

«ARMPOWER»  
Closed Joint Stock Company

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*REPORT OF ENVIRONMENTAL IMPACT  
ASSESSMENT*

**ON RECONSTRUCTION OF THE NEW COMBINED  
CYCLE POWER PLANT IN YEREVAN (YCCPP)**

**Executor**

«Consecoard» LLC

\_\_\_\_\_ V. Tevosyan

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# 1. GENERAL INFORMATION

This report concerns the Memorandum of Understanding signed between RA government and Renco S.p.A. JSC ("Sponsor") in December 2015 and between the same parties and "Armpower" CJSC (hereinafter: "Builder" or "Company") signed on April 27, 2017, dated 2018 amended and restated on November 13, 2018 and subsequently amended on December 14, 2018, April 22, 2021 and October 7, 2021, 250MW gas and steam combined cycle power plant (the "Plant") in Yerevan, Republic of Armenia) to design, develop, finance, construct, own, operate and maintain the facility constructed by the Developer pursuant to the Framework Agreement ("Framework Agreement").

The location of the company is RA, Yerevan, Vazgen Sargsyan str. 10, location of facility: RA, Yerevan, N 14/1, Artsakh street 4th lane.

Based on the provisions of the above-mentioned Memorandum of Understanding and the Framework Agreement, the "Renco" group initiated the construction project of the Plant, developed the relevant design documents, including the EIA report. The prepared EIA report was submitted to the environmental impact assessment, as a result of which a positive conclusion was issued in 2016.

As a result of further discussions and equipment market research and turbine selection, it became necessary to revise the project. For this purpose, the second EIA report was developed in 2019, which received a positive preliminary conclusion in 2020.

The completion of construction works of the station was documented on October 21, 2021, and the plant was commissioned on December 11, 2021.

The plant is operated by the Developer in accordance with the electric energy (power) production license No. JE-0636 issued by the RA Public Services Regulatory Commission on February 13, 2019, amended on December 11, 2021.

During the several months of operation of the plant, a number of circumstances were revealed that were the basis for making changes in the EIA report, the main ones being the following:

1. the drainage system needs improvement,
2. power plant capacity indicators need to be clarified,
3. it is advisable to deliver the produced energy to "Armenian Electric Networks" CJSC through its own substation, implementing a triangular connection scheme with the transmission network in the plant area.

## 2. THE LEGAL GROUNDS OF THE ACTIVITY

### 2.1. National legal acts

The operation of the station is organized and carried out taking into account the international obligations assumed by the RA in the field of environmental protection and the relevant requirements set by the RA legislation (laws and by-laws).

The main ones are (with changes and additions):

1. RA Land code (02.5.2001),
2. RA Water code (04.6.2002),
3. RA Law “On the Environmental impact assessment and expertise” (21.06.2014),
4. RA Law “On atmospheric air protection” (01.11.1994),
5. RA Law “On wastes” (24.11.2004),
6. RA Law “On administrative offences” (07.02.2012),
7. RA Law “On environmental control” (11.04.2005).
8. RA Law "On Special Nature Protected Areas" (ՀՕ-211, 27.11.2006)
9. RA Law "On Animal World" (ՀՕ -52, 04.03.2000)
10. Law "On flora" (ՀՕ-22, 23.11.1999)
11. Resolution N71-Ն of the RA Government dated 29.01.2010 on approving the Red Book of RA animals
12. Resolution N72- Ն of the RA Government of 29.01.2010 to approve the Red Book of RA plants
13. Resolution No. 967- Ն of the RA Government dated August 14, 2008 "On approving the list of natural monuments of the Republic of Armenia".

The following sub-legislative acts were the basis for design work and planning.

14. Order No. 138 of the Minister of Health of the Republic of Armenia of May 6, 2002: "On approval of sanitary norms N2-III - 11.3 on noise in workplaces, residential and public buildings and residential construction areas".
15. Order No. 01-N of the Minister of Health of the Republic of Armenia of January 25, 2010: "On the approval of sanitary rules and norms for hygienic requirements for soil quality No. 2.1.7.003-10".
16. Order N533-N of the Minister of Health of the Republic of Armenia of May 17, 2006, "On establishing the hygienic norms of vibration in workplaces, residential and public buildings HNN 2.2.4-009-06".
17. Protocol Decision No. 54-13 dated 10.12.2015 of the Government of the Republic of Armenia "On approving the ways of long-term (until 2036) development of the energy system of the Republic of Armenia".
18. "Concept of Energy Security of the Republic of Armenia" approved by the President of the Republic of Armenia on 23.10.2013.

According to the classification, established by the article 14 of the RA Law “On the Environmental impact assessment and expertise”, the planned activity is classified as “A” category activity and is subject to expertise by two stages.

## 2.2. International Agreements

In addition to the abovementioned normative acts, environmental numerous strategic, conceptual and national programs have been developed, and several international agreements and conventions have been signed and validated by the RA.

The international conventions and protocols, signed by the RA and their status in the RA are given below.

*Table 2.1. International conventions and protocols, signed and validated by the RA*

NN	Convention or protocol, title and location	Entered into force	Signed	Validated	Note
1	Convention on Wetlands of International Importance (Ramsar, 1971)	1971	As a successor, has joined upon the request of the RA MFA in 1993		
2	United Nations Convention on Biological Diversity (Rio de Janeiro, 1992)	1993	1992	1993	Has been reregistered, UNO, 1993
3	United Nations Framework Convention on Climate Change (UNFCCC) (New York, 1992)	1994	1992	1993	Has been reregistered, UNO, 1993
4	Kioto Protocol (Kioto, 1997)	2005		2002	
5	United Nations Convention on Long-range Transboundary Air Pollution (Geneva, 1979)	1983		1996	Has been reregistered, UNO, 1997
	Convention on <i>Persistent Organic Pollutants</i> , (Stockholm, 2001)	2004	2001	2003	
	<i>Protocol to Abate Acidification, Eutrophication and Ground-level Ozone</i> (Gothenburg, 1999)		1999		
6	UNECE Convention on Environmental Impact Assessment in the Transboundary Context (Espoo 1991)	1997		1996	Has been reregistered, UNO, 1997
	Protocol on Strategic Environmental Assessment (Kiev 2003)	2010	2010	2011	

7	United Nations Convention to Combat Desertification (Paris, 1994)	1996	1994	1997	Has been reregistered, UNO, 1997
8	The UN Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel, 1989)	1992		1999	Has been reregistered, UNO, 1999
9	Convention on Protection of the Ozone Layer (Vienna, 1985)	1988		1999	Has been reregistered, UNO, 1999
	Protocol on Substances that Deplete the Ozone Layer (Montreal 1987)	1989		1999	Has been reregistered, UNO, 1999
10	UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters	2001	1998	2001	

### 3. DESCRIPTION OF THE INTENDED ACTIVITY AREA, INCLUDING THE SURROUNDING ENVIRONMENT

#### 3.1. Physico-geographical conditions

The territory of the plant is located in the southern part of the city, in the industrial zone. The nearest residential districts “Erebuni” and “Noragavit” are located at 2200-2800m distance from the Power Plant.

The distance from Aintap and Nor Kharberd settlements is about 1.6 km.

The location relief is calm. The level of the location is 927m above sea level.

The seismic stability is 8-9 point.

The historical architectural museum “Erebuni” is situated at 4km distance from the location.

Groups of deposits from upper Pliocene up to contemporary age participate in the territory geological structure, which are represented in general with volcanic, volcanic-sedimentary facies.

#### *Geomorphology*

From geomorphological respect, the represented territory relief is flat, with certain slope.

From lithological respect, the following geological layers may be identified in the territory:

1. Contemporary alluvial-proluvial soils, represented by grey clayey sand of solid composition, remnants and roots of decayed plants.
2. Gravel soil with blocks, sandy and clayey aggregate up to 30-35%, the stone blocks are represented with volcanic rocks, sublayers and lens of clays and sands.

3. Blocky soil with macadam and gravel mixture; the gap between stone pieces is filled with cayey sandy and sandy aggregate up to 10%. The stone pieces are represented by volcanic rocks.
4. Upper forth age lake-alluvial deposits, represented by macadam-gravel soils, containing blocks, with sandy and clayey aggregate up to 30-35%; the stone rocks are represented by volcanic rocks, sublayers and lens of clays and sands.

No landslides have been observed in the area.

### *The hydro-geological conditions of the territory*

From hydro-geological respect, the territory of the plant is not favorable during seismic impact. Groundwater is related to the flows, located between and under lava and have infiltration nature.

The groundwater presence in the clayey soils is explained by the existence of numeral sublayers and lens of saturated sands, which have led to difficult conditions of groundwater circulation and existence to aquifers.

The groundwaters level in the site territory is 2-6m.

The seismic zones map is represented in the normative document CNRA II-6.02-2006 “Seismic Resistant Construction Design Standards”, according to which the studied territory is located in the third seismic zone. 0.4g horizontal acceleration value corresponds to that zone.

### **3.2. Climatic conditions**

In general, the climate of Yerevan has an expressed continental nature, with hot and dry summers followed by moderately cold winters with unstable snow cover. The climate features are conditiond by penetration of dry hot air masses from south in summer and cold air masses from north in winter.

