				
Gender:				
Title:				
Name: *(Please do not fill this field if you would like to remain anonymous)*				
Signature: *(Please do not fill this field if you would like to remain anonymous)*				
Local:				
Date:				

11.3 Annex 3 - Stakeholder Log

#	Entity/Individual person's name	Representative	Contact details	Communication media	Comment	Answer and Action for follow-up	Responsibility	Deadline	Confirmation of close-out
1	Municipality of Kharberd	Karo Kakoyan, Mayor	+(374 093) 400-122 Nor Kharberd village, Ararat Marz norkharberd.ararat@mta.gov.am	Personal meeting	**04.07.2017** No concerns regarding the implementation of the Project; no medical/ health issues of local population concerning the operation of the existing YCCPP-1 were reported; the mayors hope that the Project will create jobs for the local population	**04.07.2017** Not applicable	Not applicable	Not applicable	Not applicable
2	Municipality of Ayntap	Karen Sargsyan, Mayor	+(374 094) 722-222 Ayntap village, Ararat Marz ayntap.ararat@mta.gov.am						
3	Municipality of Yerevan, Head of Erebuni Administrative District	Edgar Mkrtchyan, Head of Department	+(374 11) 518-388 Building 87, Sasuntsi Davit str. Yerevan						
4	Municipality of Yerevan, Head of Shengavit Administrative District	Armen Sargsyan, Head of Department	+(374 11) 518-808 Building 26, G.Njdeh str. Yereva						

11.4 Annnex 4 - Public Grievances Form

<table>
<tr><td colspan="5">Description of Incident or Grievance (What happened? Where did it happen? Who did it happen to? What is the result of the problem?)</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="5">Date of Incident/Grievance:</td></tr>
<tr><td colspan="3">☐ One time incident/grievance?</td><td colspan="2">Date:</td></tr>
<tr><td colspan="3">☐ Happened more than once?</td><td colspan="2">How many times?</td></tr>
<tr><td colspan="5">☐ On-going (currently experiencing problem)</td></tr>
<tr><td colspan="5">Do you have suggestions on how to solve the problem?</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="3">Do you wish to receive an answer to your grievance?</td><td>☐ Yes</td><td>☐ No</td></tr>
<tr><td rowspan="2">If yes, please mark how you wish to be contacted</td><td>☐ Post</td><td>☐ Telephone</td><td>☐ E-mail</td><td>☐ Others</td></tr>
<tr><td>Address:</td><td>Contact number:</td><td>E-mail address:</td><td>Please specify:</td></tr>
<tr><td rowspan="2">Preferred language for communication</td><td>☐ Armenian</td><td>☐ Russian</td><td>☐ English</td><td>☐ Others</td></tr>
<tr><td colspan="3"></td><td>Please specify:</td></tr>
<tr><td colspan="5">☐ I prefer to remain anonymous</td></tr>
<tr><td colspan="5">Gender:</td></tr>
<tr><td colspan="5">Title:</td></tr>
<tr><td colspan="5">Name: (Please do not fill this field if you would like to remain anonymous)</td></tr>
<tr><td colspan="5">Signature: (Please do not fill this field if you would like to remain anonymous)</td></tr>
<tr><td colspan="5">Local:</td></tr>
<tr><td colspan="5">Date:</td></tr>
</table>

The legal framework of the earthcover pollution standardization in Armenia and the results of the YCCPP2 territory research

Customer
Renco Armestate LLC

Executer
Consecoard LLC

Yerevan, 2018

CONTENT

ABBREVIATION LIST

RA	Republic of Armenia
RF	Russian Federation
TLV	Threshold limit value
TPP	Thermal power plant
SN	Sanitary normative
LLC	Limite Liability Company

1. Legal framework

1.1. RA land code

The Land Code defines the basic directions of State regulatory system improvement concerning land relations, development of various organizational and legal forms of land economy, fertility of land, land use efficiency raise, protection and improvement of an environment – favorable for human vitality and health and the legal framework concerning the protection of the rights on land. The land code has been passed on 02.05.2001.

The Article 6 of the Code defines "Due to its target position, the available land of the Republic of Armenia is classified:

1) Agricultural
2) Settlement
3) Industrial, for entrails-use and production
4) **Energetic,** transport, communicational, public structural
5) Specially protected areas
6) Special importance
7) Forestry
8) Water
9) Reserved land

The lands of the thermal power plant due to target position are classified as "Energetic".

According to the Article 15 of the Code: "Lands allocated for construction and maintanence of thermal, nuclear and hydro plants, high voltage cables, gas pipes and use on other energetic purposes are considered the lands of energy objects".

The Article 16 defines "The goals and objectives of land protection", under the 7th clause of which "in order to provide for protection of human health and environment, the Government defines the general requirements of the proterction the earth from pollution, the maximum allowable norms of land contaminative substances, lands pollution level assessment order.

1.2. Sublegal acts

Based on the RA land code requirements the RA Government has passed several sublegal acts, the main ones of which in the land use and protection fields are the followings:

- "The technical regulation of the general requirements of the protection of the lands form pollution, the list of the contaminating substances, polluting the lands, and the assessment of the lands pollution level" (RA Government resolution N1277-N of 24.08.2006),

- "The technical regulation of the requiements for the decision of land fertile layer removal norms and the protection and use of the removed fertile layer" (RA Government resolution N1026-N of 20.07.2006),
- "The order of the assessment of the impact due to the economical activity on the land resources" (RA Government resolution N 92-N of 25.01.2005).

The land resources pollution indexes and the requirements for them are regulated by the "Sanitary rules and norms, hygienic requirements, for the soil quality N2.1.7.003-10", approved by the order N01-N of 25.01.2010 of the RA Minister of healthcare.

2. The standardization of soil pollution

The soil pollution permissible level is regulated by the ""The technical regulation of the general requirements of the protection of the lands form pollution, the list of the contaminating substances, polluting the lands, and the assessment of the lands pollution level" (RA Government resolution N1277-N of 24.08.2006) and "Sanitary rules and norms, hygienic requirements, for the soil quality N2.1.7.003-10" (order N01-N of 25.01.2010 of the RA Minister of Healthcare).

2.1. The standardization of soil pollution

The threshold limit values (TLV) of the chemicals (including also the pesticides) in the soil are defined in the table 1 of the sanitary norms N2.1.7.003-10 (presented with abridgements, considering the possibility of existance in YCCPP2 territory).

Table 1

THE THRESHOLD LIMIT VALUES OF CHEMICALS IN SOIL

N	Denomination of the substances	TL value mg/kg, considering the background (clarck)	Limiting indexes
15.	Petrol	0,1	Air-migration
16.	Benzol	0,3	Air-migration
19.	Vanadium	150,0	General sanitary
52.	Xylols	0,3	Translocation
61.	Nitrates	130,0	Water-migration
74.	Mercury	2,1	Translocation
75.	Lead	32,0	General sanitary
79.	Sulfur compounds (S), elementary sulfur	160,0	General sanitary
80.	Hydrogen sulfide	0,4	Օդամիգրացիոն
81.	Sulphuric acid	160,0	General sanitary
85.	Styrene	0,1	Air-migration
87.	Antimony	4,5	Air-migration
88.	Toluene	0,3	Air-migration,

N	Denomination of the substances	TL value mg/kg, considering the background (clarck)	Limiting indexes
			Translocation
96.	Potassium Chloride	360,0	Water-migration
102.	Cobalt	5,0	General sanitary
103.	Manganese a) turf-podzolic black soil, derived by 0,1N H_2SO_4 pH 4,0 pH 5,1—6,0 pH ≥ 6,0 b) pH 4,8 turf-podzolic black soil, derived by ammonium acetate buffer pH 4,0 pH 5,1—6,0 pH ≥ 6,0	 700,0 300,0 400,0 500,0 140,0 60,0 80,0 100,0	General sanitary
104.	Copper	3,0	
105.	Nickel	4,0	General sanitary
106.	Lead	6,0	General sanitary
107.	Zinc	23	Translocation
109.	Chrome	6,0	General sanitary

However the direct use of TLVs according to the sanitary norms N 2.1.7.003-10, is applied only to certain contruction types:

"10. In the soils of residential construction territories, territories, envisaged for the recreation areas for health purposes, sanitary protection zones of water supply centralized systems structures it is not allowed:

- excess of threshold limit values or orienting permissible quantities with chemical pollutants by sanitary-toxicological indicators",

...

"15. For the assessment of the soil sanitary condition of the sanitary protection zones residential construction, pre-school, school organizations, yard playground territories, recreation areas for health purposes, water supply centralized systems structures, including the water intake".

For other activity types (industrial, agriculture, not civil contruction) only land use proposals are presented.

According to the pollution level, the land use proposals are defined in the Annex 2 of the Sanitary norms N 2.1.7.003-10.

Annex 2. THE LAND USE PROPOSALS, ACORDING TO THE POLLUTION LEVEL

Land pollution class	*Land usage offer*
Clean	Usage without restriction
Permissible	Usage without restriction, except for the objects of high vulnerability - children's, school organizations, residential areas, sports, playground, children's recreational areas, resort zones, water objects, water mains
Moderately dangerous	For filling of trenches and pits during construction, for areas foreseen for landscaping, by adding 0.2m layer of clean soil
Dangerous	Restricted use for filling of pits during construction, adding no less than 0.5m layer of clean soil. In case of an epidemic hazard, disinfection (dezinvasion) is carried out on the recommendation of the hygienic anti-epidemic controls authorities, with further laboratory supervision
Emergency dangerous	Transportation and utilization in special polygons. In case of an epidemic hazard, disinfection (dezinvasion) is carried out on the recommendation of the hygienic anti-epidemic controls authorities, with further laboratory supervision

2.2. Soil classification by hazardness and the assessment of impact

Classification of soil by hazardness and the assessment of impact is made according to "The technical regulation of the general requirements of the protection of the lands form pollution, the list of the contaminating substances, polluting the lands, and the assessment of the lands pollution level" (RA Government resolution N1277-N of 24.08.2006).

Lands protection requirements and classification of land by pollution levels are provided in chapters III and IV of the regulation.

III. GENERAL REQUIREMENTS FOR THE LAND PROTECTION FROM POLLUTANTS

4. *General requirements for the land protection from pollutants include*

…

b) industrial and household trashes (if they contain elements necessary for soil nutrition or chemical amelioration) using as fertilizer or chemical amelioration to thoroughly examine their chemical composition to prevent the importation of heavy metals and other toxic elements and compounds into the soil;

c) Removal and utilization of waste, emissions, outflow, wastewater and their sediments by implementing soil pollution preventing measures.

d) pesticides, mineral fertilizers, storage and transportation of other chemicalization by implementing measures to prevent environmental pollution.

e) the planning of cleaning structures that exclude the chemical pollution of soil in the designs of new industrial organizations to be constructed, and technological lines;

f) excluding pollution and contamination of industrial and domestic wastes, coarse objects, stones, macadam and construction waste during the construction, structuring and other works, of linear structures and meliorative objects.

IV. LIST OF LAND POLLUTING CHEMICAL SUBSTANCES AND REQUIREMENTS FOR SOIL CLASSIFICATION BY POLLUTING CHEMICAL SUBSTANCES IMPACT

6. Lands according to chemical pollution are classified on the basis of threshold limit value (TLV) of chemical substances in soil and on background levels of these substances.

By pollution, the lands are classified as:

a) highly polluted lands where the content of polluting chemicals exceeds their maximum permissible concentration or approximate permissible concentration, related to the chemical pollution have low biological activity, significant changes in physical-mechanical, chemical and biological characteristics, as a result of which the chemicals content in crops exceeds the defined norms,

b) moderately polluted lands where excessive permissible concentrations of chemicals are observed, with no apparent change in soil properties,

c) less polluted lands, where the content of chemicals does not exceed the permissible concentration but is higher than the background level

7. The hazardness of soil pollution is determined by the potential adverse effects of pollution on the environment (water, air), nutrients and human health, as well as biological activity and self-cleaning ability of the land.

By the hazardness, the degree of chemical pollution of soil is divided into the following categories:

safe,

permissible,

moderately hazardous,

hazardous,

highly hazardous.

The method of soil pollution assessment is provided in Chapter V of the Regulation.

V. EVALUATION OF LANDS POLLUTION DEGREE IMPACT CALCULATION AND ASSESSMENT

12. The impact of land pollution degree is calculated on the basis of the land pollution concentration coefficient, integral index of heterogeneous land pollution indices and the land counteracting response reaction rate.

13. Soil pollution concentration coefficient (H_{ij}) is calculated according to the formula-1

$$H_{ij} = \frac{C}{C_{ф}} \quad \text{or} \quad H_{ij} = \frac{C}{C_{ИФЧ}} \qquad (1)$$

where
C- is the total content of pollutants, mg / kg,
$C_ф$-is the average background level of pollutants[1], mg / kg,
$C_{ПДК}$-is the threshold limit value mg/kg

14. integral indicator of heterogeneous soil pollution ($H_{ф}$) is calculated according to formula 2,

$$H_{фj} = \text{ or } \sum_j \frac{C_j}{C_{фj}} \qquad (2)$$

where
C_j - is the sum of controlled contaminants, mg / kg,
$C_ф$-is the sum of background levels of pollutantss, mg / kg.

15. Land counteracting response reaction rate. (K_h) according to the chemical pollution impact on the state of the land, is calculated by formula 3,

$$K_h = \frac{[A-A_ф]}{A_ф} \qquad (3)$$

where
A-and $A_ф$-are controlled parameters respectively, in polluted and background test samples.

16. The land pollution degree is considered:
a) according to the sanitary number in accordance with the norms in Table N2.

Table N 2

Land characteristics by pollution	Sanitary number
Clean (Practically)	0,98 and greater than that
Low contaminated	From 0,85 to 0,98
Contaminated	From 0,7-to 0, 85
Highly contaminated	Is less than 0,7-

b) according to the pollution hazardness categories and the hazardness classes of organic and inorganic compounds contained in the soil in accordance with the norms in Table N 3.

[1] Soil background pollution or background level, the content of pollutants in the soil of a particular territory before import of such pollutants as a result of new activity.

Table N 3

Pollution category	Sanitary number	Indicator of pollution sum number	Content in soil, mg / kg					
			Hazard 1-st class		Hazard 2-nd class		Hazard 3-rd class	
			organic compound	inorganic compound	organic compound	inorganic compound	organic compound	inorganic compound
Safe	0,98 and more than that	_	From background value up to (TLV)	From background value up to (TLV	From background value up to (TLV	From background value up to (TLV	From background value up to (TLV	From background value up to (TLV
Permissible	0,98 and more than that	Is less than 16-	From 1-up to 2 TLV	From background value 2 up to TLV	From 1-up to 2 TLV	From background value 2 up to TLV	From 1-up to 2 TLV	From background value 2 up to TLV
Moderately hazardous	From 0,85- up to 0, 98	From 16- up to 32					From 2 up to 5 TLV	From TLV up to $Ч_{maxim.}$
Hazardous	From 0,7- up to 0, 85	From 32- up to 128	From 2 up to 5 TLV	From TLV up to $Ч_{maxim.}$	From 2 up to 5 TLV	From TLV up to $Ч_{maxim}$	From 2 up to 5 TLV	
Extremely hazardous	Is less than 0,7	Is more than 128	From 2 up to 5 TLV	From TLV up to $Ч_{maxim}$	From 2 up to 5 TLV	From TLV up to $Ч_{maxim}$		

Ч- is the maximum permissible level of substances by one of the hazard indicators.
The pollution total index is the sum of the concentration coefficients of pollutant chemical substances determined by formula 1.

3. ANALYSIS OF MONITORING RESULTS CARRIED OUT IN THE YEREVAN TPP-2 TERRITORY

3.1. Introduction

Soil pollution assessment in the Republic of Armenia is carried out according to the above-mentioned technical regulation **(N1277-N resolution) methodology. However, that methodology practically is taken from the relevant standards of the Russian Federation without modification, the TLVs are particularly taken from** *"Санитарные нормы СанПиН 42-128-4433-87 "Санитарные нормы допустимых концентраций химических веществ в почве" ("Sanitary Standards of Maximum Allowable Concentration (MAC) of Chemical Substances in the Soil" Sanitary norms SanPiN 42-128-4433-87).* In relation to pollution degree, the soil use proposals (Annex 2), Chemical pollution level of land (Table 2), according to the pollution dangerousness category and the dangerousness classes of organic and inorganic compounds (Table 2) are taken from **СанПиН 2.1.7.1287-03 (SanPiN 2.1.7.1287-03)** of **the Russian Federation (table 3 and annex 1 respectively).**

However such kind of imitation has generated several complications, that do not allow to assess definitely the pollution impact or degree. The calculation methodology of soil pollution integral concentration coefficient and integral index of heterogeneous soil pollution is based on such an approach, that the background pollution level of soil is essentially lower, than threshold limit

values. It is acceptable for the Russian Federation, because the overwhelming majority of soil background pollution of that country is very low, however lower, than TLVs.

Based on the geographical conditions and geological structure of territories, in Armenia the content of heavy metals background in soli is very high and in many places significantly higher than TLVs.

Besides, accepting the brief options of the Russian Federation normative documents, the definitions and grounds of many issues were left out.

It should be particularly mentioned, that in *СанПиН (SanPiN) 42-128-4433-87* **the pollutants** classes of danger are defined, and in the technical regulation approved by the 1277-N resolution there is no such definition. In the annex of the N 430-N order of 201.12.2006 of the RA Minister of Nature Protection the "List of waste classified according to danger" is established. However, that normative act regards only the waste and there is no classification of elementary metals.

3.2. Soil pollution assessment in the territory of Yerevan TPP-2

No background pollution data of Yerevan TPP-2 territory have been found in the literary sources and internet sources.

On the order of "RENCO ARMESTATE" LLC, sampling has been carried out from 45 points in the territory and the samples analysis have been carried out in the Ministry of Nature Protection Monitoring Center laboratory.

In order to evaluate the soil pollution and determine the use procedure of that soil, calculations have been carried out according to the "**Technical regulations for general requirements for landprotection from pollution, list of substances polluting the land and assessment of land pollution level" methodology (N1277-N resolution)**"**.**

3.2.1. *Calculation of soil pollution concentration coefficient*

The calculation has been done according to the formula 1 of technical regulation:

$$H_{կ} = \frac{C}{C_{ֆ}} \quad \text{or} \quad H_{կ} = \frac{C}{C_{ՍԹԿ}} \qquad (1)$$

Taking into account the chance of choise and registered background value data, the calculation has been done according 2nd variant of formula.

Such pollutants have been included in the calculations, in one or two analysis of which the excessive TVLs have been registered.

Table 3.1.

Pollutants	Unit of measure	Threshold limit value	Average measured concentration	Maximum measured concentration	Pollution concentration coefficient
Vanadium	mg/kg	150.0	98.3	166.6	0.65
Chromium	mg/kg	6.0	72.7	230.8	12.1
Manganese	mg/kg	400.0	568.0	834	1.4
Cobalt	mg/kg	5.0	23.8	38.7	4.8

Pollutants	Unit of measure	Threshold limit value	Average measured concentration	Maximum measured concentration	Pollution concentration coefficient
Nickel	mg/kg	4.0	31.0	48.1	7.8
Copper	mg/kg	3.0	46.4	125.3	15.5
Zinc	mg/kg	23.0	54.1	119.8	2.4
Arsenic	mg/kg	2.0	13.4	19.9	6.7

3.2.2. *Integral index of heterogeneous soil pollution*

The integral index of heterogeneous soil pollution (H_{ij}) is calculated according to the 2nd formula:

$$H_{ij} = \text{Or} \quad \sum_j \frac{C_j}{C_{ij}} \quad (2)$$

where

C_j – is sum of pollutantns to be controlled, mg/kg,

C_{ij} – is the sum of pollutants background levels, mg/kg.

As the background pollution level is higher, than TLVs, here the previous subparagraph approach is also applied and the background value has been replaced with TLVs. This approach is more acceptable, as the result is stricter.

C_j – is the sum of average values of pollutants that exceed TLVs

C_{ij} – is the sum of pollutants TLVs, mg/kg.

Table 3.2.

Pollutants	Unit of measure	Threshold limit value	Average measured concentration	Maximum measured concentration
Vanadium	mg/kg	150.0	98.3	166.6
Chromium	mg/kg	6.0	72.7	230.8
Manganese	mg/kg	400.0	568.0	834
Cobalt	mg/kg	5.0	23.8	38.7
Nickel	mg/kg	4.0	31.0	48.1
Copper	mg/kg	3.0	46.4	125.3
Zinc	mg/kg	23.0	54.1	119.8
Arsenic	mg/kg	2.0	13.4	19.9
Sum		593	907.7	1583.2

H_{ij} = 907.7 : 593 = 1.53

In case of maximum indexes: H_{ij} = 1583.2 : 593 = 2.67

In order to determine the soil use procedure, the obtained coefficients are put in the third column of the technical regulation 3rd table - "Total pollution index".
In both cases (average factor - 1.53, maximum concentrations factor – 2.67) the index is less than 16 and the soil category is "permissible". Besides, even in case of use of separate substances pollution indexes factors, none of them does not exceed the "16" index.
The soil classification according to categories mentioned in the table 3 is carried out in two ways – on the basis of pollution total indexes and TLV or its multiple. In addition, on some lines of this table there are not the TLV indexes (second method).
In the previous subsection it is presented that this or any other normative act does not contain a defined pollutant classification of danger. So that method cannot be used.
Besides, it should be taken into consideration that the soil of Yerevan generally has a high background of heavy metals. This is highlighted by the investigations carried out in the vicinity of USA Embassy and the investigations done by American University in other places. It is also mentioned on the main layout of Yerevan, zoning project of Yerevan and in other documents.

4. Conclusion

The RA normative acts listed in the Report do not contain any barrier or restriction on carrying out an industrial activity or construction of an industrial facility on any landcover. These normative acts define the maximum threshold limit values of hazardous substances in the soil, but in the same normative acts it is mentioned several times, that it is prohibited to carry out construction of residential buildings, schools and preschool facilities or to install potable water containers, if there are excessive TLVs in the soil of that area.
For other activities, the soil use ***proposals*** are only mentioned.
The carried out calculations have shown, that the land pollution level does not generate any restriction, or requirement of taking additional measures.

Director of "Consecoard" LLC
Vram Tevosyan

Yerevan YCCPP-2

Soil, Surface water & Groundwater Study

Project-No.: 17.10.453

13.02.2018

Client : Fichtner GmbH & Co. KG
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Contents

Attachment:

1. General Plan
2. Detailed Plan
3. Soil profiles of the new wells
4. Geoterproject Report
5. Analysis Results Report
6. Photodocumentation

1. Scope of work

In Yerevan the Thermal Power Plant (TPP) II is planned on a site south of the city center of Yerevan next to the existing power plant TPP1. RENCO SPA will be the EPC Contractor for this Project, which will be operated by ArmPower CJSC, a subsidiary company of RENCO SPA.

Within the scope of the Environmental Impact Assessment prepared for YCCPP-2, it is necessary to get information about the near surface geology and especially about potential contamination of the soil, surface and groundwater. Our tasks are:

- Survey of field work and support of the local contractor (drilling, sampling)
- Evaluation of field work and analytical results
- Comparison to international and local standards / threshold values
- Design of a complete study with risk analysis

Field work, sampling and chemical analysis were performed considering Armenian standards. Evaluation follows international standards (EU, Germany, Armenia).

2. Geology & Hydrogeology

The area is located in Armenia ca. 8.5 km south of the Yerevan city center on an altitude from ca. 925 – 933 m above sea-level with following coordinates:

40°06`51``N
44°29`48``E

The total size of the investigated area is ca. 74,000 m².

The investigation area is situated in the “Little Caucasus” region. The regions climate is considered to be dry terrestrial with hot summers with high temperature up to + 41°C and cold winters with minimum temperature of – 31°C. The quantity of annual precipitation does not exceed 300-400 mm.

The geology at the YCCPP-2 site shows under fill-up materials (mixture of construction waste like concrete, gravel, sand and silt / clay) quaternary sediments (debris, gravel, sand, silt) up to 30 meters. Gypsum content is reported from a former geotechnical investigation. The base of the quaternary sediments is at an altitude of ca. 900 m. Beneath these sediments are tertiary (Miocene) sediments containing gypsum and igneous rocks.

The first groundwater table is supposed to be between less than 1 to 3 meters below surface depending on the geomorphological relief; the groundwater has a high mineralisation (sulphate up to 2000 mg/l).

3. Field work

Totally 45 boreholes and 3 wells with sampling and analysis were performed by Geoterproject Ltd., 27 Azatutyan Ave., Yerevan, Armenia; Geoterproject was directly contracted by RENCO SPA.

The field work was performed from November 11th till November 29th. Attachment 2 shows the map with boreholes (numbers & depths), attachment 3 contains the soil profiles and technical construction of the new groundwater wells; for the 45 boreholes no information about the soil layers is available.

3.1 Soil Borings & Sampling

Totally 45 boreholes were distributed over the area with a diameter of 110 mm. They were drilled from 2 meters (20 x) to 4 meters (25 x). The sampling depth was 1.7 to 1.9 m respectively 3.7 to 3.9 m.

3.2 Groundwater Wells & Sampling

Three new groundwater wells were installed with a depth of 10 meters.

Groundwater table was measured between 1.9 to 2.7 m below surface. The soil description of the wells is shown in attachment 3.

4. Analysis results

The chemical analysis were performed by order of Geoterproject Ltd by the Environmental Monitoring and Information Center in Yerevan. See attachment 5 for soil and water test reports.

The comparison with threshold values is done with Armenian, European (EU-WFD) and German (BBodSchG, VWV-BW, OGewV) standards which are shown in each chart.

Abbreviations:

TPH	Total Petroleum Hydrocarbons
PAH	Polycyclic Aromatic Hydrocabons
DE VWV-BW	Deutschland / Germany Verwaltungsvorschrift über Orientierungswerte für die Bearbeitung von Altlasten und Schadensfällen, Landesanstalt für Umweltschutz Baden-Württemberg
P-M3	Prüfwerte zum Schutz der Gesundheit von Menschen auf kontaminierten Flächen - Gewerbeflächen German: Baden-Württemberg administrative regulation
BBodSchG	Bundesbodenschutzgesetz; Federal Soil Protection Act
EU-WFD	EU Wasserrahmenrichtlinie; EU Water Framework Directive
GrwV	Verordnung zum Schutz des Grundwassers; Groundwater Protection

	Regulation; German implementation EU-WFD
OGewV	Oberflächengewässerverordnung; Surface Water Regulation
BOD_5	biochemical oxygen demand in 5 days
COD-Cr	chemical oxygen demand bichromate

4.1 Soil

The results from the laboratory analysis in original matrix (mg/kg) are shown on following tables:

	Borehole 1	Borehole 2	Borehole 3	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	20	19.7	28.6		
Sodium	20604	18717	25508		
Magnesium	14366	13974	27846		
Aluminum	65270	64620	33130		
Potassium	7608	6564	10249		
Calcium	85760	81470	96790		
Titanium	2359	2508	2574		
Vanadium	90.5	96.9	124.5	150	
Chromium	**61.7**	**55.4**	**230.8**	6	500
Iron	47020	45310	53160		
Manganese	**473**	**400.4**	**839.5**	400 – 700 (depending on pH)	
Cobalt	**23.3**	**21.2**	**38.7**	5	
Nickel	**32.7**	**31.9**	**48.1**	4	300
Copper	**40**	**39.9**	**125.3**	3	
Zinc	**65.2**	**59.1**	**119.8**	23	
Arsenic	**9.3**	**9.1**	**17.2**	2	130
Selenium	9.1	9	12.7		
Strontium	444	423.7	506.3		
Molybdenum	1.222	1.473	1.515		
Cadmium	0.1364	0.1516	0.1602		60
Tin	0.8928	1.141	0.9202		
Stibium	0.3494	0.4252	0.4446	4.5	
Barium	652.4	588.9	505.4		
Lead	**10.1**	**12.5**	**13.7**	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.2282	0.1493	ND	0.3	9
Xylene	0.009	0.0122	ND	0.3	
Petroleum Hydrocarbons	10.93	24.93	13.46		

Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

	Borehole 4	Borehole 5	Borehole 6	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	27.3	7.6	6.1		
Sodium	24474	6119	5833		
Magnesium	26671	5128	4629		
Aluminum	30040	19200	18480		
Potassium	8032	6655	5215		
Calcium	99230	16790	15000		
Titanium	2901	3867	4370		
Vanadium	121.8	**163.3**	**166.6**	150	
Chromium	**145.2**	**85.1**	**77.9**	6	500
Iron	52510	34070	34600		
Manganese	**749.4**	**417.2**	374.9	400 – 700 (depending on pH)	
Cobalt	**30.6**	**18.8**	**17.9**	5	
Nickel	**44.8**	**40.7**	**39.9**	4	300
Copper	**113.9**	**44.1**	**42.4**	3	
Zinc	**89.3**	**79.5**	**78**	23	
Arsenic	**15.7**	**10.3**	**10.1**	2	130
Selenium	10.8	4.3	3.9		
Strontium	539.8	182	165.2		
Molybdenum	1.773	1.273	1.471		
Cadmium	0.152	0.1102	0.1156		60
Tin	1.1488	1.2748	2.1542		
Stibium	0.4944	0.4968	0.588	4.5	
Barium	519.7	517.8	273.7		
Lead	**15.7**	**10.7**	**13.8**	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	**0.3736**	**0.4483**	0.0154	0.3	9
Xylene	0.0066	0.0079	0.0052	0.3	
Petroleum Hydrocarbons	38.21	45.85	21.78		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

	Borehole 7	Borehole 8	Borehole 9	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	22.8	21.6	19.7		
Sodium	9215	8765	10102		
Magnesium	19369	17971	14135		
Aluminum	28510	27900	51710		
Potassium	8030	6823	8130		
Calcium	188220	172690	85330		
Titanium	2296	2624	2372		
Vanadium	93.3	93.7	122.9	150	
Chromium	**136.1**	**101.7**	**76.1**	6	500
Iron	48020	46530	50190		
Manganese	**874**	**681.9**	**631.9**	400 – 700 (depending on pH)	
Cobalt	**38.3**	**37.8**	**26.2**	5	
Nickel	**38.3**	**37.2**	**37.9**	4	300
Copper	**40.7**	**37.2**	**44.9**	3	
Zinc	**50.1**	**41.4**	**55.6**	23	
Arsenic	**14.2**	**13.8**	**16.6**	2	130
Selenium	11.3	9.7	9.3		
Strontium	709.4	655	416.6		
Molybdenum	0.837	1.011	1.998		
Cadmium	0.1446	0.197	0.156		60
Tin	0.8692	1.1072	0.8976		
Stibium	0.4038	0.4572	0.4524	4.5	
Barium	353.4	369.4	535.7		
Lead	**10.2**	**10.9**	**11.6**	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.0612	**0.6002**	0.0191	0.3	9
Xylene	0.0063	0.0254	0.0054	0.3	
Petroleum Hydrocarbons	37.81	221.48	7.73		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

	Borehole 10	Borehole 11	Borehole 12	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	17.9	17	7		
Sodium	9465	9111	5023		
Magnesium	13595	13279	4533		
Aluminum	49230	47200	19640		
Potassium	7636	7347	6284		
Calcium	82490	79700	44150		
Titanium	2330	2283	2180		
Vanadium	120.7	119	101	150	
Chromium	**74.6**	**72.5**	**60.4**	6	500
Iron	48750	47790	24720		
Manganese	**613.6**	**597.1**	345.4	400 – 700 (depending on pH)	
Cobalt	**26.2**	**25**	**17.1**	5	
Nickel	**37.3**	**36.6**	**29.7**	4	300
Copper	**42.7**	**44.6**	**25.6**	3	
Zinc	**54.1**	**52.7**	**41.8**	23	
Arsenic	**16**	**15.8**	**14.6**	2	130
Selenium	9.5	9.1	6.1		
Strontium	406.5	404.1	197.7		
Molybdenum	1.953	1.957	1.142		
Cadmium	0.1444	0.1538	0.1056		60
Tin	0.8664	0.877	0.7492		
Stibium	0.459	0.458	0.3366	4.5	
Barium	537.1	535.2	251.9		
Lead	**12.3**	**12.2**	**10.1**	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.0061	0.1045	0.0201	0.3	9
Xylene	0.0039	0.0062	0.0019	0.3	
Petroleum Hydrocarbons	7.36	9.64	10.15		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

	Borehole 13	Borehole 14	Borehole 15	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	6.7	16.4	11.9		
Sodium	5004	8911	9003		
Magnesium	4371	12767	10420		
Aluminum	19280	46560	45670		
Potassium	6350	7271	7264		
Calcium	44430	78080	107480		
Titanium	2190	2244	2686		
Vanadium	101.5	118.8	112.7	150	
Chromium	**59.4**	**71**	**94.4**	6	500
Iron	24570	47400	52240		
Manganese	344.6	**596.9**	**821.3**	400 – 700 (depending on pH)	
Cobalt	**16.8**	**25.2**	**32.2**	5	
Nickel	**29.3**	**35.9**	**39.3**	4	300
Copper	**25.3**	**42.9**	**38.2**	3	
Zinc	**41.5**	**53.2**	**53.6**	23	
Arsenic	**14.1**	**15.8**	**19.7**	2	130
Selenium	5.1	9.1	10.3		
Strontium	199.3	405.5	550.4		
Molybdenum	1.154	1.907	3.066		
Cadmium	0.109	0.1442	0.1516		60
Tin	0.7526	0.8864	0.9146		
Stibium	0.3394	0.4542	0.3976	4.5	
Barium	252	538.5	796.5		
Lead	**10.2**	**12.4**	**12.9**	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.0036	0.0085	0.01064	0.3	9
Xylene	0.0016	0.0065	0.00816	0.3	
Petroleum Hydrocarbons	8.81	11.85	14.81		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

	Borehole 16	Borehole 17	Borehole 18	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	11.4	10.4	9.6		
Sodium	9075	8580	7589		
Magnesium	10303	9874	8950		
Aluminum	44970	43360	39060		
Potassium	7419	6864	6184		
Calcium	106190	104140	95550		
Titanium	2617	2545	2395		
Vanadium	112	109.6	102.9	150	
Chromium	**94.8**	**94**	**89.2**	6	500
Iron	51320	50820	49200		
Manganese	**799.4**	**782.2**	**759.4**	400 – 700 (depending on pH)	
Cobalt	**33.3**	**33.6**	**34.6**	5	
Nickel	**38.8**	**39.2**	**38.1**	4	300
Copper	**36.5**	**38.2**	**37.6**	3	
Zinc	**52.2**	**52.4**	**50.1**	23	
Arsenic	**20.3**	**19.9**	**18.8**	2	130
Selenium	10.1	10.9	10.6		
Strontium	546.4	542.8	527.8		
Molybdenum	3.057	3.063	2.959		
Cadmium	0.156	0.1684	0.1544		60
Tin	1.016	1.0224	1.0344		
Stibium	0.3928	0.4136	0.399	4.5	
Barium	781	805.8	804.5		
Lead	**12.8**	**14**	**14.4**	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.0128	0.0117	0.005	0.3	9
Xylene	0.0098	0.009	0.003	0.3	
Petroleum Hydrocarbons	17.77	16.29	13.954		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

	Borehole 19	Borehole 20	Borehole 21	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	7.8	6.9	6.7		
Sodium	7650	6675	4942		
Magnesium	6020	5147	4433		
Aluminum	30930	26660	19220		
Potassium	6890	6248	6217		
Calcium	51500	46670	43480		
Titanium	1920	1851	2131		
Vanadium	107	105.9	99.6	150	
Chromium	**55**	**52.8**	**60.7**	6	500
Iron	33830	33320	24050		
Manganese	**527**	**534.4**	339.5	400 – 700 (depending on pH)	
Cobalt	**20.5**	**21**	**16.6**	5	
Nickel	**26.6**	**26.2**	**29.1**	4	300
Copper	**122.3**	**121.3**	**25.5**	3	
Zinc	**73.1**	**73.4**	**41.1**	23	
Arsenic	**12.6**	**12.3**	**14.4**	2	130
Selenium	8.5	7.6	5.4		
Strontium	358.4	344.8	201.7		
Molybdenum	0.0008	0.773	1.164		
Cadmium	0.00017	0.1606	0.097		60
Tin	0.00097	0.9938	0.7516		
Stibium	0.00038	0.3852	0.3408	4.5	
Barium	723	761	253.3		
Lead	**14**	**15.6**	**10.3**	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.0085	0.0119	0.0307	0.3	9
Xylene	0.0065	0.0059	0.0051	0.3	
Petroleum Hydrocarbons	11.848	12.398	5.331		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

	Borehole 22	Borehole 23	Borehole 24	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	7.1	6.7	9.7		
Sodium	6988	6710	5764		
Magnesium	5541	5093	6338		
Aluminum	27970	26810	32020		
Potassium	6501	6333	6154		
Calcium	48830	46130	63510		
Titanium	1923	1858	1821		
Vanadium	105.7	104.7	96.2	150	
Chromium	**53.9**	**52.1**	**78.4**	6	500
Iron	33080	32770	36550		
Manganese	**529.5**	**515.7**	**580.1**	400 – 700 (depending on pH)	
Cobalt	**21.2**	**20**	**20.4**	5	
Nickel	**26.6**	**26**	**29.3**	4	300
Copper	**119.3**	**116.9**	**34.8**	3	
Zinc	**72.5**	**71.7**	**42.7**	23	
Arsenic	**12.4**	**11.9**	**15.3**	2	130
Selenium	7.8	7.5	2		
Strontium	358.9	348.1	419.6		
Molybdenum	0.847	0.761	1.126		
Cadmium	0.1462	0.151	0.135		60
Tin	0.979	0.9852	0.899		
Stibium	0.3974	0.3742	0.4296	4.5	
Barium	773.4	760.9	535		
Lead	**15.5**	**15.4**	**16**	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.0141	0.0166	0.0225	0.3	9
Xylene	0.0033	0.0039	0.0064	0.3	
Petroleum Hydrocarbons	4.68	5.5	9.09		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

	Borehole 25	Borehole 26	Borehole 27	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	10	6.6	10.9		
Sodium	5992	4778	6480		
Magnesium	6598	4326	6536		
Aluminum	33640	18910	36450		
Potassium	6474	6104	7216		
Calcium	64720	42940	69270		
Titanium	1837	2145	1961		
Vanadium	96.7	98.8	102	150	
Chromium	**81.5**	**59**	**80.7**	6	500
Iron	36770	24090	38990		
Manganese	**567.7**	340.9	**606.6**	400 – 700 (depending on pH)	
Cobalt	**20.8**	**17.1**	**20.6**	5	
Nickel	**29.5**	**29.4**	**28.9**	4	300
Copper	**36.1**	**25.6**	**35.7**	3	
Zinc	**42.2**	**40.9**	**44.3**	23	
Arsenic	**15.6**	**14.1**	**15.9**	2	130
Selenium	2.2	5.5	2.1		
Strontium	428.1	200	428.2		
Molybdenum	1.149	1.144	1.148		
Cadmium	0.1464	0.1088	0.1354		60
Tin	0.8936	0.7794	0.8736		
Stibium	0.4072	0.3324	0.4032	4.5	
Barium	526.4	254.5	503.9		
Lead	**15.5**	**10.4**	**13.7**	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.0086	0.0062	0.0013	0.3	9
Xylene	0.0047	0.004	ND	0.3	
Petroleum Hydrocarbons	8.44	7.56	12.52		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

	Borehole 28	Borehole 29	Borehole 30	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	11.6	8.7	5.4		
Sodium	7417	8053	10675		
Magnesium	7346	6179	4878		
Aluminum	39210	39700	26490		
Potassium	7757	7108	5049		
Calcium	74740	83940	25860		
Titanium	2048	1992	1886		
Vanadium	106.1	105.6	73.2	150	
Chromium	**84.6**	**72.5**	**35.9**	6	500
Iron	39370	54710	20430		
Manganese	**621.1**	**822.3**	**459.1**	400 – 700 (depending on pH)	
Cobalt	**20.8**	**28.7**	**17.9**	5	
Nickel	**29.7**	**22.9**	**29**	4	300
Copper	**36.8**	**42.2**	**24.5**	3	
Zinc	**45.9**	**41.1**	**57.2**	23	
Arsenic	**16.5**	**13.9**	**7.5**	2	130
Selenium	2.1	10.9	7.3		
Strontium	433.6	302.2	360		
Molybdenum	1.155	1.53	1.839		
Cadmium	0.1428	0.1624	0.1112		60
Tin	0.8682	0.9872	0.8906		
Stibium	0.3996	0.4488	0.3196	4.5	
Barium	493.5	1235.1	817		
Lead	**12.9**	**17.8**	**15.9**	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.0055	0.0055	0.008	0.3	9
Xylene	0.0033	0.0035	0.0057	0.3	
Petroleum Hydrocarbons	5.37	6.69	11.16		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

	Borehole 31	Borehole 32	Borehole 33	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	6	8.4	9.9		
Sodium	10833	7499	8261		
Magnesium	4922	5759	6414		
Aluminum	26990	36780	41470		
Potassium	5181	6723	7595		
Calcium	27150	76930	88900		
Titanium	1930	1893	1992		
Vanadium	73.4	101.7	105.1	150	
Chromium	**34.5**	**65.4**	**71.4**	6	500
Iron	21310	52060	54950		
Manganese	**475.5**	**776.3**	**812.1**	400 – 700 (depending on pH)	
Cobalt	**17.8**	**26.4**	**27.2**	5	
Nickel	**29.5**	**20.8**	**21.9**	4	300
Copper	**24.7**	**40.2**	**40.7**	3	
Zinc	**57.4**	**39.3**	**41.2**	23	
Arsenic	**7.7**	**13.1**	**13.7**	2	130
Selenium	6.7	10.8	10.9		
Strontium	365.6	296.6	311.4		
Molybdenum	1.852	1.441	1.539		
Cadmium	0.0958	0.156	0.1644		60
Tin	0.8842	0.9892	0.9772		
Stibium	0.3296	0.4256	0.4538	4.5	
Barium	810.9	1185.2	1192.4		
Lead	**15.4**	**17.2**	**16.4**	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.0656	0.0534	0.0427	0.3	9
Xylene	0.0215	0.0175	0.014	0.3	
Petroleum Hydrocarbons	18.29	14.87	11.9		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