The absolute minimum temperature is not lower than -30°C, the absolute maximum temperature reaches +42°C. The average air temperatures by months for the southern industrial district of Yerevan are given in the Table 4.1, according to the data of "Construction Climatology" СНиП II-7.01-96.

The climatic conditions of the therritory are represented based on the data of Yerevan “Erebuni” meteorological station.

The calculated climatic parameters of the year are given in tables 3.1 - 3.4 thanks to stack pipe height increase, from 25m to 65m, the emitted substances dispersion will intensify, and hazardous substances concentrations in the ground level will essentially decrease.



*Table 3.1. Average atmospheric air temperature according to Erebuni meteorological station*

Meteorological station	Height above sea level, m	Average temperature by month, C <sup>0</sup>												Average annual	Absolute minimum	Absolute maximum
		1	2	3	4	5	6	7	8	9	10	11	12			
Erebuni	888	-3.6	-1.0	5.3	12.5	17.4	21.8	25.8	25.2	20.5	13.3	6.3	-0.2	11.9	-28	42

*Table 3.2. Relative air humidity according to Erebuni meteorological station*

Meteorological station	Height above sea level, m	Relative air humidity by month, %												Average annual	Average monthly at 3 p.m	
															January	August
		1	2	3	4	5	6	7	8	9	10	11	12			
Erebuni	888	79	75	62	56	57	49	45	46	49	62	73	79	61	67	28

*Table 3.3. Atmospheric precipitation and snow cover according to Erebuni meteorological station*

Name of the settlement	Amount of precipitation average monthly / maximum daily, mm By months												Annual	Snow cover, mm	Annul snow cover days
Erebuni	1	2	3	4	5	6	7	8	9	10	11	12			
	24	23	32	35	45	23	11	8	12	29	28	21	291	58	47
	24	23	34	29	42	34	29	37	51	35	36	28	51		

Table 3.4. Wind parameters according to Erebuni meteorological station

Name of meteorological station of the settlement	Average annual atmospheric pressure (hPa)	Months	Repeatability, % / average speed, m/s in directions								repetition of no wind, %	Average monthly speed, m/s	Average annual speed, m/s	Number of days with strong winds (15 m/s)	The computing speed (m/s) Wich is possible once in No. of years		
			Northern	North-eastern	Eastern	South-eastern	Southern	South-western	Western	North-western					20	50	100
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Erebuni	912.1	January	4	9	11	14	21	25	12	4	76	0.7	1.5	29	22	27	29
			2.2	2.2	2.2	2.9	2.7	2.3	2.6	2.7							
		April	7	14	8	16	20	16	13	6	45	1.9					
			3.1	3.2	2.8	4.0	3.1	3.0	3.8	3.6							
		July	17	28	4	9	17	13	8	4	36	2.8					
			5.2	5.7	2.8	2.7	2.4	2.7	2.9	4.3							
		October	6	17	10	10	21	20	10	5	63	1.0					
			2.9	2.5	2.1	2.5	2.3	2.4	2.9	3.5							

### 3.3. Air basin

There are 45 observation posts and 5 observation stations in Yerevan. The contents of dust, sulfur dioxide, nitrogen dioxide and ground-level ozone were determined. Metal content was determined in some dust samples, whose monthly and annual average concentrations are presented in the form of graphs.

In 2021, the city's air pollution (according to 4 air pollutants) is at a lower than average level: the air pollution index\* (APC) is 2.14 (dust: 1.15, sulfur dioxide: 0.34, nitrogen dioxide: 0.61, near-ground ozone: 0.05).

Over the past 5 years, a decreasing trend of sulfur dioxide and ground-level ozone concentrations, and an increasing trend of dust and nitrogen dioxide, has been observed.

In 2021, the average annual dust concentration of the indicators determined in the atmospheric air of Yerevan exceeded the corresponding TRL by 1.1 times. The average annual concentrations of the remaining indicators did not exceed the respective TRLs. In 29% of the conducted observations, dust, sulfur dioxide in 13%, nitrogen dioxide in 0.4%, and ground-level ozone in 1% were observed to exceed the relevant OTCs, which may be due to both climatic conditions and pollution sources, as well as with the scarcity of green areas. The main sources of atmospheric air pollution in the city are transport, industry, energy, urban development<sup>1</sup>.

*Table 3.5. Results of atmospheric air observations of Yerevan, 2021.*

Compound to be determined	Observed maximum concentration, mg/m <sup>3</sup> (for monitoring station)	Average annual concentration, mg/m <sup>3</sup>	Average daily COC, mg/m <sup>3</sup>
Sulfur dioxide	0.059 (obs. N2)	0.017	0.05
Nitrogen dioxide	0.910 (obs. N7)	0.027	0.04
Dust	2.076 (obs. N1)	0.172	0.15
Ground-level ozone	0.095 (obs. N8)	0.005	0.03

In order to find out the level of background pollution in the immediate planned location and in the nearby residential districts, during the design phase of 2018-2019, the project

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<sup>1</sup> <http://armmonitoring.am/>

consultant company "Fichtner" carried out monitoring by measuring the ground-level concentrations of nitrogen dioxide and sulfur anhydride by passive sampling.

According to the results of the analyzes carried out at the "Hydrometeorology and Monitoring Center" of the RA Ministry of Environment, the concentrations of the mentioned substances were:

*Table 3.6. Air basin monitoring results*

Emission material	Allowable pollutant concentrations, mg/m <sup>3</sup>		Measurement results, mg/m <sup>3</sup>	
	Average per day	Maximum short term	maximum	minimum
NO <sub>2</sub>	0.04	0.2	0.0265	0.0042
SO <sub>2</sub>	0.05	0.5	0.0101	0.0387

### 3.4. Water resources

The background pollution of water resources in the RA territory is also monitored by the "Hydrometeorology and Monitoring Center" NCO.

By the RA government's decision "On defining water quality assurance norms for each water basin management area, depending on the specifics of the location" (RA Government Decision No. 75 N of January 27, 2011). The surface water quality assessment system in RA distinguishes five status classes for each indicator of water chemical quality: "excellent" (1st class), "good" (2nd class), "mediocre" (3rd class), "inadequate" (grade 4) and "bad" (grade 5). The general assessment of the chemical quality of water is formed by the class of the indicator showing the worst quality.

The surface water monitoring network includes 131 observation points of water bodies (rivers, reservoirs, Arpa-Sevan aqueduct and Lake Sevan) of 6 water basin management areas of the Republic (North, Akhuryan, Hrazdan, Sevan, Ararat, South).

Water quality is characterized physicochemically with up to 45 indicators (main anions and cations, nutrients, heavy metals, primary organic pollutants) with a frequency of 5-12 times per year.

#### *Hrazdan Water Basin Management Area (WBMA)*

The Hrazdan WBMA includes the Hrazdan and Kasakh river basins. Here, the sources of

pollution of water resources are mainly communal-household wastewater.

In 2020, surface water quality monitoring was carried out at 20 observation points in Hrazdan WBMA, in 10% of which the water quality was rated 2nd class, 25% - 3rd class, 15% - 4th class and 50% - 5th class. Compared to the previous year, no significant change in water quality was observed in 2020. Among the polluted rivers are Kasakh, Gegharot, Hrazdan and Getar.

The water quality of the Hrazdan River near Geghamavan village was assessed as "moderate" (class 3) due to the chemical demand for oxygen and aluminum. Below the village of Qaghsi, the water quality was assessed as "inadequate" (class 4) due to vanadium. Below the village of Argel, above the Arzni HPP, below the Yerevan, near the village of Darbnik, in the areas near the river mouth and the village of Geghanist, the water quality was assessed as "bad" (class 5). Below the village of Argel and above the Arzni HPP, due to vanadium, below the city of Yerevan, in the area near the village of Darbnik, with ammonium, phosphate ions, vanadium, total inorganic nitrogen and total phosphorus, in the mouth of the river with ammonium ion and vanadium, near the village of Geghanist, with ammonium, phosphate ions and vanadium.

The water quality of the Getar River in the estuary was assessed as "poor" (class 5) due to ammonium, phosphate ions, vanadium, total inorganic nitrogen and total phosphorus.

The distance of "Armpower" CJSC thermal power plant from the nearest water resource, Hrazdan River, is 4.5 km.

### **3.5. Soil cover**

The following types of soil are found in the region.

- ❖ Light brown breakstone, in some cases carbonates cemented
- ❖ Semi-desert grey breakestone, in some places carbonated
- ❖ Pleo-hydromorphone, combined residual alkali saline.

The ground cover in the immediate planned area was used for the maintenance of the gas-fired combined cycle power plant of "Yerevan TPP" CJSC, which was built earlier and is in operation. There is practically no fertile soil layer and vegetation here.

### **3.6. Biodiversity**

The presented site is located in the floristic region of Yerevan, in the desert-semi-desert zone.

The types of vegetation found in this area are: polygonum /two types, the seed pod of one is like a bead, the seed pod of the second is a bunch of beans/, alhagi persarum, artemisia, diphyllia, Capparis spinosa, Melilotus, alfalfa.

From grasses, the following species prevail in this area: bothriochloa and elytrigia.

The envisaged activity is to be implemented in the area of the operating TPP, in the industrial zone of Yerevan, which is deprived of natural vegetation.

The following animals are found in this area: marsh frog, lizard, grass snake, house sparrow, hooded crow, Eurasian magpie, common and social vole, brown rat from the vertebrates, and earthworm, ant, bee, tettigoniidae, cricket, grasshopper, cimex lectularius, butterfly, mosquito, house and field flies, from the invertebrates.

Birds: mallard, common moorhen, common quail, rock dove, sandpipers.

Immediately the territory of the TPP is deprived of natural vegetation and there are no wild animals.

### **3.7. Social conditions**

The Plant is located on the edge of the southern industrial zone of Yerevan. The nearest residential districts, Nor Kharberdi, Aintapi, are located 1.2 - 1.5 km away, more than 2.2 km from the residential buildings of Erebuni and Shengavit administrative areas of Yerevan.

#### **3.7.1 Yerevan**

The capital Yerevan is located in the north-eastern part of the Ararat valley. It borders the RA Aragatsotn, Kotayk, Ararat and Armavir regions.

Yerevan is the capital of the Republic of Armenia. It is the largest not only among the current 49 cities of Armenia, but also among the historical capitals of Armenia. The RA National Assembly and the RA Government are located in the capital, all RA ministries and main departments, public and other organizations, various associations, foundations, commissions, judicial bodies, the vast majority of dramatists and stock exchanges, most mass

media.

Representative offices of international (intergovernmental, interstate) and other organizations in the Republic of Armenia operate in the capital city.

Yerevan is the largest economic center of the republic. The main field of multi-branch industry is the manufacturing.

The main branches of Yerevan industry are food, including beverages, manufacturing, chemical industry and metallurgy.

Agriculture is mainly specialized in animal husbandry and plant growing.

Freight and passenger forwarding are carried out by automobile and electric transport (there is a railway station and an airport in the city that provide the communication with the outside world).

Shengavit administrative district shares borders with Erebuni, Kentron, Malatia-Sebastia and Nubarashen administrative districts. It is bordered by Ararat Marz.

Area: 4060 ha.

Population<sup>2</sup>: 141 900.

The solutions for environmental protection of Yerevan are directly related to the improvement of Shengavit administrative district and its environmental condition.

In general, there are various forms of land use in the considered administrative district of the city: residential construction, industrial production zones, special purpose lands, green mass of public purpose, landscape zone, zone built with commercial objects, medical and health facilities, educational special purpose objects, etc.

### **3.7.2 Ayntap**

Area - 8.8 km<sup>2</sup>

Population<sup>3</sup> - 9550

A village in Masis region of Ararat marz, on the Yerevan-Artashat highway. It is 25 km away from the regional center. It is in the south-east of Yerevan city. Formerly called Ayntap New, Beibudabad, Tazagyugh, Tazakend, Nakhagegh. Ayntap was renamed in 1970 to

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<sup>2</sup> <https://armstat.am/am/>

<sup>3</sup> <https://armstat.am/am/>

commemorate the Ayntap city of Cilicia: Noragyugh name is mentioned in the period of 1465-1466. In 1679 the village was completely destroyed as a result of the devastating earthquake and was deserted. In later years, it was rebuilt by settlers from the Khoy province. The village is situated in Ararat valley, at an altitude of 865m above sea level. The climate is arid terrestrial. Winters begin in mid-December, and the average January temperature varies from -30°C to -50°C. Summer lasts from May to October, with an average monthly temperature of 24°C to 26°C and a maximum of 42°C. Often there are dry hot winds that cause significant damage to agriculture. The annual precipitation is 250-300mm. Natural landscapes are semi-deserts which have been transformed into a culture-irrigable landscape during irrigation. From an agro-climatic point of view, the community is in an absolute irrigation zone.

### 3.7.3 Nor Kharberd

**Area:** 7.7 km<sup>2</sup>

**Population<sup>4</sup>:** 8500

A village in Masis region, 4 km northeast from Masis town, on the Yerevan-Artashat highway. It is 24 km from the regional center. Formerly called Kharaberde, Kharberd, Nor Kyanq. Until 1996 it was an urban settlement. The settlement was founded in 1929 by the residents of Western Armenia who moved from Kharberd, in 1938 was renamed to Nor Kyanq, and renamed Nor Kharberd since 1965.

The village is located in the Middle-Araks concavity, 920 m above sea level. The climate is arid terrestrial. Winters begin in mid-December, and the average January temperature varies from -30°C to -50°C. Summer lasts from May to October, with an average monthly temperature of 24°C to 26°C and a maximum of 42°C. Often there are dry hot winds, that cause significant damage to agriculture: The annual precipitation is 250-300mm. Natural landscapes are semi-deserts which have been transformed into a culture-irrigable landscape during irrigation. From an agro-climatic point of view, the community is in an absolute irrigation zone.

Diatomit SP CJSC, Kharberd specialized children's home SNPO of the Ministry of Labor and Social Affairs of the Republic of Armenia are located in Kharberd.

The ancestors of the majority of the population emigrated from the Kharberd regions of Western Armenia. In 1980 it had 4097 inhabitants. According to the National Statistical

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<sup>4</sup> <https://armstat.am/am/>



Service, in 2005, the population of the community is 5948 people, 49% of whom are men and 51% are women. Pre-working age of population is 27%, working age is 60%, and post-working age is 37%. The village has 1985 households. There are two secondary schools, a music school, a library, a kindergarten, a medical clinic.

The main branch of the economy is agriculture, most of the gross crop comes from the plant growing. Agricultural lands are about 404.0 ha. Most of the community land is used as arable land, occupying about 197.0 ha. There are orchards and vineyards, which respectively account for 41.0 and 19.0 ha. They are engaged in gardening, viticulture, field cultivation, vegetable growing, viticulture, field cultivation and vegetable growing. Development of heat-loving vegetable, melon, cereals and fodder crops. Pastures occupy 39.0ha. Engaged in breeding and poultry farming.

It has no industry.

Among the community problems the important ones are irrigation and drinking water issues, repair of village roads, sale of the harvest, installation of electrical substations in new district.

## **4. THE ALTERNATIVES OF THE PROJECT INCLUDING THE ZERO OPTION**

### **4.1. Zero option**

A zero or no-action option means that no changes are taking place and no restructuring is being carried out at the "Armpower" CJSC SGCCPP. In this case:

- There will be no additional man-made influence and pressure on the living environments of Yerevan.
- Environmental and social impact risks or hazards will not arise,
- The economic situation and employment levels will remain unchanged.

*However, it should be emphasized that as a result of the presented reconstruction, there will be no change in the impact on the environment.*

## 4.2 Options to consider

When considering the alternatives for each activity, consider:

- activity type alternative,
- the place selection alternative
- technological solutions, etc.

The presented reconstruction includes, first of all, the registration of the actual capacity level, as well as the technical change of the water use scheme and the construction of its own substation. All of these changes are technically operational outcomes and have no alternative.

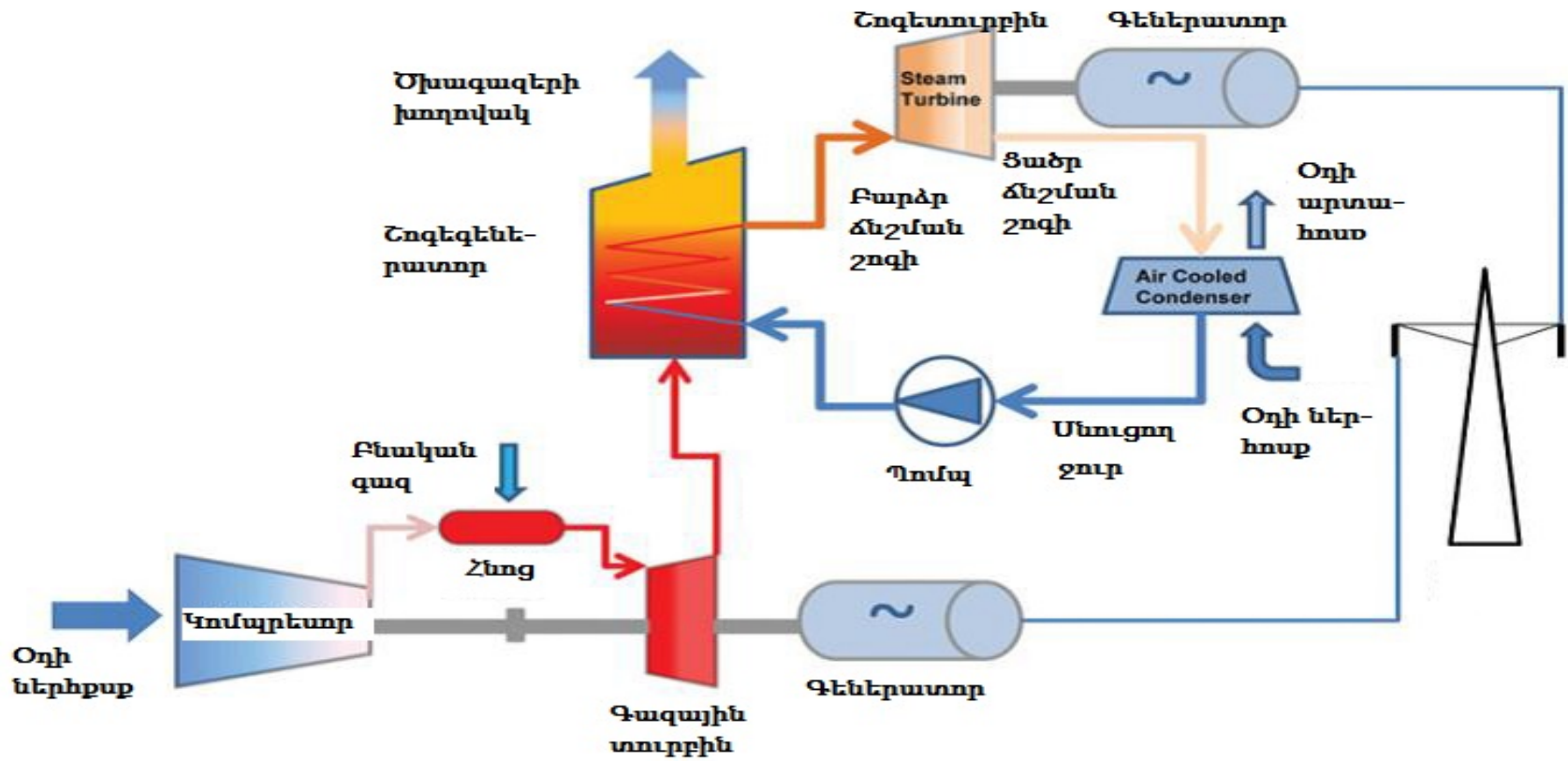
## 5. DESCRIPTION OF THE INTENDED ACTIVITY