	Borehole 34	Borehole 35	Borehole 36	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	8	6.9	6		
Sodium	6990	13698	11868		
Magnesium	5464	6136	5346		
Aluminum	34890	32680	30320		
Potassium	6632	6061	5445		
Calcium	75960	29990	27350		
Titanium	1729	2137	1994		
Vanadium	95.8	82	76	150	
Chromium	**65**	**37**	**35.2**	6	500
Iron	50240	22000	21110		
Manganese	**747.3**	**501.1**	**478.6**	400 – 700 (depending on pH)	
Cobalt	**27.5**	**17.5**	**17.3**	5	
Nickel	**21.5**	**30**	**28.6**	4	300
Copper	**39.2**	**24.3**	**24.1**	3	
Zinc	**38.8**	**59.7**	**58.2**	23	
Arsenic	**13.5**	**8**	**7.6**	2	130
Selenium	11.2	6.4	6.7		
Strontium	287.8	381.2	366.9		
Molybdenum	1.431	1.904	1.801		
Cadmium	0.1416	0.1252	0.1060		60
Tin	0.9826	0.8734	0.8528		
Stibium	0.4552	0.3264	0.3238	4.5	
Barium	1229.1	752.8	779.8		
Lead	**18.7**	**12.4**	**13.7**	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.0138	0.00133	0.00951	0.3	9
Xylene	0.0106	ND	0.00684	0.3	
Petroleum Hydrocarbons	19.26	12.64	13.29		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

	Borehole 37	Borehole 38	Borehole 39	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	8.6	9.2	9.8		
Sodium	5905	6464	6886		
Magnesium	7370	8176	8490		
Aluminum	36160	39270	41290		
Potassium	5398	5484	5668		
Calcium	84900	89850	93860		
Titanium	1567	1598	1611		
Vanadium	70.9	72.4	74	150	
Chromium	**60.6**	**63.3**	**65.1**	6	500
Iron	42160	42180	42960		
Manganese	**584.6**	**579.4**	**594**	400 – 700 (depending on pH)	
Cobalt	**27.8**	**28.2**	**28.3**	5	
Nickel	**25**	**24.7**	**25.4**	4	300
Copper	**35.2**	**36**	**37.1**	3	
Zinc	**38.8**	**39.2**	**40.4**	23	
Arsenic	**13.6**	**13.8**	**14.4**	2	130
Selenium	8.4	8.2	8.3		
Strontium	386.9	392.9	397.9		
Molybdenum	1.408	1.487	1.496		
Cadmium	0.1298	0.1542	0.1784		60
Tin	0.7906	0.7796	0.7988		
Stibium	0.3298	0.3216	0.3312	4.5	
Barium	649.7	629.1	633		
Lead	**12.5**	**11.4**	**11.3**	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.048	0.0044	0.0715	0.3	9
Xylene	0.0158	0.0026	0.0042	0.3	
Petroleum Hydrocarbons	13.39	4.33	6.6		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

	Borehole 40	Borehole 41	Borehole 42	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	8.7	9.2	9.8		
Sodium	6253	10781	11251		
Magnesium	7653	8010	8604		
Aluminum	37290	31740	33000		
Potassium	5669	6315	6709		
Calcium	87170	64400	66010		
Titanium	1594	2181	2284		
Vanadium	73.4	62.8	66.7	150	
Chromium	**62.7**	**52.5**	**53.4**	6	500
Iron	40680	30660	31560		
Manganese	**574.5**	364.8	385.1	400 – 700 (depending on pH)	
Cobalt	**28.9**	**18.5**	**17.4**	5	
Nickel	**24.3**	**27.6**	**27.1**	4	300
Copper	**36.3**	**30.2**	**29.9**	3	
Zinc	**38.9**	**48.8**	**49.6**	23	
Arsenic	**14.1**	**10.4**	**10.5**	2	130
Selenium	8.8	7.7	7.2		
Strontium	386.8	437.1	445.3		
Molybdenum	1.450	1.903	1.883		
Cadmium	0.1558	0.162	0.1404		60
Tin	0.8112	1.1134	1.1008		
Stibium	0.335	0.3064	0.3034	4.5	
Barium	634.3	700.7	678.7		
Lead	**12.1**	**14**	**13.3**	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.0804	0.00156	0.0014	0.3	9
Xylene	0.0048	0.00179	0.0016	0.3	
Petroleum Hydrocarbons	7.42	10.121	9.01		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

	Borehole 43	Borehole 44	Borehole 45	Armenian hygienic requirements N 2.1.7.003-10	German standards VWV BW P-M3
Lithium	10.2	8.8	10.1		
Sodium	11823	10212	11714		
Magnesium	8911	7969	8641		
Aluminum	34400	29490	34320		
Potassium	6585	5942	6760		
Calcium	66480	60770	67820		
Titanium	2319	2135	2322		
Vanadium	66	62.8	67	150	
Chromium	**53.2**	**50.7**	**53**	6	500
Iron	31660	29860	31820		
Manganese	387.4	369.6	384.7	400 – 700 (depending on pH)	
Cobalt	**17.5**	**18.6**	**16.9**	5	
Nickel	**27.2**	**27.5**	**27.4**	4	300
Copper	**29.9**	**29.2**	**29.8**	3	
Zinc	**49.6**	**48.5**	**50.5**	23	
Arsenic	**10.3**	**10.1**	**10.5**	2	130
Selenium	6.7	8	7.5		
Strontium	454.1	449.7	451.1		
Molybdenum	1.878	1.917	1.9		
Cadmium	0.158	0.1460	0.1536		60
Tin	1.0932	1.137	1.112		
Stibium	0.2992	0.3082	0.3074	4.5	
Barium	681.3	715	665.6		
Lead	**13**	**15.3**	**12.7**	6	4000
Benzene	ND	ND	ND	0.3	0.01
Ethylbenzene	ND	ND	ND		
Toluene	0.0116	0.0052	0.0041	0.3	9
Xylene	0.0083	0.0022	0.0018	0.3	
Petroleum Hydrocarbons	16.22	12.65	10.12		
Polycyclic Aromatic Hydrocarbons	ND	ND	ND		100

ND: not detected

4.2 Groundwater

The results from the laboratory analysis in original are shown on following table:

	Sample No.				German Imple-menta-tion EU-WFD **GrwV**	German standards **BBodSchG**
Parameter	**Borehole 1**	**Borehole 2**	**Borehole 3**	**Unit**		
pH	7.41	7.96	7.55			
Minerals	1495	1490	3145	mg/l		
BOD_5	1.18	1.01	1.6	mgO_2/l		
COD-Cr	64	32	60	mgO/l		
Lithium	34.91	11.49	58.3	µg/l		
Sodium	200.6	442	304.5	mg/l		
Magnesium	28.5	2.81	82.19	mg/l		
Aluminium	31.83	802.61	28.89	µg/l		
Potassium	2.5	0.2753	6.02	mg/l		
Calcium	188	15.59	485.8	mg/l		
Titanium	7.26	57.56	5.83	µg/l		
Vanadium	84.95	759.87	52.84	µg/l		
Chrom	4.41	12.37	9.98	µg/l		50
Iron	125.09	912.14	106.59	µg/l		
Manganese	238.24	74.39	464.01	µg/l		
Cobalt	1.1	5.4	2.33	µg/l		50
Nickel	14.96	5.41	25.28	µg/l		50
Copper	7	9.47	10.74	µg/l		50
Zinc	4.64	3.78	7.41	µg/l		500
Arsenic	**22.94**	**215.5**	**16.57**	µg/l	10	10
Selen	6.73	8.75	8.42	µg/l		10
Strontium	2.42	406.03	5.59	mg/l		
Molybdenum	**72.97**	**219.4**	**58.45**	µg/l		50
Cadmium	0.25	**0.59**	0.16	µg/l	0.5	5
Tin	0.04	0.1	0.05	µg/l		40
Stibium	0.25	0.31	0.16	µg/l		
Barium	39.86	31.43	36.57	µg/l		
Lead	0.08	0.18	0.09	µg/l	10	25
BETX	<1	0,56	<1	µg/l		20
Benzol	<1	<1	<1	µg/l		1
TPH	168	**7407**	<1	µg/l		200
PAH	ND	ND	ND	µg/l		0.2

ND = Not detected

4.3 Surface Water

The results from the laboratory analysis in original are shown on following table:

	Sample No. "B" - Before channel		**Armenian Water Quality Scale and Standards**					**German Standards OGewV**
Parameter	**Result**	**Unit**	1	**2***	3	4	5	
pH	7.45		6.5 – 9.0					5.5-8.5
Minerals	666	mg/l						
BOD_5	2.52	mgO_2/l	3	***5***	9	18	>18	<3
COD-Cr	**42**	mgO/l	10	***25***	40	80	>80	
Lithium	26.6	µg/l	1	***36***	50	<2500	>2500	
Sodium	**64.94**	mg/l	4.96	***9.92***	19.84	39.68	>39.68	
Magnesium	27.5	mg/l	2.8	***50***	100	200	>200	
Aluminium	0.0138	mg/l	65	***130***	260	5000	>5000	
Potassium	**5.74**	mg/l	1.54	***3.08***	6.16	12.32	>12.32	
Calcium	68.06	mg/l	9.7	***100***	200	300	>300	
Titanium	6.72	µg/l	7	***14***	28	56	>56	
Vanadium	**14.96**	µg/l	1	***2***	4	8	>8	
Chrom	4.34	µg/l	1	***10***	100	250	>250	
Iron	**106.72**	µg/l	0.08	***0.16***	0.5	1	>1	
Manganese	**26.11**	µg/l	5	***10***	20	40	>40	
Cobalt	**0.34**	µg/l	0.14	***0.28***	0.56	1.12	>1.12	
Nickel	3.31	µg/l	1	***11***	50	100	>100	34
Copper	1.83	µg/l	3	***23***	50	100	>100	
Zinc	2.5	µg/l	3	***100***	200	500	>500	
Arsenic	6.77	µg/l	0.13	***20***	50	100	>100	
Selen	2.1	µg/l	0.47	***20***	40	80	>80	
Strontium	387.97	µg/l						
Molybdenum	3.24	µg/l	7	***14***	28	56	>56	
Cadmium	0.021	µg/l	0.02	***1.02***	2.02	4.02	>4.02	0.45
Tin	0.0006	µg/l	0.09	***0.18***	0.36	0.72	>0.72	
Stibium	0.0912	µg/l	0.19	***0.38***	0.76	1.52	>1.52	
Barium	**32.3**	µg/l	9	***18***	36	1000	>1000	
Lead	0.21	µg/l	0.3	***10.3***	25	50	>50	14
BETX	<1	µg/l	10	***30***	42	50	>50	50
TPH	<1	µg/l	0.05	***0.1***	0.3	0.5	>0.5	
PAH	ND	µg/l	--	**--**	--	--	--	0.27

* = standard value in Armenia
1 = Excellent 2 = Good 3= Moderate 4 = Poor 5 = Bad
ND = not detected / not analysed

	Sample No. "C" - From channel		**Armenian Water Quality Scale and Standards**					**German Standards OGewV**
Parameter	**Result**	**Units**	1	**2***	3	4	5	
pH	7.76		6.5 – 9.0					5.5-8.5
Minerals	593	mg/l						
BOD_5	2.87	mgO_2/l	3	***5***	9	18	>18	<3
COD-Cr	**26**	mgO/l	10	***25***	40	80	>80	
Lithium	25.28	µg/l	1	***36***	50	<2500	>2500	
Sodium	**82.2**	mg/l	4.96	***9.92***	19.84	39.68	>39.68	
Magnesium	21.96	mg/l	2.8	***50***	100	200	>200	
Aluminium	3.3	µg/l	65	***130***	260	5000	>5000	
Potassium	**4.715**	mg/l	1.54	***3.08***	6.16	12.32	>12.32	
Calcium	50.65	mg/l	9.7	***100***	200	300	>300	
Titanium	6.09	µg/l	7	***14***	28	56	>56	
Vanadium	**17.7**	µg/l	1	***2***	4	8	>8	
Chrom	3.73	µg/l	1	***10***	100	250	>250	
Iron	**80.14**	µg/l	0.08	***0.16***	0.5	1	>1	
Manganese	8.18	µg/l	5	***10***	20	40	>40	
Cobalt	**0.55**	µg/l	0.14	***0.28***	0.56	1.12	>1.12	
Nickel	4.04	µg/l	1	***11***	50	100	>100	34
Copper	1.53	µg/l	3	***23***	50	100	>100	
Zinc	0.6	µg/l	3	***100***	200	500	>500	
Arsenic	7.58	µg/l	0.13	***20***	50	100	>100	
Selen	1.1	µg/l	0.47	***20***	40	80	>80	
Strontium	254.36	µg/l						
Molybdenum	5.98	µg/l	7	***14***	28	56	>56	
Cadmium	0.03	µg/l	0.02	***1.02***	2.02	4.02	>4.02	0.45
Tin	0.003	µg/l	0.09	***0.18***	0.36	0.72	>0.72	
Stibium	0.12	µg/l	0.19	***0.38***	0.76	1.52	>1.52	
Barium	16.72	µg/l	9	***18***	36	1000	>1000	
Lead	0.092	µg/l	0.3	***10.3***	25	50	>50	14
BETX	<1	µg/l	10	***30***	42	50	>50	50
TPH	<1	µg/l	0.05	***0.1***	0.3	0.5	>0.5	
PAH	ND	µg/l	--	**--**	--	--	--	0.27

	Sample No. "H" - After channel		Armenian Water Quality Scale and Standards					German Standards OGewV
Parameter	**Result**	**mg/l µg/l**	1	**2***	3	4	5	
pH	7.47		6.5 – 9.0					5.5-8.5
Minerals	661	mg/l						
BOD_5	3.91	mgO_2/l	3	***5***	9	18	>18	<3
COD-Cr	**30**	mgO/l	10	***25***	40	80	>80	
Litium	27	µg/l	1	***36***	50	<2500	>2500	
Sodium	**59.63**	mg/l	4.96	***9.92***	19.84	39.68	>39.68	
Magnesium	27.46	mg/l	2.8	***50***	100	200	>200	
Aluminium	13.2	µg/l	65	***130***	260	5000	>5000	
Potasium	**5.58**	mg/l	1.54	***3.08***	6.16	12.32	>12.32	
Calcium	67.72	mg/l	9.7	***100***	200	300	>300	
Titanium	6.374	µg/l	7	***14***	28	56	>56	
Vanadium	**13.205**	µg/l	1	***2***	4	8	>8	
Chrom	4.477	µg/l	1	***10***	100	250	>250	
Iron	**106.66**	µg/l	0.08	***0.16***	0.5	1	>1	
Manganese	**28.988**	µg/l	5	***10***	20	40	>40	
Cobalt	**0.304**	µg/l	0.14	***0.28***	0.56	1.12	>1.12	
Nickel	3.085	µg/l	1	***11***	50	100	>100	34
Copper	1.679	µg/l	3	***23***	50	100	>100	
Zinc	2.253	µg/l	3	***100***	200	500	>500	
Arsenic	6.365	µg/l	0.13	***20***	50	100	>100	
Selen	2.069	µg/l	0.47	***20***	40	80	>80	
Strontium	391.98	µg/l						
Molybdenum	2.763	µg/l	7	***14***	28	56	>56	
Cadmium	0.019	µg/l	0.02	***1.02***	2.02	4.02	>4.02	0.45
Tin	0.006	µg/l	0.09	***0.18***	0.36	0.72	>0.72	
Stibium	0.11	µg/l	0.19	***0.38***	0.76	1.52	>1.52	
Barium	**32.977**	µg/l	9	***18***	36	1000	>1000	
Lead	0.692	µg/l	0.3	***10.3***	25	50	>50	14
BETX	<1	µg/l	10	***30***	42	50	>50	50
TPH	<1	µg/l	0.05	***0.1***	0.3	0.5	>0.5	
PAH	ND	µg/l	--	**--**	--	--	--	0.27

5. Evaluation

There are no uniform international standards, therefore the evaluation is done by following standards: BBodSchG / Germany and GrwV (German implementation EU-WFD). The threshold values of these lists are similar in several European countries. The analytical results are compared to the threshold values of Armenia if existing. Exceeding results are written in **bold** letters in the above tables.

5.1 Soil

The bold printed results in chapter 4.1 are exceeded threshold values. Overall the Armenian threshold values of the hygienic requirements were often exceeded: the parameters Chromium, Cobalt, Nickel, Copper, Zinc, Arsenic and Lead always exceeded the threshold values; the parameter Manganese is often exceeded and rarely the values for Vanadium and Toluene are too high. On the other hand, the international standards for soil quality (the German VWV BW P-M3) are always respected, the values are typical for industrial areas. The Armenian hygienic requirements are far more strict than the international standards.

The RA Sanitary Norms 2.1.7.003-10 foresee proposals for land use based on the degree of contamination of the soils.

Proposals for land use based on the degree of pollution (Annex of the RA Sanitary Norms 2.1.7.003-10)

Category of contamination	Summary indicator of contamination	Proposals for land use
"Clean"	_	Using without any limitation
"Permissible" (allowable)	Less 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:

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

Focusing on the pollutants for which the MAC is exceeded, the following table shows the calculation of the Indicator of Contamination for the site.

Substances (heavy metals)	Unit	Maximum permissible concentration (National standard)	Average concentration	Indicator of contamination Factor
Vanadium	Mg/kg	150.0	98.3	0.65
Chromium	Mg/kg	6.0	72.7	12.1
Manganese	Mg/kg	400.0	568.0	1.4
Cobalt	Mg/kg	5.0	23.8	4.8
Nickel	Mg/kg	4.0	31.0	7.8
Copper	Mg/kg	3.0	46.4	15.5
Zinc	Mg/kg	23.0	54.1	2.4
Arsenic	Mg/kg	2.0	13.4	6.7
Lead	Mg/kg	6.0	13.4	2.2

The results show that the soil at site falls under the category „Permissible (allowable)“. This means that for the construction of the PP, no restrictions are imposed and the soil may be used.

5.2 Groundwater

In all three groundwater samples the results show several values exceeding the international standards (Arsenic, Molybdenum etc.). There are no national quality standards for groundwater. The sample 2 has to be pointed out, because here are the highest values for most of the analysed parameters. Remarkable is the value for TPH (Total Petroleum Hydrocarbons) with 7,400 mg/l.

5.3 Surface water

All three surface water samples show exceeding national threshold values for following parameters: COD-Cr, Sodium, Potassium, Vanadium, Iron and Cobalt. The international standards (German standards: OGewV) are mostly complied with (only the BOD_5 value is once exceeded slightly). The exceedances are verified before, at, and after the discharge point, and therefore no specific influence from the YCCPP-1’s discharge can be determined.

6. Risk Analysis

The soil exceeds national quality standards, but it is classified as “Permissible (allowable)“. Both nationally and internationally, no special treatment before construction is required.

The groundwater exceeds international threshold values. It is assumed that these contaminations have their origin from areas in the groundwater upstream.

For surface water, nearly no international threshold values are exceeded, but nationally it can be classified as within the 5th grade ("bad" quality). Most relevant for the assessment is the indication that the discharge of water of YCCPP-1 does not seem to have a negative influence on the water quality of the river.

7. Recommendations

- Soil: no treatment of the soil is necessary before construction.
- Groundwater: in case the water is used by the project (not foreseen presently), it shall be treated to respect international standards
- Surface water: the report does not show an influence of the existing power plant in the water quality of the river. It is recommended that the water discharged from the new power plant is treated to fulfil international standards before discharge.

8. Summary

In connection with the planned project „Yerevan Combined Cycle Power Plant (YCCPP) 2" a soil, surface water and groundwater study was requested. According to this it is necessary to get information about the near surface geology and especially about potential contamination of the soil, surface water and groundwater.

U/C-tec GmbH was asked to supervise this study. Primarily tasks were:

- Survey of field work or support of the local contractor (drilling, sampling)
- Evaluation of field work and analytical results
- Comparison to international and local standards / threshold values
- Design of a complete study with risk analysis and recommendations

Field work, sampling and chemical analysis were performed following Armenian standards. Evaluation follows international and national standards (EU, Germany, Armenia).

Totally 45 boreholes and 3 wells with sampling and analysis were performed by Geoterproject Ltd., 27 Azatutyan Ave., Yerevan, Armenia; Geoterproject was directly contracted by RENCO SPA.

The field work was realized from November 11th to November 29th.

The analytical results were compared to Armenian and European / German threshold values. The comparison shows that:

- Soil samples show compliance with international standards. The soil is also nationally classified as "Permissible (allowable)" and no remediation measures are therefore necessary.
- Groundwater samples show incompliance with international standards.
- Surface water samples show compliance with almost all international standards, and show incompliance with national standards. The incompliance cannot be attributed to the existing power plant.

The results of this study are based on punctual investigations (drillings). It is possible that between the drillings other conditions could appear.