### 5.1 Operating Plant

The currently operating Plant was built according to the 2019 project and has the following technical indicators:

- base load gas turbine with a low level of nitrogen oxide generation,
- fuel gas compressors with 2x125% or 3x75% power, fuel gas pressure at the gas compressor inlet is 8.0 - 10.0 bar,
- steam turbine - generator and their respective auxiliaries
- along with the equipment,
- condenser with appropriate equipment,
- steam generator (HRSG) based on the proposed configuration, including a bypass chimney,
- water and waste water treatment system (W&WWTS),
- based on reverse osmosis technology,
- blowout preventer systems based on the recommended configuration,
- lifting equipment, gas turbines and steam turbines
- for repair, fuel gas compressors and AC equipment,
- main step-up transformers 220 kV,
- auxiliary transformer for gas turbines and steam turbines based on the proposed configuration;
- area and station storage battery 1440 A/h,
- drinking water system,

- waste water removal system,
- industrial water and rain water sewer network,
- fuel gas supply system,
- automatic fire fighting system.



Pic. 5.1. Thermal power plant technological scheme



In order to present the exact location of the thermal power plant, the coordinates of the area using geographic and WGS-84 (ARMREF 02) national geodetic coordinate systems are given below.

National geodetic coordinates		Geographic coordinates	
X (N)	Y (X)	X (N)	Y (X)
4442191.3	8457016.8	40 ° 6'44 ".039 N	44 ° 29'44 ".991 E
4442391.7	8457032.7	40 ° 6'50 ".539 N	44 ° 29'45 ".614 E
4442368.1	8457330.3	40 ° 6'49 ".828 N	44 ° 29'58 ".186 E
4442167.8	8457314.4	40 ° 6'43 ".331 N	44 ° 29'57 ".562 E

## 5.2. Planned changes

*Table 5.1. Comparative data of design indicators*

<i>N</i>	<i>Design indicator</i>	<i>Project in progress</i>	<i>Modified project</i>
1	Location	14/1, 4th Lane, Artsakh Street	Invariable
2	Gas turbine	SGT5-2000E	Invariable
3	Steam turbine	SST600	Invariable
4	Installed capacity <sup>5</sup>	254.8 MW	277.5 MW <sup>5</sup>
5	Chimney height	65 m	Invariable
6	Chimney diameter	6 m	Invariable
7	Substation of contacts	220 kW «Yerevan TPP» CJSC	220 kW «Armpower» CJSC
8	Natural gas consumption	402407884 STD m <sup>3</sup> /year 297780 t/year	Invariable Actually, in January-April months: 128.0 mln.m <sup>3</sup>

<sup>5</sup> The term "Installed capacity" is not clearly defined in the current normative legal acts. There was no change in the installed capacity of the station. Previously, the amount of the available capacity of the Plant was declared as the set capacity in the conditions of the average annual indicators of the external environment of Yerevan. In this report, the nominal capacity of the Plant under ISO standard conditions is indicated as the installed capacity.

The nominal capacity of the plant in case of combined cycle operation is 277.5 MW under ISO standard conditions (namely: +15°C air temperature, 1013 mbar atmospheric pressure, 60% relative air humidity).

The available power of the plant depends on the climatic conditions at the location, especially the air temperature and atmospheric pressure. In the range of possible variation of air temperature from -30°C to +42°C during the year at the location of the plant, the available capacity of the plant will vary in the range of 278 - 225 MW, respectively. The average annual capacity of the plant will be 254MW. The emission volumes of the station are calculated based on the maximum volumes of gas consumption by the station in the aforementioned capacity range. In the case of working at maximum capacity, the hourly gas consumption of the station will not exceed the design amount of 56348 m<sup>3</sup>/h (41.7 t/h) specified in the 2019 EIA report. Accordingly, in the case of operating at maximum capacity, the volume of plant emissions will not exceed the indicators indicated in the 2019 EIA report. The project change will not affect the indicated indicators.

At the same time, it is necessary to emphasize that even in the case of working with the specified maximum capacity of 278 MW, the gas consumption, and therefore the amount of emissions, will not exceed the gas consumption based on the 2019 EIA.

According to the EIA report of 2019, the maximum annual consumption of gas was planned to be 402407884 st m<sup>3</sup>/year (297780 t/year), in the case of 8000 hours/year of work, respectively, the average hourly expenditure will be 50300 st. m<sup>3</sup>/hour (37.2t/hour).

During 2022 (January-April), the output of the plant was actually about 667 million kWh, and the gas consumption was about 128 million m<sup>3</sup>. Accordingly, during those 4 months, the average consumption of gas was about 44,500 m<sup>3</sup>/h.

### ***5.2.1. Water supply and drainage system***

#### **a) Water supply**

Water for the plant is obtained from the water pipeline of "Veolia Jur" CJSC, based on the relevant contract. A special water metering system allows you to control the volume of water supply.

Water is stored in the water storage tank (1900 m<sup>3</sup> usable volume) in the area of the power plant. Water is used for the following purposes:

1. water supply for cooling towers,
2. demineralized water for heat production,
3. for staff drinking and domestic purposes,

4. for fire protection.

As a result of the planned reconstruction, the volumes of water use will not change.

The planned changes are:

- *Considering the quality of the water supplied by "Veolia Jur" company, the filters provided for in the original design are not needed and they were not installed.*
- *Previously planned ionization for demineralization instead of cationic resins, a membrane reverse osmosis loop will be used.*

#### **b) Drainage**

The drainage system consists of two parts.

- domestic waste water,
- industrial outflow and surface waters.

#### *Domestic waste water*

Domestic waste water is directly supplied to the sewage network of Veolia through one internal network.

#### *Industrial outflow and surface waters*

Industrial outflow results from cooling tower system blowdowns, oil flow from surface and operating rigs. A basin (industrial outflow receiving node) was planned for the effluent generated in the production processes, which is a reservoir with concrete walls and a floor. Previously, it would also perform the role of a clarification plant, but experience has shown that the water is clean enough and sedimentation does not occur.

The volumes of industrial and domestic discharges will not change as a result of the reconstruction.

### **5.2.2. Substation**

According to the current project, the produced electric energy was to be connected to the newly built 35/110/220kV substation of "Yerevan TPP" CJSC. Currently, the Company is planning to make a triangular circuit connection to the 220 kV "Nairi" overhead line of "High Voltage Electric Networks" CJSC, which connects the substation of "Yerevan TPP" CJSC and the "Haghtanak" system, passing through the territory of the Plant.

The transformer junction is designed according to the current project, it is installed and operated. Below is the electrical diagram of the triangular connection implemented in the substation.