Walldorf, 13.02.2018

Dipl.-Geol.
Gerd M. Wiedenbeck
U/C-tec GmbH

Dipl.-Geol.
Jochen Zolk

Revised by Fichtner, 14.02.2018

Annex 1

Scale:	Description: General Plan	Project: Yerevan YCCPP-2, Soil and groundwater study
Project-no.: 17.10.453		
Client: Fichtner GmbH & Co. KG	Date: 17.01.2018	Attachment: 1

U/C-tec Umwelt Consulting & Technologie

Annex 2

N

YCCPP-1

BH1
BH6
BH24
BH11
BH2
BH7
BH33
BH32
BH41
BH3
BH8
BH12
BH34
BH25/H1
BH42
BH31
BH9
BH35
BH13
BH4
H3
BH19
BH21
BH30
BH20
BH36/H2
BH43
BH5
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BH23
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BH10
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BH17
BH40
BH45

investigation area

construction site YCCPP-2

2m borehole drillings

4m borehole drillings

groundwater wells

4m borehole drillings upgraded to groundwater wells

direction of water movement 06.05.2017

0 m 100 m

Scale: 1 : 1.400	**Description:** Detailed Plan		**Project:** Yerevan YCCPP-2, Soil and groundwater study
Project-no.: 17.10.453			
Client: Fichtner GmbH & Co. KG	**Date:** 17.01.18	**Attachment:** 2	U/C-tec Umwelt Consulting & Technologie

Annex 3

SIGN AND SYMBOLS (see DIN 4023)

SAMPLING AND GROUNDWATER
Grade of doil samples add. DIN 4021 Tab.1
groundwater after compl. of boring

TYPES OF SOIL

clay	clayey	T	t
sand		S	

KONSISTENZ wch soft fst solid

U/C-tec GmbH	Project: Fichtner GmbH & Co KG, YEREVAN YCCPP-2 Soil & Groundwater study Plan description: Borehole 1 H - 3 H Soil profiles from groundwater wells	Enclosure no: - Project no: - Date: 25.01.2018 Scale: 1 : 75 Principal: JR

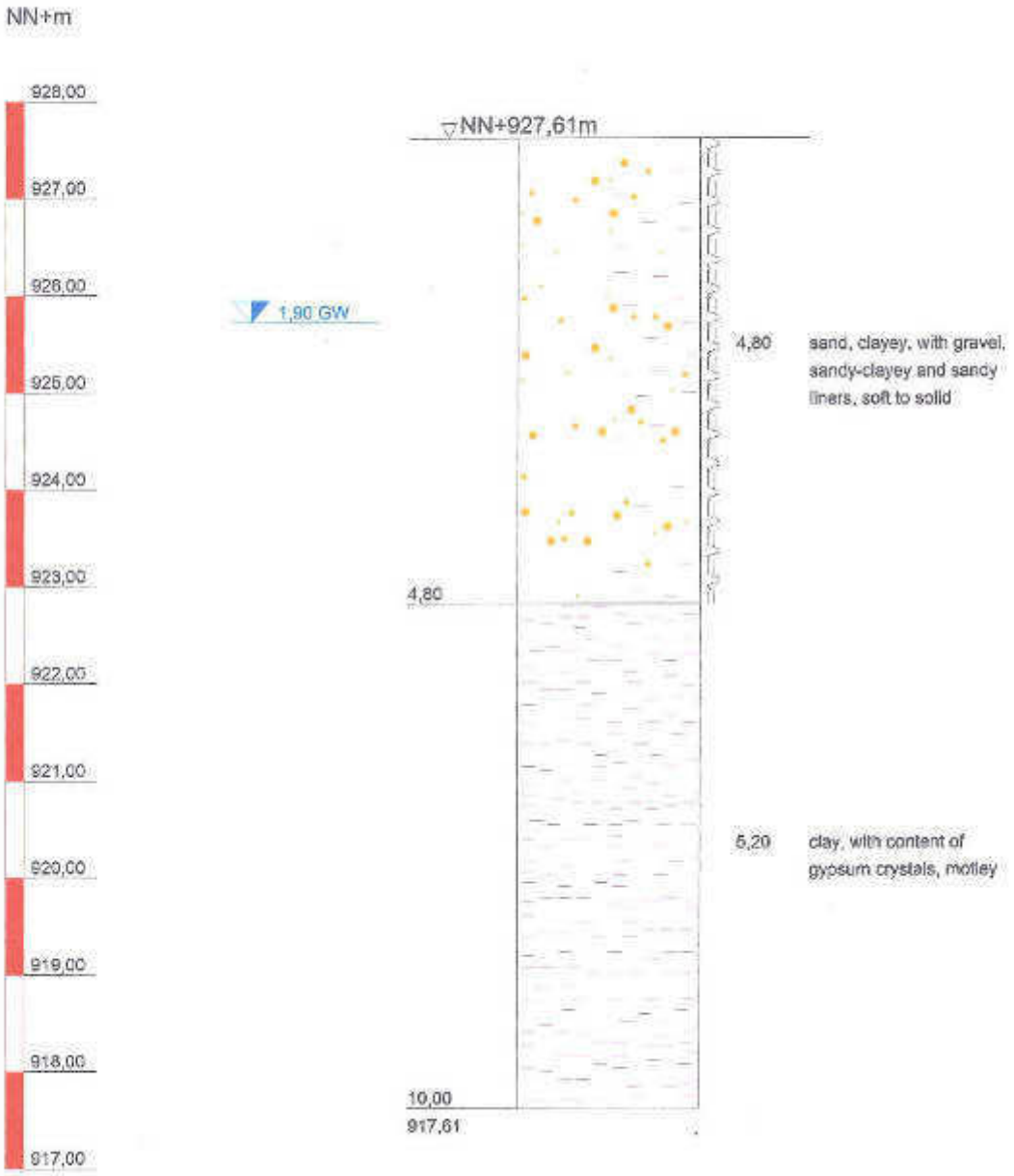
UIC-ieo GmbH

	List of soil courses for borings without continuous gaining of core samples	Enclosure: 3 Report: FN:
Project:	*Pictour GmbH & Co KG, YEREVAN YCORP 2 Soil & Groundwater study-soil profiles from groundwater wells*	
Boring No.: *Borehole 7 N* / Page 7		Date: *25.01.2013*

1	2				3	4	5	6
	a) Type of soil and additions				Remarks Special samples Water duct Boring tools Core loss	Gained samples		
... m below invest. point	b) Additional remarks [1]					Type	No.	Depth in m bottom edge
	c) State of drill chips	d) State of drilling progress	e) Color					
	f) Usual denomination	g) Geological denomination [1]	h) [1] Group	i) Lime contents				
4,90	a) *sand, clayey, with gravel, sandy-clayey and sandy liners*							
	b)							
	c)	d)	e)					
	f)	g)	h)	i)				
10,00	a) *clay, with content of gypsum crystals*							
	b)							
	c)	d)	e) *marley*					
	f)	g)	h)	i)				

[1] Notation is done by scientific reviewer

Borehole 1 H



U/C-tec GmbH	Project: Fichtner GmbH & Co KG, YEREVAN YCCPP-2 Soil & Groundwater study Plan description: Borehole 1 H Soil profiles from groundwater wells	Enclosure no: - Project no: - Date: 25.01.2018 Scale: 1 ; 75 Principal: JR

UIC tep GmbH

	List of soil courses for borings without continuous gaining of core samples	Enclosure: *3* Report: PN:

Project: *Fichtner GmbH & Co KG, YEREVAN YCCPP-2 Soil & Groundwater study-soil profiles from groundwater wells*

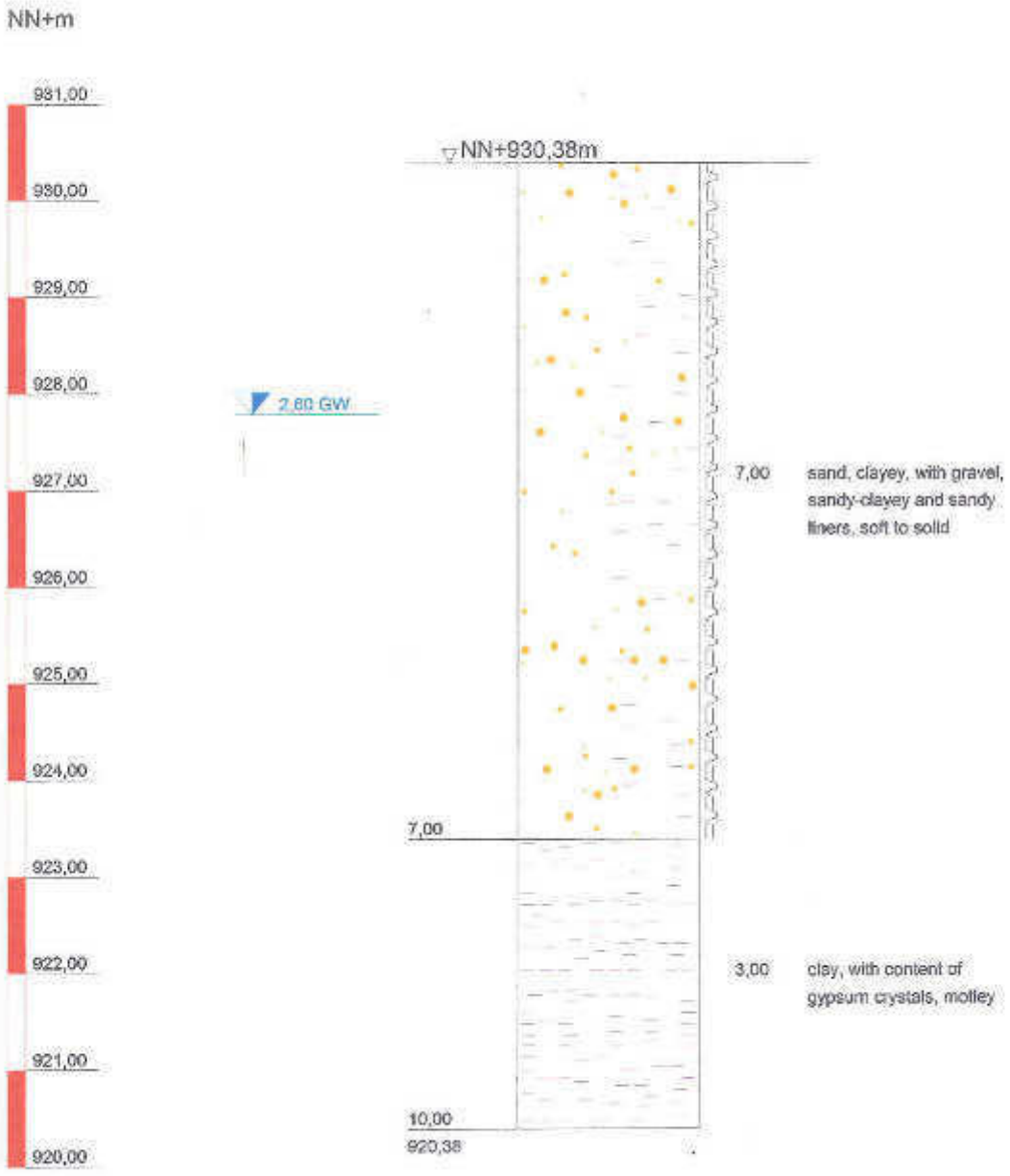
Boring
No.: *Borehole 2 H* / Page *1*

Date: *25.01.2018*

1	2				3	4	5	6
.. m below invest. point	a) Type of soil and additions b) Additional remarks [1] c) State of drill chips / d) State of drilling process / e) Color f) Usual denomination / g) Geological denomination [1] / h) [1] Group / i) Lime contents				Remarks Special samples Water duct Boring tools Core loss	Gained samples Type	No.	Depth in m bottom edge
7,00	a) *sand, clayey, with gravel, sandy-clayey and sandy lenses* b) c) *soft to solid* / d) / e) f) / g) / h) / i)							
19,00	a) *clay, with content of gypsum crystals* b) c) / d) / e) *medium* f) / g) / h) / i)							

[1] Notation is done by scientific reviewer

Borehole 2 H



U/C-tec GmbH	Project: Fichtner GmbH & Co KG, YEREVAN YCCPP-2 Soil & Groundwater study Plan description: Borehole 2 H Soil profiles from groundwater wells	Enclosure no: - Project no: - Date: 25.01.2018 Scale: 1 : 75 Principal: JR

UIC-tec GmbH

	List of soil courses for borings without continuous gaining of core samples	Enclosure: 3 Report: FN:

Project: *Fichtner GmbH & Co KG, YEREVAN YCCPP-2 Soil & Groundwater study-soil profiles from groundwater wells*

Boring

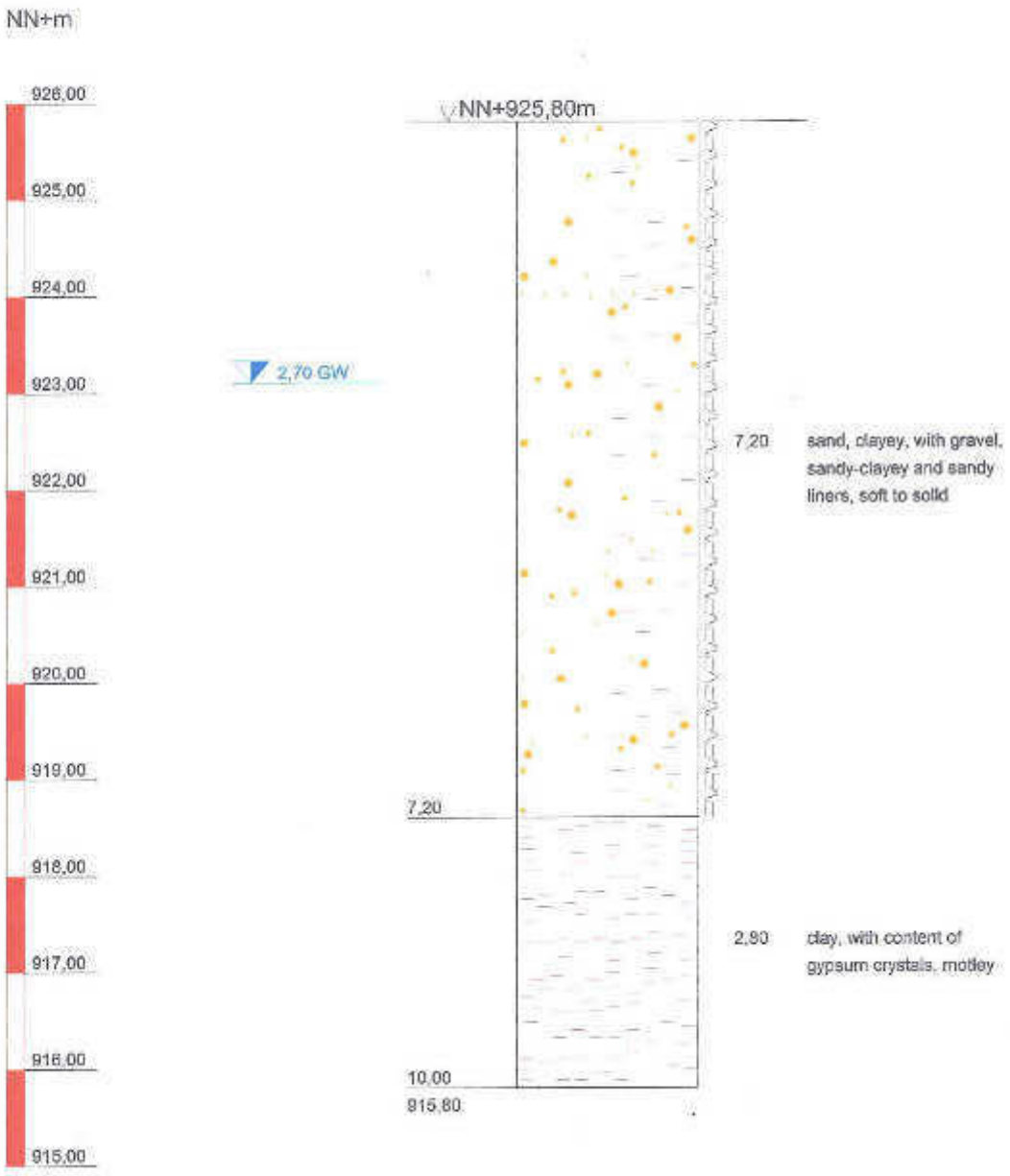
Date: *29.01.2018*

No.: *Borehole 3 H* / Page 1

1	2	3	4	5	6
...m below invest. point	a) Type of soil and additions b) Additional remarks *) c) State of drill chips / d) State of drilling process / e) Color f) Usual denomination / g) Geological cenominst on *) / h) *) Group / i) Lime contents	Remarks Special samples Water duct Boring tools Core loss	Gained samples: Type	Gained samples: No	Gained samples: Depth in m bottom edge
7,20	a) ***sand, clayey, with gravel, sandy-clayey and sandy liners*** b) c) ***soft to solid*** / d) / e) f) / g) / h) / i)				
13,00	a) ***clay, with content of gypsum crystals*** b) c) / d) / e) ***motley*** f) / g) / h) / i)				

*) Notation is done by scientific reviewer

Borehole 3 H



U/C-tec GmbH	Project: Fichtner GmbH & Co KG, YEREVAN YCCPP-2 Soil & Groundwater study Plan description: Borehole 3 H Soil profiles from groundwater wells	Enclosure no: - Project no: - Date: 25.01.2018 Scale: 1 : 75 Principal: JR

Annex 4

FIELD FORM

		Date: 11.11.2017-13.11.2017				
Samplers:			**Signatures:**		**Weather conditions**:	
Sample ID (as in bag)	**Sample name (as in bag)**	**Time**	**Depth, m**	**GPS Coordinates**	**Sample description (type and moisture)**	**Anthropogenic/ Natural Features in area**
Borehole 1	sandy loam	10.00	2.0	x-4440534.591 y-457058.321	Low moisture	Cloudy
Borehole 2	sandy loam	10.30	2.0	x-4440512.100 y-457054.471	Low moisture	Semi-cloudy
Borehole 3	sandy loam	11.00	2.0	x-4440488.082 y-457053.117	Low moisture	Cloudy
Borehole 4	sandy loam with gravel	12.00	4.0	x-4440458.083 y-457052.391	Moisture	Cloudy
Borehole 5	sandy loam with gravel	12.30	4.0	x-4440423.059 y-457053.989	Moisture	Cloudy
Borehole 6	sandy loam with gravel	10.00	2.0	x-4440533.241 y-457092.539	Low moisture	Sunny
Borehole 7	sandy loam with gravel	11.00	4.0	x-4440513.103 y-457091.482	Moisture	Sunny
Borehole 8	sandy loam	11.45	4.0	x-4440487.820 y-457096.105	Moisture	Sunny
Borehole 9	Sand with gravel	12.30	4.0	x-4440462.755 y-457093.727	Low moisture	Sunny
Borehole 10	sandy loam	13.15	2.0	x-4440407.791 y-457087.129	Moisture	Sunny
Borehole 11	sandy loam	13.45	4.0	x-4440520.939 y-457128.533	High moisture	Sunny
Borehole 12	sandy loam with gravel	14.00	2.0	x-4440487.313 y-457122.281	Low moisture	Sunny
Borehole 13	Sand with gravel	14.40	2.0	x-4440463.202 y-457119.314	Low moisture	Sunny

FIELD FORM

		Date: 14.11.2017-16.11.2017				
Samplers:			**Signatures:**		**Weather conditions**:	
Sample ID (as in bag)	**Sample name (as in bag)**	**Time**	**Depth, m**	**GPS Coordinates**	**Sample description (type and moisture)**	**Anthropogenic/ Natural Features in area**
Borehole 14	Sand with gravel	10.00	4.0	x-4440410.149 y-457110.018	Low moisture	Sunny
Borehole 15	Sand	10.40	4.0	x-4440371.347 y-457106.387	Low moisture	Sunny
Borehole 16	Sandy loam	11.00	4.0	x-4440343.253 y-457059.644	High moisture	Sunny
Borehole 17	Sand	12.00	4.0	x-4440338.463 y-457102.657	Moisture	Sunny
Borehole 18	Sandy loam	10.30	4.0	x-4440347.060 y-457164.130	Water-saturated	Sunny
Borehole 19	Sand	11.00	4.0	x-4440449.492 y-457115.310	High moisture	Sunny
Borehole 20	Sandy loam	11.45	4.0	x-4440436.107 y-457164.288	Moisture	Sunny
Borehole 21	Cabble stone, gravel	12.00	2.0	x-4440440.311 y-457195.398	Moisture	Sunny
Borehole 22	Sand	10.30	4.0	x-4440411.802 y-457188.518	Moisture	Sunny
Borehole 23	Sand with cabble stone and gravel	11.10	4.0	x-4440416.503 y-457158.038	High moisture	Sunny
Borehole 24	Sand with gravel	12.40	4.0	x-4440527.997 y-457172.447	High moisture	Sunny
Borehole 25	Sandy loam	13.30	4.0	x-4440479.585 y-457165.229	High moisture	Sunny
Borehole 26	Sandy loam	14.15	2.0	x-4440379.155 y-457190.612	High moisture	Sunny

FIELD FORM

		Date: 16.11.2017-18.11.2017				
Samplers:			**Signatures:**		**Weather conditions**:	
Sample ID (as in bag)	**Sample name (as in bag)**	**Time**	**Depth, m**	**GPS Coordinates**	**Sample description (type and moisture)**	**Anthropogenic/ Natural Features in area**
Borehole 27	Sand	14.40	2.0	x-4440369.032 y-457220.183	Moisture	Sunny
Borehole 28	Sandy loam	15.15	4.0	x-4440397.024 y-457219.620	Moisture	Sunny
Borehole 29	Sandy loam	15.40	2.0	x-4440420.874 y-457218.826	Moisture	Sunny
Borehole 30	Sandy loam	16.10	4.0	x-4440442.961 y-457220.607	Moisture	Sunny
Borehole 31	Clay loam	10.40	4.0	x-4440468.739 y-457225.429	High moisture	Sunny
Borehole 32	Sand	11.10	2.0	x-4440490.630 y-457225.574	High moisture	Sunny
Borehole 33	Sand	12.00	2.0	x-4440509.348 y-457259.649	Low moisture	Sunny
Borehole 34	Sand	11.00	4.0	x-4440483.511 y-457262.589	Moisture	Sunny
Borehole 35	Sand	11.40	2.0	x-4440459.617 y-457259.840	Moisture	Sunny
Borehole 36	Sandy loam	12.30	4.0	x-4440430.635 y-457260.629	Moisture	Sunny
Borehole 37	Sand	13.15	2.0	x-4440411.296 y-457256.538	Low moisture	Sunny
Borehole 38	Sandy loam	13.50	4.0	x-4440390.927 y-457255.824	Moisture	Sunny
Borehole 39	Sand with gravel	14.30	4.0	x-4440359.317 y-457253.071	Moisture	Sunny

FIELD FORM

		Date: 18.11.2017-19.11.2017				
Samplers:			**Signatures:**		**Weather conditions**:	
Sample ID (as in bag)	**Sample name (as in bag)**	**Time**	**Depth, m**	**GPS Coordinates**	**Sample description (type and moisture)**	**Anthropogenic/ Natural Features in area**
Borehole 40	Sand with cabble stone and gravel	15.10	4.0	x-4440331.207 y-457250.792	High moisture	Sunny
Borehole 41	Sandy loam	11.00	2.0	x-4440489.050 y-457308.720	Low moisture	Sunny
Borehole 42	Sand	11.40	2.0	x-4440468.929 y-457295.788	Low moisture	Sunny
Borehole 43	Sand with gravel	12.30	2.0	x-4440429.310 y-457298.440	Low moisture	Sunny
Borehole 44	Sand	13.10	2.0	x-4440374.051 y-457302.843	Low moisture	Sunny
Borehole 45	Sand with gravel	13.50	2.0	x-4440329.460 y-457298.229	Low moisture	Sunny

«Գեոտարածքնախագիծ»
ՍՊԸ

"Geoterproject"
LTD

№ ..... / ..... /

R E P O R T

On geological survey and laboratory analysis of Yerevan TPP new area

(Part 1)

Yerevan 2017

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R E P O R T

On geological survey and laboratory analysis of Yerevan TPP new area

(Part 1)

Client: *'Renco Armestate' LLC*

Director R. Manukyan

Chief specialist F. Avetisyan

Yerevan 2017

Contents

Text annex

Graphic annex

1. Introduction, description of the works

Pursuant to the contract N17/09, signed on 8.11.2017 by “Renco Armestate” LLC and “Geoterproject” Ltd, as well as annex N1 (technical specification), during November-December of 2017 the company “Geoterproject” Co. Ltd has carried out a complex geological survey and laboratory analysis of the territory of Yerevan TPP new area in Republic of Armenia.