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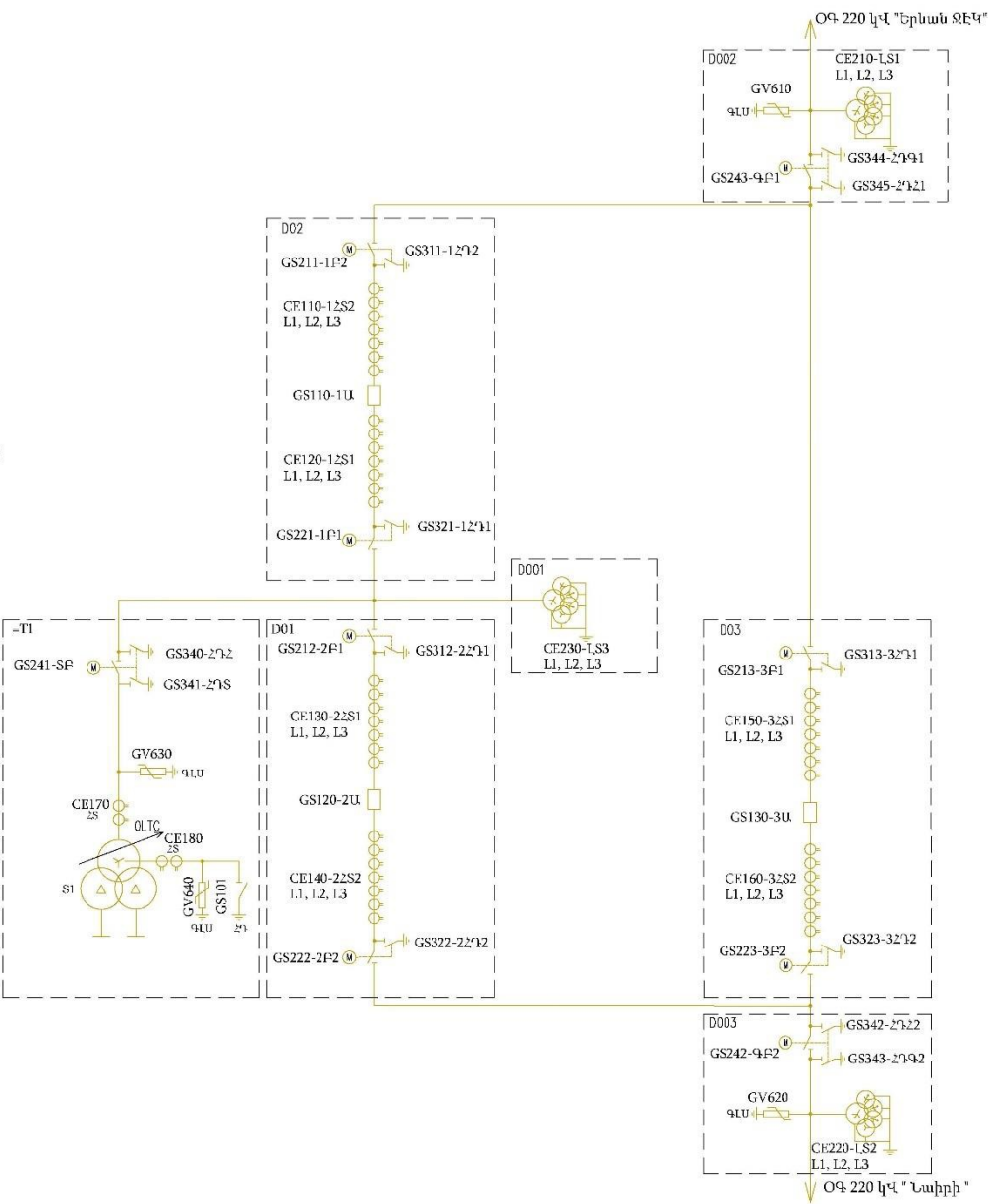
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03	13.01.2021	ԲԲ	Բաժնի համարձակություն		Բաժնի Անուն
02	11.01.2021	ԲԲ	Բաժնի համարձակություն		Բաժնի Անուն
01	30.01.2020	ԲԲ	Բաժնի համարձակություն		Բաժնի Անուն
00	23.11.2019	ԲԲ	Բաժնի համարձակություն		Բաժնի Անուն

Տեսակ	Թվական	Տեսակ	Նկարագր	Ստորագրող	Ստորագրողի Անուն

**ARMPower** **RENCO**

ARMENIA 250MW CCGT

Ձևակերպող: 220 կՎ էներգետիկ Ստանդարտի սինխրոն  
Yerevan Combined Cycle Power Plant 2

ՓՈՒՄԿ-ի Ծագումը	ՓՈՒՄԿ-ի Ծագումը	ՓՈՒՄԿ-ի Ծագումը	ՓՈՒՄԿ-ի Ծագումը
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## 6. ASSESSMENT OF POSSIBLE IMPACT ON THE ENVIRONMENT AND SOCIAL RISKS OF THE PLANNED ACTIVITY

### 6.1. Air pollution

During the operation of the thermal power plant, the impact on the atmospheric air is due to the emission of products resulting from fuel combustion. Taking into account the fact that modern gas turbine equipment is operated at the plant, emission calculations were made according to the European Environmental Protection Agency's "Guidelines for the Inventory of Emissions of Air Basin Pollutants"<sup>6</sup>.

The guide provides specific emission factors for different combustion technologies and power plants, according to the amount of energy produced.

"Armpower" CJSC Power Plant is equipped with turbines produced by the Siemens AG concern, which meet the requirements of the European normative document IPPC "Reference Document on BAT for Large Combustion Plants" and other highest international standards.

Coefficients of Guideline's Tables 3-17 were used for gas turbine emission calculations.<sup>7</sup>

Many compounds are listed in the table, but the coefficients of some of them are insignificant and only the main pollutants were taken into account in the calculations below. The guide provides specific emission factors for different combustion technologies and power plants, according to the amount of energy produced

*Table 6.1. Specific coefficients of emissions*

No.	Pollutant	The unit of measurement	Specific emission coefficient
1	Nitrogen oxides (calculated as nitrogen dioxide)	g/GJ	30
2	Carbon monoxide	g/GJ	20
3	Non-methane volatile organic compounds (VOCs)	g/GJ	0.65
4	Solid particles	g/GJ	0.445

In the table, the unit of energy is gigajoule, GJ.

1 gigajoule = 277.8 kWh.

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<sup>6</sup> European Environment Agency. EMEP/EEA air pollutant emission inventory guidebook 2013

<sup>7</sup> Table 3-17. Tier 2 emission factors for source category 1.A.1.a, gas turbines using gaseous fuels

According to the EIA report of the thermal power plant inspected in 2019 the average hourly consumption of gas will be 50,300 m<sup>3</sup>/hour, and in case of maximum productivity and adverse climatic conditions, the maximum consumption of gas will be 56,348 m<sup>3</sup>/hour.

In this report, the short-term (g/s) emissions were calculated based on the maximum hourly consumption, and the annual average hourly consumption.

56348 m<sup>3</sup>/h x 9.564 kWh/m<sup>3</sup> = 538912.0 kWh/h, where:

- 9.564 kWh/m<sup>3</sup> - the average calorific value of natural gas.  
The hourly productivity of the power plant expressed in gigajoules is:
- 538912.0 kWh/hour; 277.8 kWh/GJ = 1940 GJ/h.

Using the specific emission factors presented in table 6.1, the emissions generated during the combustion of natural gas were calculated. The results of calculations are given in table 6.2.

*Table 5.2. Emissions of pollutants*

No.	Pollutant	Emissions quantities		
		g/sec (0.539 GJ/s)	kg/hour (1940 GJ/hour)	t/year
1	Nitrogen oxides (calculated as nitrogen dioxide)	16.17	58.2	415.5 <sup>8</sup>
2	Carbon monoxide	10.78	38.8	277.0
3	Non-methane volatile organic compounds (VOCs)	0.35	1.26	9.0
4	Solid particles	0.24	0.86	6.1

*Calculation of flue gas volumes*

The stoichiometric volume of air required for burning 1 m<sup>3</sup> of natural gas is 9.52 m<sup>3</sup>. Taking into account the excess air factor of 1.05, the volume of air will be:

$$9.52 \times 1.05 = 10 \text{ m}^3.$$

$$\text{Annually: } 402407884 \text{ m}^3/\text{year} \times 10 = 4024078840 \text{ m}^3$$

As a result of burning one m<sup>3</sup> of gas, the volume of flue gases will be: 1 + 10 = 11 m<sup>3</sup>.

The volume of flue gases per minute: 15.65 m<sup>3</sup> x 11 = 172.2 m<sup>3</sup>/s.

Emission source characteristics and emissions quantities are given in Table 6.3.

<sup>8</sup> Annual emissions were calculated based on annual gas volume

Table 6.3. Quantities of atmospheric emissions and characteristics of emission sources

Name of production site	Emissions generation source		Sources of emissions	Emission source number	Height of emission source, H, m	Source diameter, m	Gas smoke volume, m3/s	Emission temp. T°C
	name	quantity						
Thermal power plant	Steam and gas turbine	2	flue gas pipe	1	65.0	6.0	172.2	96

Table 6.3 continuation

Materials to be cleaned	Average level of cleaning	Coordinates of the source on the map scheme (see part of the annexes)				Name of emissions	Emissions quantities	
		X <sub>1</sub>	X <sub>2</sub>	Y <sub>1</sub>	Y <sub>2</sub>		g/sec	t/year
-	-	260	-	225	-	<ul style="list-style-type: none"> <li>• Nitrogen dioxide</li> <li>• Carbon monoxide</li> <li>• VOCs</li> <li>• Solid particles</li> </ul>	16.17	415.5
							10.78	277.0
							0.35	9.0
							0.24	6.1

### Calculation of near-surface concentrations

To assess the impact of emissions, it is necessary to compare them with established norms. For this reason, modeling of expected concentrations in the near-ground layer as a result of the dispersion of the calculated emissions was carried out.