The schematic plan of the area has been provided by the Client.

The study area is situated in the south-eastern part of Yerevan, in Erebuni district, RA.

The following operations have been carried out:

1. Collecting of the data on geotechnical and projective surveys carried out in these and neighboring areas, their coordination, comparison and analysis.
2. On the area mentioned by the client (75.000 square m.) for soil and water sampling had been done geological reconnaissance by drilling. These drilling works have been carried out by drilling rig UGB-50M (d=151mm, 131mm, 127mm and 112mm) by the dry mechanical column method, with a screw auger, core selection. 45 boreholes have been drilled in the proposed areas. 20 boreholes with 2m depth, 25 boreholes with 4m depth with overall volume of 140m/l.


Pic: Drilling and sumpeling works.

3. Using the drilled holes core, the sampling of soils has been carried out depending on non-disturbed and disturbed structure. Depths according to the technical task (2m and 4m, 45 boreholes, one sample from each).

4. For underground waters sampling have been drilled 3 hidro-geological boreholes, each by 10m depth with fastening. Drilling was made with a diameter of 151 mm, PVC porous tubes are installed in each of 3 hydro-geological wells. Each boreholes walls and the middle of the filter was made topping by sand. From each hydro-geological borehole was taken one water sample. From 1st borehole at the depth of 1.9m, from 2nd at the depth of 2.6m and from 3rd at the depth of 2.7m: depending on the groundwater stabilization level. See Appendix 3 hydro-geological wells columns.

5. On the area mentioned by the client has been carried out sampling of 3 of surface water samples from the following locations:
   Sample 1, upstream of the sewage discharge point of the Yerevan TPP1,
   Sample 2 downstream of the sewage discharge point of the Yerevan TPP1,
   Sample 3 at the sewage discharge point of the Yerevan TPP1 (access had been provided).

6. Carried out field and fund works office exploration.

7. Had been carried out analysis of the implemented works.

The field survey works, engineering-geological operations and office works were coordinated and headed by the director of “Geoterproject” Co. Ltd R. Manukyan and chief specialist geological engineer F. Avetisyan.

2. Area and site overview

The study area is located near the existing Yerevan TPP, in the south-estern part of Yerevan, RA, towards South from Yerevan TPP.

The absolute levels vary from 923.0m to 930.0m.

Pic. The space photo of the area

The study area is located in warm climatic zone, with hot simmer and cold, windless winter.

The absolute maximum air temperature is +41°C, the minimum- -30º.

Winds, having South-Western direction of maximum 5.9m/sec. speed predominate in winter (January), while winds of North-Eastern direction – in summer (June). Winds with the velocity up to 24m/sec may occur once in 20 years. Wind velocity pressure reaches up to 45kg/m^2.

Annual atmospheric precipitation is 302mm.

The highest snow cover in this area reaches 58cm, pressure- 70kg/m^2.

Maximum depth of frost in soil is 60cm.

The geological structure of the area and the study site is represented by radical clays, generally covered by contemporary alluvial, dilluvial-prolluvial, and technogenic generations, formed of clayey and sandy soils.

From the seism tectonic respect the territory and the study area are located within the limits of corrugated zone of Armenia. The territory is one of the seism active zones in Armenian plateau.

From the hydro-geologic respect the area underground waters are related to alluvial and dilluvial generations, belong to layer waters type.

3. The format of the geological works (45 boreholes) and the conditions

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5. ÑÍèÏ 2.02.01-85. Îñíîâàíèÿ çäàíèé è ñîîðóæåíèé.
6. ÑÍèÏ IV-2-82. Ñáîðíèê. Çåìëÿíûå ðàáîòû.
7. ÐÐÞÜ II-6.02.2006. ê»ÛëÙ³Ï³ÛáõÝ ßÇÝ³ñ³ñáõÃÛáõÝ: Ü³Ë³·ÍÙ³Ý ÝáñÙ»ñ
8. ÐÐÞÜ 1-2.01-99. ÆÝÅ»Ý»ñ³Ï³Ý Ñ»ï³½áïáõÃÛáõÝÝ»ñ ßÇÝ³ñ³ñáõÃÛ³Ý Ñ³Ù³ñ: ÐÇÙÝ³Ï³Ý ¹ñáõÛÃÝ»ñ.
9. ÐÐÞÜ II -7.01-2011.ÞÇÝ³ñ³ñ³Ï³Ý ÏÉÇÙ³Û³µ³ÝáõÃÛáõÝ
10. Ð³Û³ëï³ÝÇ ³½·³ÛÇÝ ³ïÉ³ë, §¶»áù³ñï Ï»ÝïñáÝ¦ äà²Î, 2 007Ã.

b. library material

1. “ Report on engineering-geological survey of Yerevan TPP 220/110/35kv substation”
“Geoterproject LLC” 2017

2. “Report on engineering-geological survey of Yerevan TPP new energy block area”
“Geoterproject LLC” 2016


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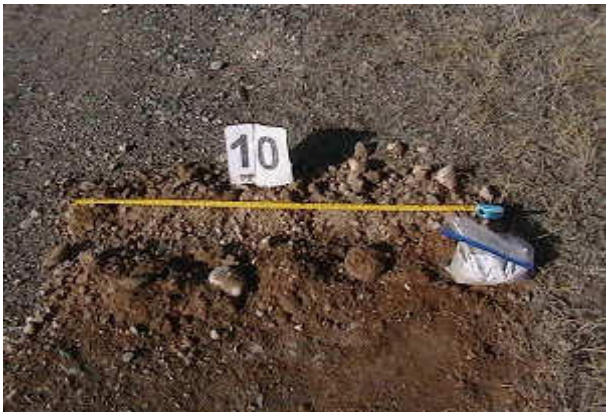
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46 Charents Str., 0025 Yerevan, Armenia, Tel.: (+374) 10 272007

Annex 5

Client: **"Geoterproject" LTD**
Contract number: **22-1/17**
Date of receiving of sample: **13.11.2017**
Date of issue of results: **20.12.2017**
Soil sampling: **Client**

APPROVED
Deputy Director
G. Shahnazaryan

Sample ID: Borehole 1

Sample name (as in bag): Sandy loamy

SOIL TEST REPORT

N	Testing parameter	Unit	Measured value	Maximum permissible concentration
1	Lithium	g/kg	0.0200	NA*
2	Sodium	g/kg	20.604	NA
3	Magnesium	g/kg	14.366	NA
4	Aluminum	g/kg	65.27	NA
5	Potassium	g/kg	7.608	NA
6	Calcium	g/kg	85.76	NA
7	Titanium	g/kg	2.359	NA
8	Vanadium	g/kg	0.0905	0.15
9	Chromium	g/kg	0.0617	0.006
10	Iron	g/kg	47.02	NA
11	Manganese	g/kg	0.4730	0.7
12	Cobalt	g/kg	0.0233	0.005
13	Nickel	g/kg	0.0327	0.004
14	Copper	g/kg	0.0400	0.003
15	Zinc	g/kg	0.0652	0.023
16	Arsen	g/kg	0.0093	0.002
17	Selenium	g/kg	0.0091	NA
18	Strontium	g/kg	0.4440	NA
19	Molybdenum	mg/kg	1.222	NA
20	Cadmium	mg/kg	0.1364	NA
21	Tin	mg/kg	0.8928	NA
22	Stibium	mg/kg	0.3494	4.5
23	Barium	g/kg	0.6524	NA
24	Lead	g/kg	0.0101	0.032
25	Benzene	mg/kg	<0.0001	0.3
26	Ethylbenzene	mg/kg	<0.0001	NA
27	Toluene	mg/kg	0.2282	0.3
28	Xylene	mg/kg	0.0090	0.3
29	Petroleum Hydrocarbons	mg/kg	10.93	NA
30	Polycyclic Aromatic Hydrocarbons	mg/kg	ND*	NA

NA*-not assigned
ND-not detected

Submitted:

Head of Water quality research laboratory — A. Zurnachyan

ENVIRONMENTAL MONITORING AND INFORMATION CENTER
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46 Charents Str., 0025 Yerevan, Armenia, Tel.: (+374) 10 272007

Client: **"Geoterproject" LTD**
Contract number: **22-1/17**
Date of receiving of sample: **17.11.2017**
Date of issue of results: **20.12.2017**
Soil sampling: **Client**

APPROVED
Deputy Director
G. Shahnazaryan

Sample ID: Borehole 19

Sample name (as in bag): Sand

SOIL TEST REPORT

N	Testing parameter	Unit	Measured value	Maximum permissible concentration
1	Lithium	g/kg	0.0078	NA
2	Sodium	g/kg	7.65	NA
3	Magnesium	g/kg	6.02	NA
4	Aluminum	g/kg	30.93	NA
5	Potassium	g/kg	6.89	NA
6	Calcium	g/kg	51.50	NA
7	Titanium	g/kg	1.92	NA
8	Vanadium	g/kg	0.107	0.15
9	Chromium	g/kg	0.055	0.006
10	Iron	g/kg	33.83	NA
11	Manganese	g/kg	0.527	0.7
12	Cobalt	g/kg	0.0205	0.005
13	Nickel	g/kg	0.0266	0.004
14	Copper	g/kg	0.1223	0.003
15	Zinc	g/kg	0.0731	0.023
16	Arsen	g/kg	0.0126	0.002
17	Selenium	g/kg	0.0085	NA
18	Strontium	g/kg	0.3584	NA
19	Molybdenum	mg/kg	0.0008	NA
20	Cadmium	mg/kg	0.00017	NA
21	Tin	mg/kg	0.00097	NA
22	Stibium	mg/kg	0.00038	4.5
23	Barium	g/kg	0.723	NA
24	Lead	g/kg	0.0140	0.032
25	Benzene	mg/kg	<0.0001	0.3
26	Ethylbenzene	mg/kg	<0.0001	NA
27	Toluene	mg/kg	0.0085	0.3
28	Xylene	mg/kg	0.0065	0.3
29	Petroleum Hydrocarbons	mg/kg	11.848	NA
30	Polycyclic Aromatic Hydrocarbons	mg/kg	ND	NA

NA*-not assigned
ND-not detected

Submitted:

Head of Water quality research laboratory — A. Zurnachyan

ENVIRONMENTAL MONITORING AND INFORMATION CENTER
State non-commercial organization
46 Charents Str., 0025 Yerevan, Armenia, Tel. (+374) 10 272007

Client: "Geoterproject" LTD
Contract number: 22-1/17
Date of receiving of sample: 21.11.2017
Date of issue of results: 20.12.2017
Water sampling: Client

APPROVED
Deputy Director
G. Shahnazaryan

Sample ID: C
Sample name (as in water sampling bottle): from channel

WATER TEST REPORT

N	Testing parameter	Unit	Measured value	Maximum permissible concentration
1	pH	-	7.76	6.5-9
2	Mineralization	mg/L	593	148
3	BOD_5	mgO_2/l	2.87	5
4	COD-Cr	mgO/L	26	25
5	Lithium	mg/L	0.02528	0.036
6	Sodium	mg/L	82.20	10
7	Magnesium	mg/L	21.96	50
8	Aluminum	mg/L	0.0033	0.13
9	Potassium	mg/L	4.715	3
10	Calcium	mg/L	50.65	100
11	Titanium	mg/L	0.00609	NA
12	Vanadium	mg/L	0.01770	0.002
13	Chromium	mg/L	0.00373	0.011
14	Iron	mg/L	0.08014	0.16
15	Manganese	mg/L	0.00818	0.01
16	Cobalt	mg/L	0.00055	0.00028
17	Nickel	mg/L	0.00404	0.011
18	Copper	mg/L	0.00153	0.023
19	Zinc	mg/L	0.00050	0.1
20	Arsen	mg/L	0.00758	0.02
21	Selenium	mg/L	0.00110	0.02
22	Strontium	mg/L	0.25436	NA
23	Molybdenum	mg/L	0.00598	0.014
24	Cadmium	mg/L	0.00003	0.001
25	Tin	mg/L	0.000003	0.00018
26	Stibium	mg/L	0.00012	0.00038
27	Barium	mg/L	0.01672	0.018
28	Lead	mg/L	0.000092	0.01
29	Benzene	mg/L	<0.001	0.03
30	Ethylbenzene	mg/L	<0.001	NA
31	Toluene	mg/L	<0.001	NA
32	Xylene	mg/L	<0.001	NA
33	Petroleum Hydrocarbons	mg/L	<0.001	0.1
34	Polycyclic aromatic hydrocarbons	mg/L	ND**	NA

BOD_5- Biochemical Oxygen 5-days Demand, COD- Cr Chemical Oxygen Demand bichromate
NA*-not assigned
ND*-not detected

Submitted:

Head of Water quality research laboratory A. Zurnachyan

ENVIRONMENTAL MONITORING AND INFORMATION CENTER
State non-commercial organization
46 Chaarents Str., 0025 Yerevan, Armenia. Tel: (+374) 10 272007

Client: **"Geoterproject" LTD**
Contract number: **22-1/17**
Date of receiving of sample: **21.11.2017**
Date of issue of results: **20.12.2017**
Water sampling: **Client**

APPROVED
Deputy Director
G. Shahnazaryan

Sample ID: B

Sample name (as in water sampling bottle): Hrazdan river, before channel

WATER TEST REPORT

N	Testing parameter	Unit	Measured value	Maximum permissible concentration
1	pH	-	7.45	6.5-9
2	Mineralization	mg/L	666	148
3	BOD_5	mgO$_2$/l	2.52	5
4	COD Cr	mgO/l	42	25
5	Lithium	mg/L	0.0266	0.036
6	Sodium	mg/L	64.94	10
7	Magnesium	mg/L	27.50	50
8	Aluminum	mg/L	0.0138	0.13
9	Potassium	mg/L	5.74	5
10	Calcium	mg/L	68.06	100
11	Titanium	mg/L	0.00672	NA
12	Vanadium	mg/L	0.01496	0.002
13	Chromium	mg/L	0.00434	0.011
14	Iron	mg/L	0.10672	0.16
15	Manganese	mg/L	0.02611	0.01
16	Cobalt	mg/L	0.00034	0.00028
17	Nickel	mg/L	0.00331	0.011
18	Copper	mg/L	0.00183	0.023
19	Zinc	mg/L	0.00250	0.1
20	Arsen	mg/L	0.00677	0.02
21	Selenium	mg/L	0.00210	0.02
22	Strontium	mg/L	0.38797	NA
23	Molybdenum	mg/L	0.00324	0.014
24	Cadmium	mg/L	0.000021	0.001
25	Tin	mg/L	0.0000005	0.00018
26	Stibium	mg/L	0.0000912	0.00038
27	Barium	mg/L	0.0323	0.018
28	Lead	mg/L	0.00021	0.01
29	Benzene	mg/L	<0.001	0.03
30	Ethylbenzene	mg/L	<0.001	NA
31	Toluene	mg/L	<0.001	NA
32	Xylene	mg/L	<0.001	NA
33	Petroleum Hydrocarbons	mg/L	<0.001	0.1
34	Polycyclic aromatic hydrocarbons	mg/L	ND*	NA

BOD$_5$-Biochemical Oxygen 5-days Demand, COD Cr Chemical Oxygen Demand bichromate
NA*-not assigned
ND*-not detected

Submitted:

Head of Water quality research laboratory A. Zatmachyan

ENVIRONMENTAL MONITORING AND INFORMATION CENTER
State non-commercial organization
46 Charents Str., 0025 Yerevan, Armenia, Tel.: (+374) 10 272007

Client: **"Geoterproject" LTD**
Contract number: **22-1/17**
Date of receiving of sample: **21.11.2017**
Date of issue of results: **20.12.2017**
Water sampling: **Client**

APPROVED
Deputy Director
G. Shahnazaryan

Sample ID: H

Sample name (as in water sampling bottle): Hrazdan river, after channel

WATER TEST REPORT

N	Testing parameter	Unit	Measured value	Maximum permissible concentration
1	pH		7.47	6.5-9
2	Mineralization	mg/L	661	148
3	BOD_5	mgO_2/l	3.91	5
4	COD Cr	mgO/L	30	25
5	Lithium	mg/L	0.0270	0.036
6	Sodium	mg/L	59.63	10
7	Magnesium	mg/L	27.46	50
8	Aluminium	mg/L	0.0132	0.13
9	Potassium	mg/L	5.58	3
10	Calcium	mg/L	67.72	100
11	Titanium	mg/L	0.006374	NA
12	Vanadium	mg/L	0.013205	0.002
13	Chromium	mg/L	0.004477	0.011
14	Iron	mg/L	0.106664	0.16
15	Manganese	mg/L	0.028988	0.01
16	Cobalt	mg/L	0.000304	0.00028
17	Nickel	mg/L	0.003085	0.011
18	Copper	mg/L	0.001679	0.023
19	Zinc	mg/L	0.002253	0.1
20	Arsen	mg/L	0.006365	0.02
21	Selenium	mg/L	0.002069	0.02
22	Strontium	mg/L	0.391978	NA
23	Molybdenum	mg/L	0.002763	0.014
24	Cadmium	mg/L	0.000019	0.001
25	Tin	mg/L	0.000086	0.00018
26	Stibium	mg/L	0.000110	0.00038
27	Barium	mg/L	0.032977	0.018
28	Lead	mg/L	0.000692	0.01
29	Benzene	mg/L	<0.001	0.03
30	Ethylbenzene	mg/L	<0.001	NA
31	Toluene	mg/L	<0.001	NA
32	Xylene	mg/L	<0.001	NA
33	Petroleum Hydrocarbons	mg/L	<0.001	0.1
34	Polycyclic aromatic hydrocarbons	mg/L	22'	NA

BOD5-Biochemical Oxygen 5-days Demand, COD- Cr Chemical Oxygen Demand bichromate
NA*-not assigned
ND*-not detected

Submitted:

Head of Water quality research laboratory A. Zamashyan

Annex 5

Foto 1: Entrance area to YTPP-2 site

Fotos 1 – 8 were taken by GefaÖ in 2017

Foto 2: Area overview with construction site (center) and TPP-1 on the right side

Foto 3: Larger overview of the area, view NW

Foto 4: On the site, view to SE

Foto 5: On the site with some waste

Foto 7: On the site, view to NE

Foto 7: On the site, view to N with TPP1

Foto 8: On the site with old barrels and pollution with unknown liquid

Foto 9: Drilling works from November, 15th of borehole 14 (4 meters)

Foto 10: Drilling core from borehole 14 ready to take sample.

Foto 11 : Taking soil sample from borehole 14 in plastc bag

Foto 12: Drilling core of borehole 13 with soil sample. TPP1 in the background.

The legal framework of the emissions standardization in Armenia and the assessment of the planned YTPP-2 emissions

Customer
Renco Armestate LLC

Executer
Consecoard LLC

Yerevan, 2018

Contents

ABBREVIATION LIST

RA	Republic of Armenia
TLV	Threshold limit value
ELV	Emissions limit value
TPP	Thermal power plant
EIA	Environmental impact assessment
LLC	Limite Liability Company

1 Main principles

The standardization of the hazardous substances in Armenia is carries out on the basis of sanitary-hygienic principle. The main criteria is the consideration of the sanitary norms of the given substances content in the air of public areas (cities, settlements, villages).

The emissions simultaneous maximum quantity (on the edge of the tube) is defined on the conditions that after dispersion the given substance ground level concentration, considering the unfavourable weather condition and background pollution, does not exceed the maximum threshold limit emissions one-time concentration (maximum one-time TLV).

This order has been passed yet during SSSR, the aim of which was the protection of the polulation.

2 Permits

The enterprises get separate permits for the impacts on the different components of the environment, such as for water use and wastewater leaks, emissions to the atmospheric air, placement of hazardous refuses, separately. All of them are given by the RA Ministry of Nature Protection.

The permits are given based on the normative projects of the water use, limit permissible leaks (LPL), emissions limit value (ELV) and refuses formation.

The order, form and the content of the permits are defined in the relevant legal and sub-legal acts.

In 2011 changes have been made in the RA law "On the atmospheric air protection". Together with other changes, the enterprise's minimum limit of the pollution potential has been defined, based on which the way of the definition and release of the emission norm of the substances, polluting the atmosphere, is defined. According to that change, based on the ELV project, the emission permit is given only to those enterprises, the required air use[1] (RAU) of which exceeds 2bilion m^3.

For the enterprises the RAU of which is from 200mln to 2billion m^3, the emission norm is defined based on the factual emissions (RA Government resolution N259 of 22.04.1999). The enterprises the RAU of which is less than 200mln, are not to be registered. In case of having more than 2billion m^3 RAU, the enterprises develop drafts of Emissions limit vales (ELV) normatives and submit them to the RA Ministry of Nature Protection for approval and for getting emissions permit.

Starting from the moment of giving emissions permit, the emissions quantities, presented in the ELV draft, become normatives of the relevant enterprise (equipment).

[1] Required air use- the volume of the clean air, necessary for rarefying the polluting substances emissions up to threshold limit values level

The emissions permit is given to the objects, which are under construction, enlargement and reconstruction, on the basis of the state ecological expertise positive conclusion, for a term of 1 year, starting from the commissioning day. After that term the emissions standardization is realized according to the atmospheric air protection law.

3 Normatives of hazardous substances emissions limit values

The ELV normative draft describes technologies, used raw materials and products, sources of emission parameter query of sources, emission substances names. In the draft there are mentioned substances with a hazardous amount of impact, the timeframe for achieving the ELVmorms and the costs required for it, the extent of damage, caused to the environment by the organization's emissions.

Based on technological processes, quantities and productivity of consumed substances, the quantities of all emissions are calculated at average annual, t / year, as well as short-term emissions at maximum productivity with g/sec quantity.

Based on these data, The Ministry of Nature Protection of Armenia performs a dispersion calculation compares the calculated concentration of each substance with the established maximum lump-sum TLVs and if the results do not exceed the TLV, an emission permit is given.

4 Legal frameworrk

4.1 Law abuot protection of atmospheric air of the Republic Armenia

« The subject of the RA law “On the atmospheric air protection” is the regulation of the publis relations in the field of the atmospheric air cleanliness protection, minimization and prevention of the hazardous impacts on the atmospheric air.

The law has passed on 10.11.1994, after which several changes have been made.

The articles, referring to the standardization of the hazardous substances emissions, are given in the annexes.

4.2 Sub-legal acts

In pursuance of the requirements of the law, the Government of the Republic of Armenia has made the following resolutions:

a. “On the approval of the state registration order of the harmful impacts on the atmospheric air” (22.04.1999 N 259)
b. ON DEFINING THE DEVELOPMENT AND APPROVAL PROCEDURE OF ENVIRONMENTAL AIR POLLUTING SUBSTANCES EMISSION LIMITS NORMATIVES AND ON DECARING THE RESOLUTIONS OF THE GOVERNMENT OF ARMENIA N 192 OF MARCH 30, 1999 AND N953-N OF AUGUST 21, 2008 AS INVALID *(*27 December 2012, N 1673-N*)*

c. “ON THE APPROVAL OF THE NORMATIVES OF ENVIRONMENTAL AIR POLLUTING SUBSTANCES THRESHHOLD LIMIT VALUES (CONCENTRATIONS-TLV) IN SETTLEMENTS” (2 February 2006, N 160)

The air quality of the workplaces in the produtive enterprises areas is defined by:
The rules “ON DETERMINING “THE CHEMICALS THRESHOLD LIMIT VALUES IN THE WORK ZONE AIR OF WORKPLACES OF ORGANIZATIONS’’ N 2.2.5-004-10 SANITARY RULES AND NORMS”, approved by the resolution N27 of 6 December, 2010, of the RA Ministry of Healthcare
The productive organizations should organize sanitary-protective zones in order to mitigrate or minimize their impact.
These zones are defined by the CH 245-71 construction norms, which may be adjusted in the result of comparison with the TLVs of the concentrations, received in the result of the hazardous substances emissions dispersion.
Those articles or sections of the listed normative acts, which refer to the emissions standardization, are given in the annexes of the present report.

5 Assessment of the planned YTPP-2 emissions

In 2016-2017, the planned power plant EIA works were organized by “Renco Armestate” LLC, according to the RA acting legislation.Emissions quantities calculation was done in the EIA framework. Taking into account that it is planned to install gas turbine equipment of Siemens production, which correspond to IPPC “Reference Document on BAT fo Large Combustion Plants” Europian normative document requirements, the calculation was done on the basis of this normative document specific factors.

Emissions dipersion calculation of obtained quantities was done with “Raduga” computer program and the results are presented in the table 1.

Table 1.

№	Poluttants	Residential zones maximum one-time TLV[2], mg/m^3	Maximum near-ground concentrations	
			mg/m^3	on TLV
1	Nitrogen dioxide	0.2	0.0876	0.438
2	Carbon monoxide	5	0.0585	0.0117

[2] RA GOVERNMENT N 160-N RESOLUTION OF 02.02.2006 “ON THE APPROVAL OF THE NORMATIVES OF ENVIRONMENTAL AIR POLLUTING SUBSTANCES THRESHHOLD LIMIT VALUES (CONCENTRATIONS-TLV) IN SETTLEMENTS”

As it is seen in the table, the obtained maximum near-ground concentrations do not exceed the Republic of Armenia standards.

Those calculations in EIA have been presented to the Republic of Armenia Ministry of Nature Protection and, in the result of the carried put expertise, a positive conclusion has been obtained by the Republic of Armenia Ministry of Nature Protection.

At the end of 2017, based on the changes done in the project, according to which the power plant project capacity has been slightly increased, at the same time the stack height has been significantly increased, a ELV normatives draft development of the power plant has been undertaken by "Renco Armestate" LLC.

The draft has been developed according to the N 1673-N resolution methodology.

Emissions calculations have been done according to the European Environment Agency EMEP/EEA "Air pollutant emission inventory guidebook"[3].

Specific emissions factors for combustion of various technologies and power equipment are presented in the guidebook, according to the produced energy quantity.

For gas turbines the factors of Guidbook 3-17 Table[4] have been used.

The emissions quantities are presented in the table 2.

Table 2.

Substance name	TLV one-time maximum, mg/m^3	Substance emission, t/year
1	2	3
Carbon monoxide	5.0	365.5
Nitrogen dioxide	0.2	36.5
Hydrocarbons - limit	1.0	12.2

The table form is taken from the guidebook of "Approval and development order of normatives of the substances polluting the atmospheric air" approved by the RA Government N 1673-N resolution of 27.12.2012. In the second column of this table the maximum TLV is clearly mentioned. It is needed to mention also, that this normative on nitrogen dioxide corresponds to the quota (standard) accepted in several international documents.

Emissions dipersion calculation of obtained quantities was done with "Raduga" computer program and the results are presented in the table 3.

Table 3.

№	Polluting substances	Residential zones maximum one-time TLV[3], mg/m^3	Maximum near-ground concentrations	
			mg/m^3	on TLV
1	Carbon monoxide	0.2	0.0232	0.116
2	Nitrogen dioxide	5	0.002	0.0004
3	Hydrocarbons	1	0.0008	0.0008

The significant reduction of the near-ground concetrations is conditioned on the double increase of the emission pipe height. Accoridng to the Raduga computer program mathematic model, the pipe height has a great influence.

5 Conclusion

The above-mentioned calculations and grounds show, that in the result of planned YTPP-2 operation, the hazardous substances will not exceed both the Republic of Armenia and international normative requirements, even under the maximum productivity conditions.

The above-mentioned grounds and citations are received from several RA legal acts, of which relevant extracts are presented in the present report annexes part.

"CONSECOARD" LLC director:

Vram Tevosyan

[3] European Environment Agency. EMEP/EEA air pollutant emission inventory guidebook 2013

[4] Table 3-17. Tier 2 emission factors for source category 1.A.1.a, gas turbines using gaseous fuels

[5] RA GOVERNMENT N 160-N RESOLUTION OF 02.02.2006 "ON THE APPROVAL OF THE NORMATIVES OF ENVIRONMENTAL AIR POLLUTING SUBSTANCES THRESHHOLD LIMIT VALUES (CONCENTRATIONS-TLV) IN SETTLEMENTS"

ANNEX 1.

LAW OF THE REPUBLIC OF ARMENIA

On **atmospheric air protection** *

Passed on 11.10.1994

ARTICLE 10.

Specifications of Threshold limit values (maximum permissible concentration) of substances polluting atmospheric air and maximum permissible physical harmful influences

Specifications of Threshold limit values (maximum permissible concentration) of substances polluting atmospheric air and maximum permissible physical harmful influences are established for estimation of a state of atmospheric air.

These specifications should answer interests of nature protection and health of people.

ARTICLE 13. The principle of establishing the limit permissible normatives of Threshold limit values (maximum permissible emissions) of substances polluting atmospheric air and maximum permissible harmful physical influences

Specifications of levels of maximum permissible emission of substances polluting atmospheric air and maximum permissible harmful physical influences are established so that taking into account prospects of development of the given region emissions of polluting substances and harmful physical influences from the given territory and from all other sources have not resulted in exceeding of specifications of maximum permissible concentration of polluting substances in atmospheric air and maximum permissible physical harmful influences.

The threshold limit values are established for those emission sources or the groups, the required air use, calculated on which emissions maximum design indicators in one year exceeds two billion cubic meter or in one second exceeds two thousand cubic meter.

All those influences on a state of atmospheric air for which corresponding specifications are not established are forbidden.

The active influences on the atmosphere or atmospheric phenomena are carried out on the procedure, established by the Republic of Armenia.

ARTICLE 14. Regulation of emissions of substances polluting atmospheric air by stationary sources of pollution

Specially authorized state body in the sphere of protection of atmospheric air permits emissions by stationary sources of pollution of substances polluting atmospheric air in each case, on the order,

established by The Government of the Republic of Armenia, within 30 days upon applying by the organizations, having stationary sources of pollution. In case of not giving an answer by the authorized body within the established terms, the normative of the emissions limit values of the air polluting substances should be considered as accepted.

ARTICLE 15. Ensuring of execution of requirements to emissions of substances polluting atmospheric air

The enterprises, establishments and organizations which activity is connected to emission of substances polluting atmospheric air, are obliged to carry out technical, economic, organizational and other actions for ensuring of execution of conditions and requirements stipulated in permissions on emission, to take measures on reduction of emission of polluting substances, to provide a working order of nature protection constructions and equipment, their uninterrupted and effective work, and also in accordance with established procedure carry out the constant account and measurement of amount and contents of substances emitted in atmospheric air.

Realization of actions on atmospheric air protection should not result in pollution of other natural environments.

ARTICLE 16. Restriction, suspension or prohibition of emission of substances polluting atmospheric air

Specially authorized state bodies in the sphere of atmospheric air protection have the right to restrict, suspend or prohibit emission of substances polluting atmospheric air, down to the termination of activity of separate establishments, enterprises, shops and organizations if the conditions and requirements stipulated by permissions are broken, and also a threat to health of the population emerges.

ARTICLE 22. Establishment of sanitary - protective zones

At selection of places for new enterprises, constructions and other objects, reconstruction or expansion of the working enterprises, constructions and other objects influencing a state of atmospheric air, establishment of sanitary - protective zones is provided.

ANNEX 2.

RESOLUTION

OF THE GOVERNTMENT OF ARMENIA

27 December 2012, N 1673-N

ON DEFINING THE DEVELOPMENT AND APPROVAL PROCEDURE OF ENVIRONMENTAL AIR POLLUTING SUBSTANCES EMISSION LIMITS NORMATIVES AND ON DECARING THE RESOLUTIONS OF THE GOVERNMENT OF ARMENIA N 192 OF MARCH 30, 1999 AND N953-N OF AUGUST 21, 2008 AS INVALID

Based on the articles 5, 5.1, 12, 13 and 14 of the RA law on "The environmental air protection", the Government of the Republic of Armenia *decides*:

1. To define the order of development and approval procedure of environmental air polluting substances emission limits normatives, according to the annex.
2. Define that
   1) The normatives of hazardous substances emissions in the environment are developed for those hazardous substances for which health, nature protection or other normatives of their content in the environment are established. If in the result of the business entities' activity a substance, for which no health, nature protection or other normatives are established, is emitted, then the business entity applies to the liable authority in order to develop a normative for that substance, according to the established procedure.
   2) According to the resolution N259 of April 22, 1999 of the RA Government, for those organizations or private entrepreneurs (hereinafter referred as business entities) under state registration, based on whose emissions maximum design indexes the "required air usage" (hereinafter RAU) is calculated and is from two hundred million up to two billion cubic meter, the emissions limit quantities are the factual emissions, generated in the result of their activity.
   3) For those business entities, that have such emission sources, the RAU, calculated based on their emissions maximum design indexes, exceeds two billion cubic meter annual or two thousand cubic meter in a second, the emission quantities are defined based on the emission limits value (ELV) normatives projects, moreover;
      a. If in the result of dispersion in the ground-level strata – at the edge of the emitting organization territory and(or) in the nearest settlements – the polluting substances emissions cause such concentrations which, together with the given territory pollution background concentration, do not exceed the treshhold limit values (TLV), the ELV normatives are acceptable and are emission limit quantities (emissions permissions),

b. If the ground-level concentrations of polluting substances, formed in the result of the emissions, together with the given territory pollution background concentration, at the edge of the emitting organization territory and(or) in the nearest settlements, exceed the corresponding TLV, and the given substances background pollution does not exceed the TLV, a program of air polluting substances emissions reduction measurements is developed, the realization of which will ensure the TLV normatives formation.
c. If for some substances, existing in the business entity's emissions, the background pollution exceeds the corresponding TLV, the ELV normatives are accepted as temporary. The temporary normatives are operating until the new quantities provision, based on the territorial standardization realization in the established procedure in the territories which have hazardous substances background over-pollution.

3. In the cases, defined in the b) and c) paragraphs of the 3rd sub-clause of the 2nd clause of the present resolution, the emissions quantities are provided to the extent of the ELV normatives.
4. To define that:
   1) The air polluting substances emissions limit normatives for the air polluting immobile sources are developed by the business entities which have such sources.
   2) The provided emission quantities remain valid as long as there are no quantitative or qualitative modifications for the polluting immobile sources and polluting substances, as well as there is no background over-normative pollution of those substances. Related to the background over-normative pollution, the emission quantities are being reviewed not earlier than within 5 years upon the provision moment.
   3) The information about the territory background pollution is provided by the RA Ministry of Nature Protection, on its official web-site. If the data of that territory background pollution are missing, the background pollution is determined, based on the population quantity of that territory.
   4) The emission quantities for the new constructed, expanded and reconstructed buildings are being determined within 7 days upon the day of its commissioning in the established procedure, for one year, based their construction, expansion and reconstruction design solutions. Then, depending on the emissions capacity or quantity, in conformity with the present resolution 2nd clause 2nd or 3rd sub-clauses.
5. To declare invalid the resolutions of the RA Government N192 of March 30, 1999 "On giving permissions for the normatives of environmental air polluting substances limit emissions and physically hazardous impacts permissible limit levels and for making emissions" and N953-N of August 21, 2008 on "The approval of the procedure of giving permission for the normatives projects examination of the emissions limits of the organizations, having environmental air polluting immobile sources, and for making emissions"

Annex of the RA Government resolution
N1673-N of December 27, 2012

ORDER
OF THE DEVELOPMENT AND APPROVAL OF THE NORMATIVES OF ENVIRONMENTAL AIR POLLUTING SUBSTANCES EMISSIONS LIMIT VALUES

1. The designs of the normatives of environmental air polluting substances emissions limit values (hereinafter design) are being developed and submitted to the revision of the Ministry of Nature Protection of the Republic of Armenia (hereinafter Ministry) by the organizations, satisfying the condition, mentioned in the 4th point of the present resolution, in accordance with the guideline of the present order. Required air use (RAU) is being calculated by the formula of the present order 7th clause.
2. The design, together with the attached letter (claim), is submitted via electronic version, by placing it on the Ministry's web-site, notifying the Ministry about it via email: min.ecology@mnp.am.
3. Within 30 days upon the day of the notification about placing the design on the web-site, mentioned in the 2nd clause of the present order, the Ministry informs the organization about the results of the submitted design revision:

1) in case of the absence of the remarks about the design- about the approval of the emissions normatives, represented in the design, which are being considered as emissions quantities, provided to the given organization (emissions permits). Also an excerption, signed and sealed by the authorized body is being attached to the letter, the table 6 of the design "Normatives/quantities of the emissions limit values (ELV) (QUANTITIES OF POLLUTING SUBSTANCES, EMMITTED TO THE ENVIRONMENT FROM IMMOBILE SOURCES/ EMMISSION PERMITS).
2) In case of any remarks about the design, the remarks and their legal bases are being enumerated, and the design is being returned to reworking.

4. the reworked design again is submitted to revision on the procedure, envisaged by the present order.
5. The provided quantities of emissions remain in force as long as there are no quantitative or qualitative changes regarding the pollution immobile sources and polluting substances, as well as there is no background sub-normative pollution with the given substances. In case of the above mentioned changes the business entity develops a new design and submits it to revision, according to the present order.
6. If within 30 days the Ministry does not give a written answer to the organization, then the emissions normatives, submitted in the design, are considered as approved.

7. The required air use (RAU) in one year or in one second is calculated by the following formula:

$$RAU = \sum_{i}^{n} \frac{Ei}{TLVi}$$

Where

Ei is the maximum emission of each i-rd substance, relatively in one year or in one second, according to the technological regulations (mg/year or mg/sec),

TLV_i is relatively the average daily or maximum one-time threshold limit value of the i-rd substance (mg/m^3).

GUIDELINE

ON THE COMPOSITION AND CONTENTS OF THE NORMATIVES/QUANTITIES DESIGNS OF THE EMISSIONS LIMIT VALUE (ELV)

1. The cover sheet

The cover sheet is the first page of the project and is formed based on the attached exemplary form.

2. Executers' list

The executers' list is written on the 2nd page of the cover sheet. The list represents the organizations and the surnames of all the responsible executers, co-executers, who have participated in the design development activities. On the left side the position, scientific degree are mentioned, while the surname is written on the right side. At each surname, in brackets, the number of the section they have prepared, is mentioned.

3. Summary

The summary should contain the main results of the executed works, the denominations of the polluting substances and the emissions annual quantities, the substances with harmful total impact, the terms of reaching the substances ELV norms and the expanses necessary for them, the amount of the damage on the environment in the result of the emissions by the organization.

4. Contents

The project contents should contain the titles of all the sections and the annexes, with the notes of the relevant pages.

5. General information about the organization

This chapter contains:

1) The location of the business entity, the quantity of production areas, information about the industrial area and the bordering objects, settlement, industrial zones, forests, agricultural fields, transport highways disposition.
2) The map-scheme of the business entity, mentioning the pollution sources.
3) The situational map of the business entity's location, mentioning the settlements, including the resort zones, resorts, kindergartens, schools, hospitals.

6. the characteristics of the business entity as a source of environmental air pollution

This chapter includes:

1) The production technology description and the brief charachteristics of the used equipment from the environmental pollution point of view as well as information about the product, main raw material, main and reserve fuel.
2) The brief description of existing dust-gas-treating equipment, the generalized analysis of their tchnical condition and efficiency of the activity.
3) Information about the used technology, the modernity of the technological and dust-gas-treating equipment and the best available production technologies.
4) The perspective development of the business entity.

The decisions about the information of the reconstruction, expansion, technical or technological upgrading, reprofilation, conservation, replacement or liquidation.
It is made a reference to those documents which determine the development perspective: the existance of the project of reconstruction, expansion and new construction, the results or process of their ecological expertise.

5) The list of the polluting substances, emitted to the environment.
Represented in the form of a table, given below.

TABLE 1.

The list of the polluting substances, emitted to the environment

Substance denomination	TLV one-time maximum, mg/m^3	Substance emission, t/year
1	2	3

Under the table the substances with total harmful impact are mentioned, as well.

The quantities of the emissions of the environmental air polluting substances (column 3) are calculated for each substance, based on the business entity operational mode, technological processes and equipment commissioning indexes, consumption quantities of raw material and fuel, on an annual basis.

6) the characteristics of the shock emissions
The brief characteristics of the shock emissions generation conditions are given.
The shock emissions are represented in the form of the below mentioned table, they are not included in the table 1. The shock emissions are considered only in the emissions quantities on an annual basis. No dispersion calculation is carried out for them and they cannot be included in the quantity of the given substance maximum one-time (g/sec) emission.

ANNEX 3.