Calculations of dispersion of harmful emissions in the atmosphere were made with the computer program "Era" based on the data given in table 6.3. Calculations determined:

- coordinates of calculation points, m;
- ground-level concentrations of harmful emissions in terms of SPC and  $\text{mg}/\text{m}^3$  units;
- the wind speed in m/s at which the ground-level concentration reaches the greatest value at the calculation point.

The terrain is calm. The slope of the terrain from east to west is 10m. Since the differences in heights do not exceed 50m at a distance of 1km, the relief factor is assumed to be 1.

The maximum near-ground concentrations obtained in the results of computer calculations are given in table 6.4.

*Table 6.4. Results of surface concentration calculations*

№	Pollutants	Maximum one-time PLC <sup>9</sup> of residential zones, $\text{mg}/\text{m}^3$	Maximum ground concentrations	
			$\text{mg}/\text{m}^3$	PLC
1	nitrogen dioxide	0.2	0.2306	0.0461
2	Carbon monoxide	5	0.0043	0.0215
3	Frontier Hydrocarbons (BHCs)	1.0	0.00069	0.00069
4	Solid particles (ashes)	0.15	0.0095	0.00142

The results of the calculations of the dispersion of harmful substances in the atmosphere show that the expected ground concentrations are within the norms set for residential zones.

Tables for computer calculations of near-surface concentrations are provided in Appendix 1 of this report.

### Sanitary protection zone (SPZ)

According to the sanitary norms 245-71, the SPZ for thermal power plants is formed based on the calculation of ground concentrations as a result of dispersion of emitted substances. Taking into account the fact that the calculated near-ground concentrations do not exceed the established norms and the nearest residential district is more than 1600 m away, no special measures are planned for the purpose of organizing the SPZ.

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<sup>9</sup> RA Government Decision No. 160-N dated February 2, 2006 "On establishing the norms of permissible limit concentrations of atmospheric air pollutants in residential areas"

## 6.2. Water Resources

### 6.2.1. Water supply

The water for the plant is supplied from the water pipeline of "Veolia Jur" CJSC based on the relevant contract. A special water metering system allows you to control the volume of water supply.

Water is collected in a water storage tank (with a usable capacity of 3000 m<sup>3</sup>). The water will be used for the following purposes:

- Water supply for cooling towers,
- Demineralized water for heat production,
- Staff drinking and domestic purposes.

#### *a) Demineralized water*

The filtered water is pumped to the demineralization unit with a volume of 12.06 m<sup>3</sup>/hour.

The recovery cycle of the demineralization loop is carried out sequentially with return water, which is pumped to the circulating water basin of the cooling towers with an average volume of 4.86 m<sup>3</sup>/hour.

The demining node consists of the following main sections:

- Multimedia filters + appropriate reverse flow structures (pumps, ventilators, etc.),
- Mechanical cartridge filters for final water treatment,
- Reverse osmosis (RO) auxiliary compressor pumps,
- First stage reverse osmosis membranes (2 X 50%),
- solution tank,
- Reverse osmosis (RO) feed pumps,
- Second stage reverse osmosis membranes (2 X 50%);
- Mechanical electrodeionization prefilters,
- electrodeionization equipment (2 X 50%)
- Chemicals (pH control, antiscalants).

Demineralized water is collected in a special container, the volume of which is 340m<sup>3</sup>.  
Demineralized water is used for heat production.

---

#### *b) Cooling towers*

Cooling water is used for the following purposes:

- vacuum condenser cooling (outside temp. 15°C, return temp. 23°C, averaged values)
- heat exchanger (outside temp.: 15°C, return temp.: 30 °C, averaged values)
- Cooling of auxiliary compressors
- Gas turbine generator cooling,
- Steam turbine generator cooling,
- Gas turbine oil system cooling
- Steam turbine oil system cooling
- Cooling of various pumps.

Six towers are planned. Water is pumped through three pumps. The cooling system works in a circulating way. Water losses are compensated by pumping from the water storage tank, as well as backwash water from the demineralization unit and heat production exhausts.

Drinking quality water is used for all purposes, because, except for irrigation water use, which is seasonal in nature and constitutes a small amount in the total water use, it is practically not possible to use Hrazdan River or ground water in all other nodes due to their high pollution. The systems of the "Armpower" CJSC thermal power plant are designed for a certain quality of water, and the Hrazdan River or ground water do not meet these requirements in any way. In addition, the project was designed in accordance with the technical conditions defined by the framework agreement signed with the RA government, and the tariffs defined by the framework agreement are based on the same technical conditions. The 2019 EIA report reflects the relevant water supply data and no change is planned in that respect.

### ***6.2.2. Drainage system***

The drainage system consists of two parts:

- domestic wastewater,
- industrial outflow.

*Domestic wastewater* is delivered directly to the sewerage network of the Veolia company through a single internal network.

#### *Industrial outflow*

A neutralization basin is designed for the outflow generated in the production processes, which is a basin with concrete walls and a floor.

Two vertical pumps are installed inside the basin, the purposes of which are:

- for water averaging



- to pump the averaged waters to the canal of "Yerevan HPP" CJSC.

### **6.2.3. Calculation of water use**

#### Industrial requirement

For production purposes, water will be used for heat production and cooling of various nodes of the system.

#### Mining

Demineralization is carried out in order to prepare water for heat production. Moreover, water consumption for demineralization is 12.06 m<sup>3</sup>/h, of which 7.2 m<sup>3</sup>/h is used directly for demineralization, and the remaining 4.86 m<sup>3</sup>/h for backwashing of filters. Wash water is pumped to the cooling tower pool to make up for losses.

#### Heat production

For the production of heat, demineralized water is used, which is poured into the heat circulation system once, after which it is only replenished.

The 7.2 m<sup>3</sup>/hour of dewatered water mentioned in the previous point is pumped to the heat generation unit to supplement the exhaust from the condensate circulation system.

The exhaust of the heat circulation system, with a volume of 7.2 m<sup>3</sup>/hour, is directed to the basin of the cooling towers.

#### Cooling system

The system consists of 6 towers. The circulation of each tower is 2197.5 m<sup>3</sup>/h, total 13185 m<sup>3</sup>/h. As the water is cooled by air, evaporation and water loss occur. Water losses are as follows:

- evaporation and system losses: 275.49 m<sup>3</sup>/hour,
- exhaust: 132.82 m<sup>3</sup>/hour.

Total losses: 408.31 m<sup>3</sup>/hour.

Cooling system losses are replenished:

- backwashing water of the demineralization unit: 4.86 m<sup>3</sup>/hour,
- exhaust of the circulating system of heat production: 7.2 m<sup>3</sup>/hour,
- from fresh water storage capacity: 396.25 m<sup>3</sup>/hour,

The total fresh water requirement for production purposes will be:

$$12.06 + 396.25 = 408.31 \text{ m}^3/\text{hour}.$$

---

Taking into account the maximum annual working hours of the thermal power plant, 8400 hours/year, the losses and, accordingly, the water demand for production purposes will be:

408.31 m<sup>3</sup>/hour x 8400 hours/year = 3429804.0 m<sup>3</sup>/year.

Water use for drinking, domestic and auxiliary needs

a) Domestic drinking water use

According to the project documents of "Armpower" CJSC, drinking and food water demand for cooking and showers is 0.7 m<sup>3</sup>/hour,

daily: 0.7 m<sup>3</sup>/hour x 24 hours/day = 16.8 m<sup>3</sup>/day and

annually: 0.7 m<sup>3</sup>/hour x 8400 hours/year = 5880.0 m<sup>3</sup>/year.

b) Water demand for washing floors and open spaces

According to the project documents of "Armpower" CJSC, the water demand for washing floors and open spaces is 1.3 m<sup>3</sup>/hour,

annually: 1.3 m<sup>3</sup>/hour x 8400 hours/year = 10920.0 m<sup>3</sup>/year.

c) Irrigation Water use

Irrigation is carried out during the hot and dry season of the year. The number of such days is taken as 144 days/year. Irrigation water demand will be:

$W_{\text{irrig.}} = S \times Q \times K$ , where:

S – the surface of green areas, 6000 m<sup>2</sup>,

Q – per mc the rate of watering, 3L,

K – number of irrigations per day: 2.

$W_{\text{irrig.}} = 6000 \text{ m}^2 \times 0.003 \text{ m}^3/\text{m}^2 \times 2 = 32 \text{ m}^3/\text{day}$ :

The maximum number of hot and dry days per year for the southern part of Yerevan is 250, from here the annual water demand will be:

32 m<sup>3</sup>/day x 250 day/year = 8000 m<sup>3</sup>/year:

Conventionally dividing by the number of total annual working hours, we will get an average hourly rate of 1.0 m<sup>3</sup>/hour.

The total water demand of the company will be:

3429804.0 + 5880.0 + 10920.0 + 8000.0 = 3454604.0 m<sup>3</sup>/year:

#### **6.2.4. Drainage**

a) Industrial outflow

A significant part of industrial water use is spent to compensate for the losses of circulating systems. Outflow is only from cooling tower system exhaust, which is 132.82 m<sup>3</sup>/h or:

132.82 m<sup>3</sup>/h x 8400 h/year = 1115688 m<sup>3</sup>/year.

The outflow is collected in the averaging and streamlining basin, from where the purified outflow is pumped to the production outflow collector of "Yerevan TPP" CJSC.

b) Domestic drinking water outflow

The volumes of drinking and domestic waste water are calculated as follows:

$$W_{\text{domestic sewage}} = W_{\text{dom.}} \times (1 - L), \text{ where:}$$

“L” is for losses, generalized 5 percent /0.05/,

$$W_{\text{dom. sewage}} = 5880.0 \text{ m}^3/\text{y} \times (1 - 0.05) = 5586.0 \text{ m}^3/\text{y:}$$

c) Outflow of the water for auxiliary needs

Washing of floors and open spaces

Runoff resulting from washing floors and open spaces is calculated in the same way:

$$W_{\text{washing leakage}} = W_{\text{washing water}} \times (1 - L), \text{ where:}$$

“L” is for losses, generalized 5 percent /0.05/,

$$W_{\text{dom. sewage}} = 10920.0 \text{ m}^3/\text{y} \times (1 - 0.05) = 10374.0 \text{ m}^3/\text{y.}$$

**Irrigation**

Irrigation water use is irreversible and no outflow occurs.

Total domestic and auxiliary water use outflow:  $5586.0 + 10374.0 = 15960.0 \text{ m}^3/\text{year}$  is pumped into the city sewer network of "Veolia Jur" CJSC.

Total outflow of the Plant will be:

$$1115688.0 + 15960.0 = 1131648.0 \text{ m}^3/\text{y.}$$

*Table 6.5 Summary volumes of water use and drainage*

Purpose of water consumption	Water consumption (fresh), m <sup>3</sup> /year	Water loss or irreversible use		Drainage, m <sup>3</sup> /year
		%	m <sup>3</sup> /year	
Production needs	3429804.0	67.5	2314116.0	1115688.0
Drinking, domestic	5880.0	5	294.0	5586.0

Auxiliary needs	18920.0	45.2	8546.0	10374.0
Total	3454604.0	-	2322956.0	1131648.0

Total water consumption for the plant's industrial needs will be:

- 3429804.0 m<sup>3</sup>/year
- 9799.44 m<sup>3</sup>/day
- 408.31 m<sup>3</sup>/hour

Total water consumption for drinking and domestic needs of the Plant will be:

- 5880.0 m<sup>3</sup>/year
- 16.8 m<sup>3</sup>/day
- 0.7 m<sup>3</sup>/hour

Total water consumption for the auxiliary needs of the Plant will be:

- 18920.0 m<sup>3</sup>/year
- 55.2 m<sup>3</sup>/day
- 2.3 m<sup>3</sup>/hour

Total water consumption of the Plant will be:

- 3454604.0 m<sup>3</sup>/year
- 9871.44 m<sup>3</sup>/hour
- average hourly: 411.31 m<sup>3</sup>/hour

Total outflow of wastewater from the Plant to the city sewer network of Veolia will be:

- 15960 m<sup>3</sup>/year
- 45.6 m<sup>3</sup>/day
- 1.9 m<sup>3</sup>/hour

Total industrial outflow of the Plant to the outflow system of "Yerevan TPP" CJSC will be:

- 1115688.0 m<sup>3</sup>/year
- 3187.68 m<sup>3</sup>/day
- 132.82 m<sup>3</sup>/hour

Total outflow of the Plant will be:

- 1131648.0 m<sup>3</sup>/year
- 3233.28 m<sup>3</sup>/day
- 134.72 m<sup>3</sup>/hour.

### Rainwater treatment

For rainwater treatment, there is a basin in the plant area, the purpose of which is to collect the rainwater flowing in the plant area, simplify it, clean it from possible oil products and direct it to the domestic sewage system.

The basin is equipped with the American API Separation Unit, which is a rectangular concrete basin. After the sump is filled, sufficient time and pause is necessary to allow the oil droplets to rise to the surface where they will be removed. At the same time, the total suspended particles settle to the bottom of the basin.

### **6.3. Waste management**

No industrial wastes of I-IV hazard class are generated during the new combined cycle power plant operation.

No turbine and compressor oil wastes are generated in the new power plant. In the compressors, the abovementioned oils evaporation occurs under high pressure.

The evaporated oils are caught in separators and returned to the process. Quality control of the used oil is regularly performed. Fresh oil is added if necessary. The specified operations are performed by specialized companies with the appropriate license.

Domestic waste in the amount of 60-64 t/year is planned to be transferred to the Nubarashen landfill based on the contract with sanitary services. The waste corresponds to the type of waste "Unsorted waste generated from the domestic premises of organizations (except for large dimensions)", classifier: 9120040001004.

### **6.4. Social impact**

#### The forecast changes of social conditions.

As a result of the new thermal power plant operation there will be generated emissions, wastes, noise, there will be performed transportation activities which will have certain social impact. The main directions of social impact:

- Population health
- Visible places
- Re-distribution of natural resources
- Work relations

#### Analysis of benefits and losses

As already mentioned, the emission of hazardous substances and the noise level do not exceed the sanitary norms, while hazardous wastes are not generated at all. Thus, there will be no negative effect for the health of population.

The production facilities and infrastructures will be distributed far from the residential areas

and there will be no change of visible scenes. As for the natural resources, the following will be used:

- Natural gas
- Water
- Atmospheric air

The envisaged quantities are indicated in the corresponding sections of the present report.

The transport movements will mainly be connected to the transfer of the personnel.

The employee salaries are more than the average salary accepted in the Republic. This will allow to improve the social conditions of the employees' families.

In parallel, there will be services which will contribute to raising the general standard of living. In the residential area the service sphere, waste removal, etc. will be improved.

### **6.5. Thermal power plant closing**

The ecological risks during the thermal power plant closing are related to the collection and transportation of reagents, present in the plant, as well as to the demounting, demolition and transportation of the equipment.

The main ecological risks of the closing procedure are the following:

- The reagents are chemicals, the operation with which requires vocational training and the operational safety rules should be strictly followed
- During the demolition works, dust emissions and construction wastes are generated
- During the demounting of metallic structures and cutting of equipment and devices, wastes of metals and other materials are produced
- During the operation of construction technical equipment, the noise level is increased and emissions of fuel combustion results are produced.

### **6.6. Cumulative (combined) impact**

In order to completely evaluate the impact of the planned activity, it is necessary to consider it in the context of all polluting factors of the area and the area potential.

From the point of view of anthropogenic impact, the main polluting source in the area of the planned power unit is the operating power unit of YTPP CJSC.

As the assessment presented in this report has shown, the main environmental impact of the TPPs of "Armpower" CJSC and "Yerevan TPP" CJSC is due to the emissions of harmful substances generated during the burning of natural gas.

~~The contribution of the "Armpower" CJSC Plant to the pollution of the area and the corresponding cumulative effect are presented below in the form of emission quantities and ground level concentration values of the two TPPs.~~

*Table 6.6. Thermal power plants emissions and ground concentrations*

№	Pollutants	Emissions of harmful substances, t/year			Maximum ground-level concentrations in terms of PLC		
		«Yerevan TPP» CJSC	«Armpower» CJSC	Total	«Yerevan TPP» CJSC	«Armpower» CJSC	Total
1	Nitrogen dioxide	344.0	415.5	759.5	0.076	0.2306	0.3066
2	Carbon monoxide	<sup>10</sup> -	277.0	277.0	-	0.0043	0.0043
3	Limit hydrocarbons (VOC)	-	9.0	9.0	-	0.00069	0.00069
4	Solid particle (ash)	-	6.1	6.1	-	0.0095	0.0095

As can be seen from table 6.6, the sums of ground concentrations do not exceed the PLC values.

## 7. ASSESSMENT OF THE ECONOMIC DAMAGE ON THE ENVIRONMENT

### 7.1. General provisions

The Power plant has a direct or indirect impact on the environment. The impact on the environment can, in addition to being measured in physical units, also be expressed in monetary form, as an indicator of economic damage. Assessment of possible economic damage to the environment is carried out according to environmental components. The economic loss is calculated according to the decision of the Government of the Republic of Armenia dated 27.05.2015 N764-N.

The possible economic loss is calculated:

$$DE=LIA+WIA+AIA$$

where:

“DE” is the possible economic damage expressed in monetary terms,

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<sup>10</sup> Differences in the list of emissions of existing and planned thermal power plants are explained by the use of different calculation methodologies

“LIA” is the value of the impact of damage on land resources, caused by economic activity (negative environmental changes that cause pollution of natural environment, impoverishment of natural resources, abrasion or damage of ecosystem) that is calculated according to the RA government resolution N92-N of 25.01.2005.

“WIA” is the value of the direct and indirect impact of damage on water resources, caused by economic activity that is calculated according to the RA government resolution N1110-N of 14.08.2003.

“AIA” is the value of the impact of damage on the atmosphere, caused by economic activity, that is calculated according to the RA Government resolution N91-N of 25.01.2005.

## 7.2. Atmospheric air

The economic damage is the value of the measures, necessary for the elimination of the damage caused to the environment, expressed in monetary terms.

The economic damage considers:

- the expenses related to the worsening of the health condition of the population,
- damages caused to agriculture, forestry and fishery,
- damages caused to industry.

The economic damage was calculated according to the “Order of assessment of impact caused to the atmosphere by the economic activity” confirmed by the RA Government resolution N91-N of 25.01.2005.