GOVERNMENT OF THE REPUBLIC OF ARMENIA

R E S O L U T I O N

N 160-N of 2 February 2006

ON APPROVAL OF THE NORMATIVES OF THE THRESHOLD LIMIT VALUES (CONCENTRATIONS-TLV) OF THE SUBSTANCES PULLUTING THE ENVIRONMENTAL AIR IN SETTLEMENTS

(title modified on 05.04.07 N 403-N)

In conformity with the clauses 5, 10, 11 and 18^1 of the Republic of Armenia's law "On the environmental air protection", the Government of the Republic of Armenia *decides:*

1. To approve the normatives of environmental air polluting substances threshold limit values (concentrations-TLV) in settlements, in conformity with the Annex N1.
2. *(the clause has lost validity on 05.04.07 N403-N)*
3. To define that in sanatoriums, specially protected areas and touristic regions and (or) centers the threshold limit values of the hazardous substances, included in the Annex N1 of the present resolution, are accepted to the extent of the 0.8 threshold limit value of the given substance.
4. The present resolution enters into force the tenth day, successive to the official publication day.
5. THE NORMATIVES OF ENVIRONMENTAL AIR POLLUTING SUBSTANCES THRESHHOLD LIMIT VALUES (CONCENTRATIONS-TLV) IN SETTLEMENTS

NN	Hazardous substance denomination	TLV (mg/m^3)		Danger class
		one-time maximum	Average daily	
1	2	3	4	5
1.	Nitrogenic acid (by HNO_3 molecule)	0.4	0.15	2
2.	Nitrogen dioxide	0.2	0.04	3
3.	Nitrogen oxide	0.4	0.06	3

ANNEX 4.

MINISTER OF HEALTHCARE
OF THE REPUBLIC OF ARMENIA

December 6, 2010 **N 27-N**

ORDER

ON DETERMINING "THE CHEMICALS THRESHOLD LIMIT VALUES IN THE WORK ZONE AIR OF WORKPLACES OF ORGANIZATIONS'' N 2.2.5-004-10 SANITARY RULES AND NORMS

Taking as a base the sub-clause d) of the clause 12 of the RA Ministry of Healthcare statute, defined by the resolution N1300-N of 15 August 2002 of the RA Government "On creating a state governmental institution "Staff of RA Ministry of Healthcare ", establishing the Republic of Armenia's Ministry of Healthcare statute and staff structure", as well as the proposals of the World Health Organization for the development of the regions of Eastern Europe, Caucasus and Central Asia, based on the population's health care interests,

I order

To approve the sanitary rules and norms N 2.2.5-004-10 "The chemicals threshold limit values in the work zone air of workplaces of organizations", according to the annex.

Minister H. Kushkyan

Annex
Of the resolution N27-N of 6 December 2010
Of the RA minister of Healthcare

SANITARY RULES AND NORMS
THE CHEMICALS THRESHOLD LIMIT VALUES IN THE WORK ZONE AIR OF WORKPLACES OF ORGANIZATIONS
N 2.2.5-004-10
THE HAZARDOUS SUBSTANCES OF ACCUTE IMPACT THRESHOLD LIMIT VALUES (TLV) IN THE WORK ZONE AIR

N	Substance denomination	Threshold limit value (TLV) mg/m^3	The prevailing aggregate state of the substance in production conditions	Danger class
1	2	3	4	5
1.	Nitrogen dioxide	2	g	3
2.	Nitrogen oxides (recalculated on NO_2)	5	G	3

ANNEX 5.

SANITARY NORMS OF DESIGNING INDUSTRIAL ENTERPRISES

Approved by
The State Committee of
Council of Ministers of the USSR
for construction
November 5, 1971

in accordance with the sanitary classification of enterprises, industries and facilities, the following sizes of sanitary protection zones for enterprises are established:

class I – 1000 m;
« II - 500 m;
« III - 300 m;
« IV - 100 m;
« V - 50 m.

8. SANITARY CLASSIFICATION OF ENTERPRISES AND PRODUCTION, THERMAL POWER STATIONS, WAREHOUSE BUILDINGS AND STRUCTURES AND DIMENSIONS OF SANITARY - PROTECTION ZONES FOR THEM

8.1. For enterprises, buildings and structures with technological processes that are sources of production hazard emissions into the environment, sanitary-protection zones should be provided in accordance with section 2 of these standards, depending on the sanitary classification.

Note. When organizing new productions and technological processes not included in this classification, the size of the sanitary-protection zone should be established in each specific case on agreement with the Chief Sanitary-Epidemiological Administration of the Ministry of Health of the USSR and the USSR Gosstroy.

INDUSTRIAL ENTERPRISES

8.2. For industrial enterprises, depending on the nature of production and capacity, the following sanitary protection zones should be envisaged.

THERMAL POWER STATIONS AND BOILERS

8.3. Sanitary-protection zones for thermal power plants and boilers should be determined by calculating by the dispersion in the atmosphere of harmful substances contained in the emissions, on the basis of normative documents approved in accordance with the established procedure.

ANNEX 6.

OFFICIAL COMMUNICATION FROM THE HEAD OF WASTE AND ATMOSPHERE EMISSIONS MANAGEMENT AGENCY

ՀԱՅԱՍՏԱՆԻ ՀԱՆՐԱՊԵՏՈՒԹՅԱՆ ԲՆԱՊԱՀՊԱՆՈՒԹՅԱՆ ՆԱԽԱՐԱՐՈՒԹՅԱՆ
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MINISTRY OF NATURE PROTECTION OF THE REPUBLIC OF ARMENIA
HEAD OF WASTE AND ATMOSPHERE EMISSIONS MANAGEMENT AGENCY

ՀՀ,0010 Երևան, Հանրապետության
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№ 5/19.3/1900223

«15» 03 2018թ.

<<Ռենկո Արմէստեյտ>> ՍՊԸ
գործադիր տնօրեն պարոն Քրիստիան Կուկուռակիին

Հարգելի պարոն Կուկուռակի

Ի պատասխան Ձեր 2018 թվականի փետրվարի 5-ի N42/18 գրության, հայտնում եմ.

Հայաստանի Հանրապետությունում վնասակար նյութերի արտանետումների նորմավորումը կատարվում է համաձայն ՀՀ կառավարության 2012 թվականի դեկտեմբերի 27-ի «Մթնոլորտային օդն աղտոտող նյութերի սահմանային թույլատրելի արտանետումների նորմատիվների մշակման ու հաստատման կարգը սահմանելու և Հայաստանի Հանրապետության Կառավարության 1999 թվականի մարտի 30-ի N 192 և 2008 թվականի օգոստոսի 21-ի N 953-Ն որոշումները ուժը կորցրած ճանաչելու մասին» N 1673-Ն որոշման պահանջների:

Շրջակա միջավայրի վրա ազդեցության գնահատման (ՇՄԱԳ) հաշվետվություններում վնասակար նյութերի մթնոլորտային արտանետումների ազդեցության գնահատումը նույնպես կատարվում է վերը նշված կարգով:

Ըստ այդ կարգի ձեռնարկություններն, որոնց արտանետումներն ենթակա են նորմավորման, հաշվարկում են իրենց տարեկան (տ/տարի) և կարճաժամկետ (գ/վրկ) արտանետումների քանակները և ներկայացնում ՀՀ բնապահպանության նախարարություն անշարժ աղբյուրներից աղտոտող նյութեր մթնոլորտ արտանետելու չափաքանակներ/արտանետման թույլտվություններ ստանալու համար:

Տարեկան արտանետումները հաշվարկվում են պլանային կամ նախագծային հզորությունների կամ արտադրողականության հիման վրա, իսկ կարճաժամկետ արտանետումները՝ վատագույն պայմանների համար, որոնք են՝ առավելագույն արտադրողականությունը, նույն նյութերը արտանետող աղբյուրների միաժամանակ աշխատանքը և այլն:

Արտանետումների քանակների թույլատրելիությունն որոշվում է վատագույն պայմանների համար, համեմատելով արտանետումների ցրման արդյունքում սպասվող գետնամերձ կոնցենտրացիաները սանիտարական նորմերի հետ:

Գետնամերձ կոնցենտրացիաների հաշվարկները կատարվում են ըստ «Ձեռնարկությունների արտանետումներում պարունակվող վնասակար նյութերի կոնցենտրացիաների հաշվարկի մեթոդակարգի» (ՕՀԴ 86), կամ դրա հիման վրա մշակված «Ռադուգա» համակարգչային ծրագրի միջոցով:

Հաշվարկների համար մուտքագրվում են վերը թվարկված վատագույն պայմաններով հաշվարկված կարճաժամկետ արտանետումները, ինչպես նաև կլիմայական պայմանների ցուցանիշները:

Հաշվարկի արդյունքում ստացվում են մի քանի հարյուր կամ հազար կետերում գետնամերձ կոնցենտրացիաներ, որոնցից ամենաբարձրը համեմատվում է նույն նյութերի առավելագույն միանվագ սահմանային թույլատրելի խտության՝ կոնցենտրացիաների (ՍԹԿ) հետ:

Դրա հիմքերը նշված են «ՕՀԴ 86» մեթոդակարգի՝ «1. Ընդհանուր դրույթներ» գլխի 1.4 ենթակետի 1.1. բանաձևի բացատրությունում, ՀՀ կառավարության 2012 թվականի դեկտեմբերի 27-ի N1673-Ն որոշման Հավելվածի Ուղեցույցի աղյուսակ 1-ում, որտեղ տեղադրվում են վնասակար նյութերի բնութագրերը և պարամետրերը, ինչպես նաև՝ «Մթնոլորտի պահպանության միջոցառումների փորձաքննության համար օրենսդրական և նորմատիվամեթոդական փաստաթղթերի ժողովածու»-ի 5 գլուխի 5.2 ենթագլխի 2-րդ կետի 2.1 ենթակետում:

Հարգանքով՝

Մ. Ղազարյան

Մթնոլորտ արտանետումների և օզոնային շերտը
քայքայող նյութերի առաքման թույլտվությունների բաժին
Շ. Մադոյան 011 818 529

MINISTRY OF NATURE PROTECTION OF THE REPUBLIC OF ARMENIA

HEAD OF WASTE AND ATMOSPHERE EMISSIONS MANAGEMENT AGENCY

N 5/19.3/1900223

"15".03.2018

To the chief executive director

Of "Renco Armestate" LLC

Cristian Cucurachi

Dear Mr. Cucurachi,

In response to your N 42/18 letter of 05.02.2018, I inform that,

In the Republic of Armenia, the normalization of hazardous substances emissions is done according to the RA Government N 1673-N resolution requirements of 27.12.2012 on "Establishment of threshold limit values emissions normatives development and approval procedure of the substances polluting the atmospheric air and on consider invalid the N 192 of 30.05.1999 and N 953-N of 21.08.2008 resolutions of the RA Government.

In the environmental impact assessment (EIA) reports the assessment of hazardous substances atmosphere emissions impact is also carried out in the above-mentions procedure.

According to this procedure, the enterprises, of which emissions are subject to normalization, calculate their annual (t/year) and short-term (g/s) emissions quantities and submit to the RA Ministry of Nature Protection for obtaining polluting substances quantities/emission permissions to emit into atmosphere from immobile sources.

The annual emissions are calculated on the basis of plan or project powers or productivity, and the short-term emissions for the worst conditions, which are the maximum productivity, the simultaneous work of sources emitting the same substances etc..

The emissions quantities permit is determined for the worst conditions, by comparing the near-ground concentrations originating from emissions dispersion with the sanitation norms.

The near-ground concentrations calculations are determined according to the "Methodology of calculation of hazardous substances concentrations being in the enterprises emissions" (ОНД 86), or through "Raduga" computer program developed on its basis.

The short-term emissions calculated by the worst conditions listed above are entered for the calculations, as well as climate conditions indicators.

In the result of calculation, in the several hundred or thousand points near-ground concentrations are obtained, the highest one of which is compared with the same substances maximum one-time threshold limit values (TLV).

Its bases are mentioned in the "1.General provisions" chapter 1.4. sub-point 1.1. formula explanation of "ОНД 86" methodology, in the Guideline Annex table 1 of RA Government N 1673-N resolution of 27.12.2012, where the hazardous substance characteristics and parameters are added, as well as in the 5 chapter 5.2 subchapter 2nd point 2.1 sub-point of the "Legislative and normative-methodological documents collection for the atmosphere protection measures expertise".

Best regards,

M. Ghazaryan

Public Consultation Meeting
at Yerevan 10th February 2018

1. Invitation letters and newspaper advertisements

Invitation letters for participation at the Public Consultation Meeting were sent to the following institutions/ agencies:

Armenia, 0025 Yerevan, 46 Charents st.
RA Ministry of Nature Protection, 2
Tel: (37411) 81 85 93; /374 91/81-60-55
Silva Ayvazyan (coordinator of Aarhus Center of Yerevan)

Armenia, 0803, Ararat province, Ayntap village
6th street, 47 building
Tel: +374-236-60506
Karen Sargsyan (executive of Ayntap Municipality)

Armenia, 0817, Ararat province, Nor Kharberd village,
Tel: +374-236-60030, +374-93-400122 (cell.)
Kamo Kakoyan (executive of Nor Kharberd Municipality)

Armenia, 0026, Yerevan
26 Garegin Nzhdeh st.,
(Shengavit administrative district)
Tel: +374-11-518808, +374-11-518811
Armen Sargsyan (head of Shengavit administrative district of Yerevan)

Armenia, 0008, Yerevan
87 Sasuntsi Davit st.,
(Erebuni administrative district)
Tel: +374-11-518331, +374-11-518333
Davit Grigoryan (head of Erebuni administrative district)

Armenia, 0015, Yerevan,
1 Argishti st.,
(Kentron administrative district)
Tel: +374-11-514264
Avet Martirosyan (chief of deparment of Nature Protection of Staff of Yerevan Municipality)

Armenia, 0012, Yerevan,
29 Komitas, 3rd and 4th floors
(Arabkir administrative district)
Tel: +374-10-272007
Sasun Sahakyan (director of Environmental impact monitoring center (Ministry of Nature Protection of the Republic of Armenia))

Armenia, 0010, Yerevan
Republic square, Government House 3,
(Kentron administrative center)
Tel: +374-11-818506, +374-11-818520
Artsvik Minasyan (RA minister of Nature Protection)

These invitation letters had the following content:

Public Consultation Invitation

Dear Mr./Mrs. …

We inform, that the Ministry of Energy (MOE) of the Republic of Armenia plans to improve the total output capacity of its electric energy production, complementing the power units of the existing Yerevan Combined Cycle Power Plant (YCCPP-1) with a most modern and efficient power plant. For this reason a new gas fired Combined Cycle Power Plant of 254 MW (YCCPP-2) is planned to be built at the site next to the existing YCCPP-1. The MOE wants to provide reliable national power supply, allow Armenia to become a major exporter of electricity, and shift the burden of electricity production from the public to the private sector.

RENCO SPA will be the Engineering, Procurement and Construction Contractor for this Project. The operation of the power plant will be made by ArmPower CJSC, a subsidiary company of RENCO SPA.

The Project has already obtained the national environmental approval from the Ministry of Nature Protection in January 2017. However, the project developer aims to obtain financing from the International Financing Corporation (IFC) and the Asian Development Bank (ADB). Because of this, an Environmental and Social Impact Assessment (ESIA) has been prepared for the YCCPP-2 Project in December 2017 following international best practices.

ArmPower CJSC/RENCO SPA would like to inform all interested authorities and NGO's about the construction of the new YCCPP-2 and the ESIA. Therefore, you are invited to come and join the Public Consultation Meeting at ''DoubleTree by Hilton Yerevan City Centre'' hotel ''Milano'' hall, 4/2 Grigor Lusavorich str., on February 10, 2018, at 10:00.

In a short presentation we will introduce the project to you and the general public, talk about possible environmental and social impacts and mitigation measures, and inform you about the grievance mechanism we implemented for the project. After that, in an open questions & answers session, you will have the chance to ask everything you want to know about the project.

Several experts on all different fields will be available to discuss the project and would welcome your comments and feedback.

Comments can also be emailed to: info@armpower.am

or posted to: Yerevan 0010, 10 Vazgen Sargsyan str., 105 office

We would also like to request your support for disclosing the ESIA documents that were prepared for the project, which we attach to this letter. We would like to request you to please post these documents on your official website, and to make the hard copies available at your installations, together with a sign informing people about the existence of these documents.

Thank you in advance for your cooperation and we are looking forward to seeing you at the public consultations.

Best regards,

''ArmPower'' CJSC (a subsidiary company of RENCO SPA)

An **advertisement** was published on 17th January 2018 in the Armenian local **newspaper** regarding the invitation to the Public Consultation Meeting with the following content:

Public notice

We inform, that the ArmPower CJSC (an Italian RENCO SPA group company) will begin to build a new gas fired Combined Cycle Power Plant of 254 MW (YCCPP-2) near the existing ''Yerevan TPC'', in regard of which the ArmPower CJSC wants to inform all interested citizens about the new plant construction and Environmental and Social Impact Assessment (ESIA). Therefore, you are invited to come and join the Public Consultation Meeting at ''DoubleTree by Hilton Yerevan City Centre'' hotel ''Milano'' hall, 4/2 Grigor Lusavorich str., on February 10, 2018, at 10:00. For participating in consultations, free transportation is available from the following locations:
From the front of Ayntap Municipality – at 09:30
From the front of Barekamutyun Metro station of ''Hayastan'' supermarket (exit)- at 09:30
From the front of Shengavit administrative district – at 09:30
From the front of Erebuni administrative district – at 09:30

Հայաստանի Հանրապետություն

Մի ամբողջ դարաշրջան մարմնավորող կենսագրություն

Ներկայացվել են մի շարք օրինագծեր

PRESS STAND

2. List of Participants

	Name	Surname	Occupation
1	Boris	Ohanyan	
2	Qnarik	Hovhannisyan	Independent expert in water resources
3	Lala	Tevosyan	Social and technology academy
4	Emil	Sahakyan	Energy expert
5	Aram	Grigoryan	"Arsar" center
6	Suren	Sargsyan	"Golos Armenia" newspaper
7	Kristy	Harrison	ADB
8	Ashot	Mirzoyan	"Consumers Support Center"
9	Zoya	Beniamonovaya	"Consumers Support Center"
10	Karen	Chilingaryan	"Consumers Support Center"
11	Arsen	Hazarapetyan	Yerevan municipality
12	Silva	Ayvazyan	"Aarhus Center Yerevan"
13	Ruzanna	Ghazaryan	
14	Vram	Tevosyan	"Consecoard"
15	Eduard	Arzumanyan	"Consumers Support Center"
16	Samvel	Khachatryan	

3. Minutes of the meeting

MINUTES

OF PUBLIC CONSULTATIONS

ON ESIA REPORT REGARDING YCCPP-2

OPENING REMARKS:

Mr. Sargis Grigoryan:

I welcome you all at this Public Consultations. Thank you for attending it. I wish all of us a fruitful meeting.

Ladies and gentlemen, the purpose why we have gathered is to conduct public consultations on the activities we have so far carried out in relation to the Environmental and Social Impact Assessment for Yerevan Combined Cycle Power Plant 2. I would like to emphasize the importance of the project for the Republic of Armenia, as it will ensure very efficient cooperation among the Asian Development Bank, the International Finance Corporation and the Government of the Republic of Armenia. The Renco Group in cooperation with Fichtner, German company, has conducted an Impact Assessment which will be presented to you today. It will be our pleasure to address your recommendations and remarks. First I would like to give the floor to Mr. Michele Arcangeletti, the Industrial Plants

Division Director at Renco S.p.A., to address an opening for this event. Afterwards, Mr. Detlev Paulsch, Fichtner representative, will present the Impact Assessment. A Q&A session will follow the presentation, and you will be welcome to provide us with your remarks and opinion. This is our agenda. Please feel free to ask any question on the agenda. If there is no question, we should start.

Mr. Michele Arcangeletti:

Buongiorno a tutti! First of all, I thank you all for attending this event, which relates to a stage of enormous importance to our project. I would not like to get into much technical detail regarding the project, as such detail will be presented by our colleagues. I will also skip the contractual matters surrounding the project, as it is long time you have the opportunity to get the respective information through various websites. I will address all your questions answers to which you have probably not found in the information published so far. The points I am going to make will help appropriately present the philosophy and vision of the project. If I were sitting among you, on that side, I would probably be interested in getting the answers to the following four main questions. First, it would the question: "Who will implement this project?"; second, it would be "Why this is being implemented? What is the aim pursued by the one has assumed the implementation?; third: "How well or how bad will the project be implemented?". And the fourth question I would address if I were you would be: "What will be the benefits of the project for the society at large, for the surrounding people?"
Let me start with the first question about Renco and its activities. I will try to be short to save our time for the discussions. Renco is an Italian company, born in Italy and with its headquarter in Italy, namely in Pesaro. About one hundred percent of Renco's activities are carried out abroad Italy. Now about the philosophy of what we do. Renco is not the company which enters a country for specifically one project and quits it after implementation of the project, nor is it the company which enters a country as a tourist. Wherever Renco operates, it makes that particular country its home. That is to say, Renco brings its huge expertise to that country and takes from there some of the country's experience, skills, and culture. This is the same philosophy of when a person makes its home bigger or when he builds a new home elsewhere. And this very philosophy is proved by the fact that twenty years ago Renco came to Armenia for its first project and stayed here for all these twenty years. Renco still operates here, implementing various projects, makes investments, and feeling home. Renco has become, so to say, an Armenian company, operating under the name RENCO ARMESTATE. Thus, I would like specifically highlight that we have extended the idea of what is our home. This concept leads to an answer to the second questions, which, as you might recall, refers to the reason why we have undertaken the implementation of this project. Because when one extends the area of its home or when he builds home elsewhere, he has to consider two aspects, technical and moral. The technical considerations relate to the durability of what one builds, as he wants to live for a long period. So, one has to exert maximum of his efforts to build it in a perfect manner. After, one has to be considerate and to build good relations with the neighbors on a mutuality

principle, trying to have good impact on the neighborhood. And if one wants to live well and to feel good where he lives, he cannot do it alone, but he can achieve it when the neighbors also live in tranquility and happily. Last but not least, one has to preserve and have good impact on the environment as much as possible. All these considerations lead to answering to the third question. How well will we implement this project? Is it environmentally safe? Let me give you some background to help you better understand these matters. First, one of the most important guarantees for quality is that our project must be viable for quite a long period, meaning that the project must operate well, be implemented with high quality and flawlessly, at least for twenty years, so that we can enjoy the fruits of our investments. This is why our choice of the technological partner was Siemens, a world technology giant having the experience of generating numerous gigawatts of energy all over the world. Our choice has also been conditioned by that Siemens agreed to enter into the project as a partner, as a shareholder, which fact is an additional guarantee for the minimum twenty years of viability of our project. The engagement of Siemens in the project is itself a guarantee for us, for the project. Second, as to the issue whether the project is environmentally-friendly, whether all relevant studies and expert examinations have been carried out, we have carried out double examinations to be sure that everything is appropriate in that regard. The first ESIA has been carried out by an Armenian organization, so that we also comply with the Armenian laws and regulations regarding the expert examinations. Afterwards, we also undertook the second impact assessment, not because we did not trust the assessment of the Armenian company, but because we also have international investors and we needed to comply with the international standards required by them. Mr. Detlev Paulsch will present in detail how that assessment has been carried out. The reason why we undertook the second assessment is also that, apart from the international standards, we wanted to double check for our comfort that everything goes as it should. Almost every day, and even yesterday, we visited the site to make sure that we did not overlook or miss any detail. Whenever we took samples, even if the laboratories issued positive opinions, we conducted double examinations, not economizing on any resources for that purpose. The logical continuation of these environmental principles I was presenting is the answer to the last questions, which I would like to have addressed if I were sitting there among you. What is the positive impact that the project will have on the community and the surrounding environment? First of all, the project will create 400 new jobs throughout its construction and operation periods. To note, this is not a short project, and following the construction, the project will operate for another 20 years. This means that throughout the whole period of operation, the project will guarantee over 100 jobs. An added value is that these employees will acquire new skills and expertise, not only in Armenia, but also abroad, with the help of Siemen's specialists. Last but not least, during the construction period, millions of dollars will be circulated through transactions for provision of services, acquisition of materials and goods. I hope the answers to these four questions have provided with some introduction to the project. Now I am pleased to give the floor to Mr. Detlev Paulsch, who represents the German company Fichtner having conducted the assessment.

PRESENTATION ON THE ESIA:

Dr. Detlev Paulsch presents the overview and main details of the Environmental and Social Impact Assessment for the project, including main possible impacts and respective mitigation and monitoring measures as well as different aspects of future public participation during the Project, including the Grievance Redress Mechanism.

Q&A SESSION:

Mr. Sargis Grigoryan:

Thank you Mr. Detlev Paulsch for the detailed presentation. I also want to thank for the enormous work that has been done. Particularly, I would like to highlight the introduced dispute settlement mechanism for addressing the complaints. This is highly important in the Republic of Armenia. I also want to refer back to Mr. Michele's opinion, which I share, regarding neighbors and home. The approaches of the Italians and the Armenians towards this matter coincide, with no doubt, so there can be some synergy in terms of style of working and the implementation of the project. I also want to emphasize the degree of Renco's social and other responsibility, which is another important quality for an investor who will make investments and implement a project in Armenia. Now, let's commence the final section, the Q&A. I am sure you all have questions, but please take into account that everyone should be provided with the opportunity to address questions and to have these questions answered; therefore, please consider that we have time limitations and address short questions, and we in our turn will try to give short and precise answers to them. I assure you in case of further questions which will not be addressed now, the whole time will be ready to attend any matter you will later raise. Using my privilege of the moderator, I would like to start with the question of Mr. Aram Grigoryan, as he has raised some matters during the coffee break.

Question 1:

Mr. Aram Grigoryan, representative of the Armenian Technological Academy:

- Thank you for this opportunity and for the detailed presentation, which enabled us to have some understanding of the preparatory works and of the further steps. I have several questions.

Mr. Sargis Grigoryan:

- Please, mind the time constraints. Please, stick to the "one question" principle. Each person addresses one question, then at the end we will come back to the questions which remained unaddressed.

Mr. Aram Grigoryan:

- OK! But I want to note, this is not my question, that we have gathered today for consultations, but why we do not have here the representatives of our Government so that to address some of the questions to them. All what you have told us today has been rather clear, but an important matter that has been and is still unaddressed: "Was there a true necessity for commencing such a transaction, for the construction of a new thermal power plant?" But this is a question which I believe should not be asked to the speakers. Anyway, I will address one question to the speakers: "What standards, e.g. European or some other standards, have been applied for project in general?"

Mr. Sargis Grigoryan:

- Since the main topic of our today's event is the environmental aspects, I am sure you mean the ESIA. If we talk about the project in general, then it would outside the scope of the subject of today's meeting. Therefore, I will ask Mr. Detlev Paulsch to answer this question.

Dr. Detlev Paulsch:

- We have used two types of standards. First, the national standards, which are defined in different decrees and regulations of Armenian Government. Second, we have used international standards, which are defined for example by IFC, ADB or the World Bank. The strategy is that always the stricter one of these standards has been included in our assessment.

[One of the participants attempts to correct the interpreter's comment in relation to the translation of the word "stricter of the standards"; Mr. Sargis Grigoryan asks the participants not to make additional comment so that each question receives its proper answer; Then, Mr. Detlev Paulsch continues]:

- And where, for example, no national standard exists, international standards are used.

Question 2:

Mr. Ashot Mirzoyan, president of the Consumers Support Center:

- Welcoming your style of working, not trusting our Government, I would like to touch upon one point. Among the objectives, you have mentioned shifting of the financial burden for power generation from the government to the private sector. Please specify how you plan to do this, as the years of practice shows that at the end everything rests on the shoulders of the end-users, through an increase in the tariffs. What is the mechanism?

Mr. Sargis Grigoryan:

- I have just noted that the subject of today's public consultations is Environmental and Social Impact Assessment; therefore, please ask questions related to this topic, and we might later discuss some global strategical questions for example during a coffee break or maybe we will provide additional clarifications later. So, please stick to the objective and format of today's event.

Mr. Ashot Mirzoyan:

- I am sorry but you have mentioned this among your objectives.

Mr. Sargis Grigoryan:

- The objective of today's meeting is the environmental impact, and the whole presentation made by Mr. Detlev Paulsch was aimed at this very topic. So, please stick to the format.

Question 3:

Mrs. Qnarik Hovhannisyan, independent expert in water resources:

- My question relates to water resources. From these reports, I could not finally understand what resources will be used to have the monthly water quantity of 300 000 m^3. Surface water or groundwater? What you mean by potable water is the water supply system? Then why you mention underground water? In short, what water is used for water supply?

Mr. Sargis Grigoryan:

- Mr. Michele has just pointed to me that we have received confirmation that water use will not have any negative impact on the consumers. Now, as to your question, I will translate and ask Detlev to answer it quickly.

Dr. Detlev Paulsch:

- The water to be used for the operation of this power plant is taken from the Yerevan Water Grid/ Network. And there are agreements already in place with the water provider that this amount of water can be taken, and this will be no problems for other water users.

Mr. Michele Arcangeletti:

- You have asked a question very much to the point, relating to our concerns with the decrease in the levels of underground water. There has been a recommendation to decrease the levels of underground water. The guidelines for the international standards require that when digging is done during construction works, it should be verified and made sure that

there is no negative impact on the level of underground water. But at this point, there is not such a plan. This is just, as you said, a hypothesis that if we choose that option, we will conduct additional studies to mitigate the impacts.

Mr. Michele Arcangeletti:

- I would like also to come back and answer to the previous question about Tariff, remembering anyhow that the Frame Work Agreement between Government of Armenia and ArmPower is a public document. As to the previous question on financing, as you know, we do not have any mechanism of influence on the tariffs. There is special authority, which regulates the tariffs, and as you know, this authority is the Public Services Regulatory Commission. Nor we have any say in the energy balance for the upcoming twenty years, in the quantity of energy that will be required to be generated. The thing that is indeed within the scope of our competence and that is the primary objective of our company is to invest our reputation and our expertise to be able to introduce respective technology and to attract respective financial resources, in addition to our resources, to attract respective loans due to our reputation, to be able to build this very efficient power plant.

Mr. Gegham Baklachev:

- Answering to Mr. Ashot Mirzoyan about question on Tariff: Sorry, why do you address this question to us? You should address this question to the Public Services Regulatory Commission; you are a member of that Commission!

Mr. Edward Arzumanyan:

- You just tell me whether what the [tariff] will be in the first year, fifth year when the plant operates. I have addressed a question in writing, but have not received an answer.

Mr. Sargis Grigoryan:

- I ask you to stick to the format of our meeting and respect each other. As to the tariffs, I should repeat that it is outside the scope of our today's meeting. Anyway, we always there ready to fully answer questions. Please, next question, Mr. Arzumanyan. One question, one answer. There are time constraints.

Question 4:

Mr. Edward Arzumanyan, energy sector expert, Consumers Support Center NGO:

- Since the questions on use of underground water have already been addressed, but the answers were not satisfactory, I now ask another question which is the most topical one for me at this point. We already have the bad experience. Since 2010, when the first Yerevan Combined Cycle Power Plant's 1st block, which is now next to your territory, was commissioned, we have received alarms that the temperatures of gas emitted by the plant exceed 200°C. Please answer whether in the normal operational mode or in case of 100% or 50-60% load, which is quite a possible scenario for the Armenian energy system, what will be the temperature of the emitted gas? I have more questions, but if I am to ask just one question, then this is my only question for now.

[Following the question, there starts a conversation regarding the questions of Mr. Arzumanyan which have allegedly been sent but remained unaddressed. Mr. Grigoryan says the responses have already been sent, but they will be resent if needed. Mr. Arzumanyan says he had received the response, but it referred to some websites. He says there is a question the answer to which has been left blank. Mr. Grigoryan says this is a technical matter, which will be clarified with Mr. Arzumanyan after the meeting, and clarification will be refurbished, if necessary.]

Dr. Detlev Paulsch:

- The temperatures of emissions at the stack will be 97° C. This temperature and also the emissions will be monitored during the operation. They are below the national and international limits. This is also the case, for example, for the emission of CO2. This will be also within the range of typical CO2 emissions which are provided by the IFC international guidelines.

Question 5:

Mrs. Qnarik Hovhannisyan:

- I am concerned with the issue of contamination. You have written here that wastewater treatment plants will be built. What type of plants are these: mechanical or biological? Do we comply with the required norms or not?

Dr. Detlev Paulsch:

- There will be a wastewater treatment plant constructed on site. This will be part of the new power plant. And all this industrial wastewater will be led to this treatment plant. The water that leaves this plant will be

monitored in order to adhere to all limit values. And then this wastewater will be led to the existing discharge structure of YCCPP-1.

Mrs. Qnarik Hovhannisyan:

- So, is this a mechanical or biological plant?

Dr. Detlev Paulsch:

- It will be both. There will be mechanical clearing, for example, for some oil contents. And there will also be biological clearing.

Question 6:

Mr. Tevosyan Vram, Consecoard LLC:

- Please specify how you are going to calculate the quantities of outflowing water. Will there be calculation or some metering device for clarifying the quantities?

Mr. Michele Arcangeletti:

- Usually the outflowing water quantity cannot be more than the 300 000 m^3 of water that will flow to the power plant. Anyway, usually when designing such power plants, the preliminary data calculations are very precise, very close to the reality.

Dr. Detlev Paulsch:

- This blowdown water will also be led to the wastewater treatment plant.

Question 7:

Mrs. Silva Ayvazyan, representative of Aarhus Center Yerevan:

- I would like to make some slight clarification. It has been mentioned that you cooperate with Aarhus Center Yerevan, but I do not know why it has been mentioned as NGO. To note, our organization is not a non-governmental organization, but is a public environmental information center. Yes we have met with representatives of Fichtner and we have promised that we will support in this public participation process. We have posted the draft on our website and have disseminated it among the public as much as possible. The interested parties are present today. This is all for the clarification part, and I also want to address a question to the representatives of Renco. The draft here mentions that the monitoring data will be coordinated with the Monitoring Center of the Ministry of Nature Protection, and thus the contamination data will be made publicly available. However, there are numerous modern technologies, innovative

mechanisms, which particularly make the information transparent. For example, the company might create its self-regulation mechanism and introduce devices for making the data available to the public online. I mean, can we expect the availability of such data on your website?

Dr. Detlev Paulsch:

- This will be an ongoing process throughout the construction and also the operation of the plant. So, there are different aspects. For example, the Emergency Preparedness and Response Plan will have to be developed/ sent also with/ to the communities. Furthermore, there will be information done by Renco, probably on their website, showing the ongoing process and showing the adherence to limit values and the implementation of the mitigation measures. This is all part of the Stakeholder Engagement Plan, which is also one part of our study. And also another aspect is the grievance redress mechanism, where during the construction and also during the operation people can send their concerns or their questions to the companies.

One of the participants makes a clarification with regard to Mrs. Silva Ayvazyan's question:

- "Sorry, I think she was wanting to know if the monitoring data that will be collected will be collected automatically, and then put on the website at the same time. So, automated monitoring. I think she means gas and water discharges.

Dr. Detlev Paulsch:

- To have these data also online is a good suggestion, which will be taken into account by Renco. And the monitoring data will be sent, in form of quarterly reports, to the Ministry of Nature Protection and to the other stakeholders.

Question 8:

Mr. Ashot Mirzoyan:

- "A Waste Management Plan which shall include a risk assessment…" etc. The world is progressing. Why do we store the waste? Let's just handle this waste. I want to make a recommendation to Fichtner. There are numerous technologies in the world for waste disposal. Why do we store and thus contaminate? There are technologies for disposal, if you are interested, we can send, if you do not know of them.

Dr. Detlev Paulsch:

- This Waste Management Plan I was talking about will, of course, follow some suggestions. This will follow waste management hierarchy, which is first to avoid any waste. If this is not possible, try to reuse or recycle. If all this is not possible, this will probably be disposed [*here the interpreter translates as "properly stored"*]. We will not have any contaminated waste.

Mr. Sargis Grigoryan:

- Let me sum up. What Mr. Detlev said, is that there will be a Waste Management Plan, which will generate solutions depending on the different types of waste.

Question 9:

Mr. Edward Arzumanyan:

- You have mentioned that there will be no contaminated waste in the plant. Does this mean that the plant will not have a chemical plant for water treatment? If there is a chemical treatment plant, then contaminated water or wastewater will be discharged from there. This is a point with regard to the previous question which needs clarification. Now, my question. You have a heat recovery steam generator. How many sections does it have: one, two, or three?

Mr. Gegham Baklachev:

- We kindly ask you to address these questions in writing, so that we give you a detailed and precise answer.

Question 10:

Mrs. Ruzanna Ghazaryan, "Dalma-Sona" Cultural and Educational, Social and Ecological Foundation:

- I wish all the success to the project. The project area, as I can judge at first sight, is located within the Erebuni-Arin Berd line. We all know that the Armenian land is really old, unpredictable. Maybe, no historical and cultural sight has been discovered at the area during the Soviet period, but I believe there is huge probability that something might be discovered there. It has been mentioned that a proof of occurrence/absence of any cultural or historical goods will be requested from the Ministry; however, if for example some 3000-year-old cultural monument is discovered, are you ready to abandon the project at all?

Mr. Gegham Baklachev:

- Such matters are always our focus. In our case, there will be no deep digging, but if anything valuable or unusual for the soil structure is discovered, we will inform both you and the Ministry of Culture. It will be our great pleasure to cooperate with you.

Dr. Detlev Paulsch:

- First of all, the area we are talking about, there has been some kind of earth work in the past. So probably there will be no cultural goods found anymore. But the Ministry of Culture shall be informed before the project, in order to give them the possibility to have a look at this area. And during the construction, as I said before, there will be a Chance Find Procedure. This means that if any cultural goods will be found during the construction works, during earth works, then the Ministry of Culture has to be informed about it and they have decide on the future steps.

Mr. Sargis Grigoryan:

- Mr. Detlev Paulsch's statements are fact-based. Let's stick to the facts. The fact is that currently there are no cultural and historical goods, but if there will be such, a proper plan will be in place. As to the termination or abandonment or continuation of the project, it depends on the particular event that will occur, the goods that will be found, and on the possibility to further implement the project. Answering your question now and saying that we will or will not terminate the project, I think will be an unprofessional attitude on our part. Thank you.

Mr. Michele Arcangeletti:

- These engineering and geological studies carried out so far, do not give room for assuming that there will be any chance finding. But if we have the chance to detect anything of true historical and cultural value, we will be really happy and we will not make any decision independently, but will engage the respective authorities and the civil society. Let's hope that the big treasure, as you said, will be found not in the project site but in the vicinity. In that case we all will be happy.

Question 11:

Mr. Ashot Mirzoyan:

- The question relates to the gases. Based on what you said, the technology is quite clean and environmentally-friendly; however, please explain how it happens that the gases are so clean. Is this due to special filters or a well-developed deep combustion process?

Dr. Detlev Paulsch:

- Of course, this will be state-of-the-art equipment that will be installed there, including filters and, for example, low NOx burner to reduce the emissions. As you know, the stack will be 66 meters high. We calculated different scenarios for different stack heights, showing that this 66-meter stack height will have least impact on the residential areas and also showing that all national limits and all the international limits are adhered to and are not exceeded. And of course, there will be a monitoring system installed to monitor continuously the emissions.

Mr. Michele Arcangeletti

- The technology to be used will be supplied by Siemens, and their technology is internationally approved. Siemens plays a primary role in the world in this regard. There are just a few companies in the world competing with Siemens. This competition makes these companies to invest enormously in minimizing the hazardous emissions. And there is no wonder that by the time the emissions are less risky, less hazardous. These companies are global players, and they know that in order to sell their equipment on a worldwide basis they have to pay ever more attention to environmental aspects, to lower the emission levels, and to make their equipment more efficient. Knowing well that the environmental awareness of people is continuously raising, these global producers do not simply focus on profits, but on making their equipment more efficient and more environmentally friendly. As you know, Siemens is a German company. The Italians, whenever they learn that the used technology is German, they get the ultimate trust. When we were to choose the technology, we again relied on Siemens, relying also on the information provided by Siemens with regard to the parameters of the equipment.

Question 12:

Mr. Emil Sahakyan, energy and nature protection sector expert:

- I think the work you have done is extensive, useful and exhaustive. I have just one question. Will the main equipment in the newly built thermal power plant be different from the existing ones? And also, will their impact in terms of the water discharges be different, given that the two blocks will use the same system, which discharge the waters into Hrazdan River?

Dr. Detlev Paulsch:

- It is planned to use the existing discharge structure of the YCCPP-1, and the treated wastewater from the new power plant will be led to this discharge structure with pipelines and channels leading finally to Hrazdan

River. But it is important to mention that we will have our own wastewater treatment system in this new plant.

Mr. Michele Arcangeletti:

- The Monitoring Plan will be applied to our own wastewater system. Though the infrastructure is shared, but the monitoring plan will help clearly distinguish how wastewater from our plant is treated. As to the equipment, the existing power plant uses the main equipment produced by General Electric, whereas we will use the equipment produced by Siemens. So they will be different.

Question/recommendation 13:

Mrs. Yepremyan, interpreter at ADB:

- Actually I live in Shengavit District, so this issue is quite relevant for my family. My recommendation or question will be as follows. As part of the mitigation plan, do you envisage any type of landscaping for particularly Shengavit and Erebuni Districts, like tree planting or maybe establishing some small green oasis within these two districts, because the districts are also very poor in vegetation?

Dr. Detlev Paulsch:

- It is foreseen to have a landscape management plane at least near to the power plant. But it is a good idea to also include your recommendation in this plan.

Mr. Gegham Baklachev:

- I would add that we cooperate with the landscaping department of Yerevan Municipality, and we participate in Community Cleanup Days and tree planting events in different parts of the city. This is a good recommendation. We will further focus our attention on the cooperation with the district administration offices. We are already in direct contact with them. For sure, we will implement landscaping activities.

Question/recommendation 14:

Mr. Ashot Mirzoyan:

- I just suggest that Renco to engage the Consumers Support Center as much as possible in relation to the grievance redress mechanism. We are receiving numerous complaints with regard to the road construction project with the Asian Development Bank. The practice shows that if we work in collaboration, the results are more efficient for you and for us. As

to the landscaping projects, we are always ready to help with our volunteers, etc. Thanks.

Dr. Detlev Paulsch:

- As I showed before in the grievance mechanism scheme, there is always the chance to place the grievance indirectly, e.g. with the support of NGOs, who will then direct the grievance to the risk manager at Renco.

Mr. Gegham Baklachev:

- I would like to add that it will be our pleasure to collaborate. Maybe after the event, we can exchange ideas on an additional mechanism.

CLOSING REMARK:

Mr. Sargis Grigoryan:

- Ladies and gentlemen, thank you all for your presence, your participation and for your recommendations, which are really important to us. I am sure this will not be the only such event. We are always ready to cooperate with you on different matters. We highly estimate your opinion and your recommendations. Please always feel free to approach our team, should you raise any matter. We are always here to help.

Mr. Gegham Baklachev:

- One more point regarding the earlier questions on tariffs. There is the Framework Agreement with the Government, which is publicly available, and is posted on the website of the Ministry of Energy. If you wish, we can supply it to you. There you will find the tariffs and all the relevant provisions of the agreement.

Mr. Michele Arcangeletti / Dr. Detlev Paulsch:

Thank you to everyone.

COFFEE BREAK:

During the coffee break, Mr. Edward Arzumanyan received answers to some of his questions and was informed that additional response had been sent to him the day before. Hard copy of the responses has been supplied to him.

Public Consultation Session - 10.02.2018 - Photo documentation