The damage caused to the economy for each emission source is evaluated, according to the following formula:

$$I = E_c T_i \sum A_i Q_i$$

where:

“I” is the impact, expressed in AMD.

“E<sub>c</sub>” is the coefficient expressing the characteristics of polluting source environment (active pollution zone), according to the mentioned order, it is considered 4 for the industrial sites mentioned in the table 9;

“T<sub>i</sub>” is the transfer indicator, which is stable and is selected based on the principle of stimulation of the process of environmental protection. According to the present order,

“T<sub>i</sub>” is 1000 AMD;

“A<sub>i</sub>” is the value expressing the relative adversity of i substance (dust type), 12.5 for nitric dioxide, 1 for carbon monoxide, 3.16 for saturated hydrocarbons, 10.0 for solid elements (ash or inorganic



dust of construction works);

“ $Q_i$ ” is the coefficient related to the quantity of the emission of the given (i) substance;

“ $Q_i$ ” coefficient is defined by the second formula

$$“Q_i” = g (3A_{ei} - 2 TLV_i), A_{ei} > TLV_i (2)$$

where:

“ $TLV_i$ ” is the quantity of annual threshold limit value of emission of the i substance, in tons.

“ $A_{ei}$ ” is the annual factual emission of the i substance, in tons, taken from table 11.

Considering that the emissions of hazardous substances take place in the areas situated far from the residential areas, where the quality of air is not standardized, it is considered  $Q_i=A_{ei}$

$g=1$  for fixed sources

$g= 3$  for mobile sources

The impact of those substances, the norm concentration of which is not defined by state standards, is not calculated.

$$I = EcTi\sum A_i Q_i = 4 \times 1000 \times (12.5 \times 415.5 + 1 \times 277 + 3.16 \times 9.0 + 10 \times 6.1) = 22240760 \text{ AMD/year}$$

### **7.3. Water resources**

During the operation of the "Armpower" CJSC thermal power plant, water resources will not be directly discharged into waste water. All discharges will be connected to the sewerage system of "Yerevan TPP" CJSC. Accordingly, economic damage is not calculated.

### **7.4. Soil cover**

The thermal power plant of "Armpower" CJSC was built in the production area and new land covered areas will not be used, accordingly no economic damage is calculated.

## **8. SUGGESTED POLLUTION REDUCTION MEASURES AND EMERGENCY ACTION PLAN**

In order to prevent and mitigate the negative impact on the environment during the operation of the "Armpower" CJSC combined steam-gas cycle power plant, mitigation measures have been developed. The procedure for monitoring the implementation and effectiveness of the measures, the persons responsible for their implementation and the implementation dates are included in the Monitoring Program, which is presented in Chapter 8.

### **8.1. Risk assessment**

Environmental hazards in the performance of the activities presented are mainly related to:

- the emissions of dust, noise and fuel combustion during the construction phase.
- the emissions of hazardous substances resulting from the combustion of gas during operation,
- consumption of water resources used in cooling systems and their water make-up;
- the level of noise resulting from the operation of the equipment

Environmental, social measures and environmental management plans have been developed to reduce and offset the impact of the processes listed.

### **8.2. Atmospheric air**

To protect the air basin from pollution it is intended:

- to use Siemens steam energy-efficient and low-emission state-of-the-art steam turbine equipment as a power generation device;
- to complement various sections of the power unit with air-gas mixture quality control and monitoring equipment,
- to reduce the amount of hazardous substances arising in the gas turbine unit by means of hydrating the reaction environment by water spraying,
- develop and implement a pollution plan for the intended power plant site.

### **8.3. Water Resources**

The following measures have been envisaged to ensure the efficient use of water resources and to prevent additional pollution of local water flows.

- complete main water flow units with water meters;
- arrange cooling system with closed water circulation cycle,
- use a state-of-the-art waste-free technology system for water chemical treatment (Water softening).

### **8.4. Soil resources**

The following are planned for the protection of soil resources:

- fuel and lubricant storages will be placed in a specially allocated area on a concrete surface,
- to install garbage collection facilities in different parts of the thermal power plant area,
- the operating transformer is equipped with a concrete sump for the collection of

emergency oil spills.

### **8.5. Landscaping**

In the 2019 EIA report, it was planned to green the borders of the area. Based on that demand, "Armpower" CJSC undertook landscaping works, within the framework of which 7000 sq.m. a lawn was organized on the territory, 100 barberry bushes, 30 poplar trees, 20 boxwoods, 13 conifers were planted. At the current stage, maintenance works are being organized, some tree species have dried up and it is planned to replace them. The stickiness of the bushes is practically 100 percent.

### **8.6. Noise**

To reduce the noise level is planned to:

- install gas turbine equipment in a covered building,
- when selecting compressor equipment, take into account the low noise level indicators,
- where possible use noise silencers.

### **8.7. Measures and plans foreseen for adverse conditions and emergencies**

Emergency situations as well as natural disasters and adverse weather conditions are possible during operation of the thermal power plant. In all possible cases, an action plan has been developed by the operating company to prevent or reduce as much as possible the environmental additional pollution, including the following measures:

#### *Adverse meteorological conditions*

Adverse meteorological conditions are conditions created in the air basin that contribute to the accumulation of harmful substances in the near-ground layer of the atmosphere.

During the period of unfavorable meteorological conditions (in cases of wind speed reduction, lack of wind, formation of fog) due to the slowing down of dispersion processes, significant increases in ground level concentrations of harmful substances are possible.

The presence of adverse meteorological conditions is determined by responsible workers visually.

Visually, it is necessary to check the decision made regarding weather conditions as unfavorable by querying the nearest "Erebuni" meteorological station.

In case of the mentioned decision, the personnel responsible for the TPP are instructed and informed about the possible occurrence of adverse meteorological conditions.

3 categories of adverse meteorological conditions are accepted. There are no clear standards for them in normative acts. Differentiation by categories is made on the basis of the following

general principles:

- I category: decrease of wind speed
- II category: windlessness, dry weather
- III category: windlessness, thick fog

In case of unfavorable atmospheric conditions is necessary to take the following measures:

I category:

- The control over the technological processes is increased in order to avoid the excessive emissions defined in the clause 5.1 of the present Report.

II category:

- Water sprinkling works are added until maximum permissible reactionary environment.

III category:

- The productivity of gas turbine is reduced up to 70-75% of installed capacity.

#### Fire safety

- A. The flammable units, situated in the thermal power plant, should be equipped with automatic fire-fighting equipment that controls every fire ignition in the industrial area and in case of fire detection switches on the fire insulation system.
- B. All the electric equipment that don't have automatic devices, will be provided with manual fire extinguishers.
- C. The responsible person implements the site inspection in all the territory as a part of working day plan.
- D. During the fire all the electrical devices will be disconnected, the fire- fighting water system will be turned on, the staff will be transferred to a safe place.

#### Emergency conditions

In case of natural disasters (earthquake, landslide, flood, etc.) as well as in case of technological (man-made) accidents, the operation of the thermal power plant is stopped, all the electrical devices are disconnected, the staff is immediately transferred to a safe place.

The responsible persons of Erebuni administrative district subdivision of the rescue service of the Ministry of emergency situations and Yerevan Municipality are immediately informed about the phenomena and situations.

## **8.8. Social impact mitigation measures**

The operation of the thermal power plant is carried out by about 40 employees, who are mainly recruited from the residents of local communities. Thanks to this, a fairly high standard of living is ensured for 40 families.

In addition, a number of works are ordered to local organizations on a contractual basis, thereby solving the problem of permanent employment of about 20 additional employees.

"Armpower" company will participate in the process of development and further implementation of annual socio-economic programs of Yerevan community, as well as Aintap and Nor Kharberd. The company also plans to carry out environmental and social activities at its own expense, in particular, to participate in the repair works of selected pre-school or other educational institutions, improvement and greening activities. The scope of these programs will depend on the efficiency of the company's work and in all cases will be agreed with the communities.

It is planned to regularly meet with the officials and residents of the affected communities, to present the implemented actions, to clarify their environmental and social risks and benefits.

An emergency preparedness and response plan based on a risk assessment and hazard identification study will be developed for the power plant operation phase. During the meetings with officials and residents of the affected communities, the emergency preparedness and response plan will be presented, as well as the procedure for resolving complaints submitted by community residents.

## **9. MONITORING PROGRAM**

### **9.1. Monitoring purpose**

The implementation of monitoring in the production area, exhaust pipe and adjacent areas of the "Armpower" CJSC combined steam-gas cycle power plant will provide an opportunity to create an information base to monitor the further continuous impact of the plant's activities on the environment for the development and implementation of disaster prevention and prevention measures.

The main purpose of monitoring is to generate information about changes in the environment.

### **9.2. Observation post installation and monitoring frequency**

#### ***9.2.1. Production equipment***

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A continuous emission monitoring system (CEMS) is installed on the chimney of the power

plant. This system continuously monitors the levels of pollutants in the exhaust gases, which are the changing concentrations of NO<sub>x</sub>, CO, CH<sub>4</sub>, CO<sub>2</sub> and O<sub>2</sub>. Basically, the system performs the following actions:

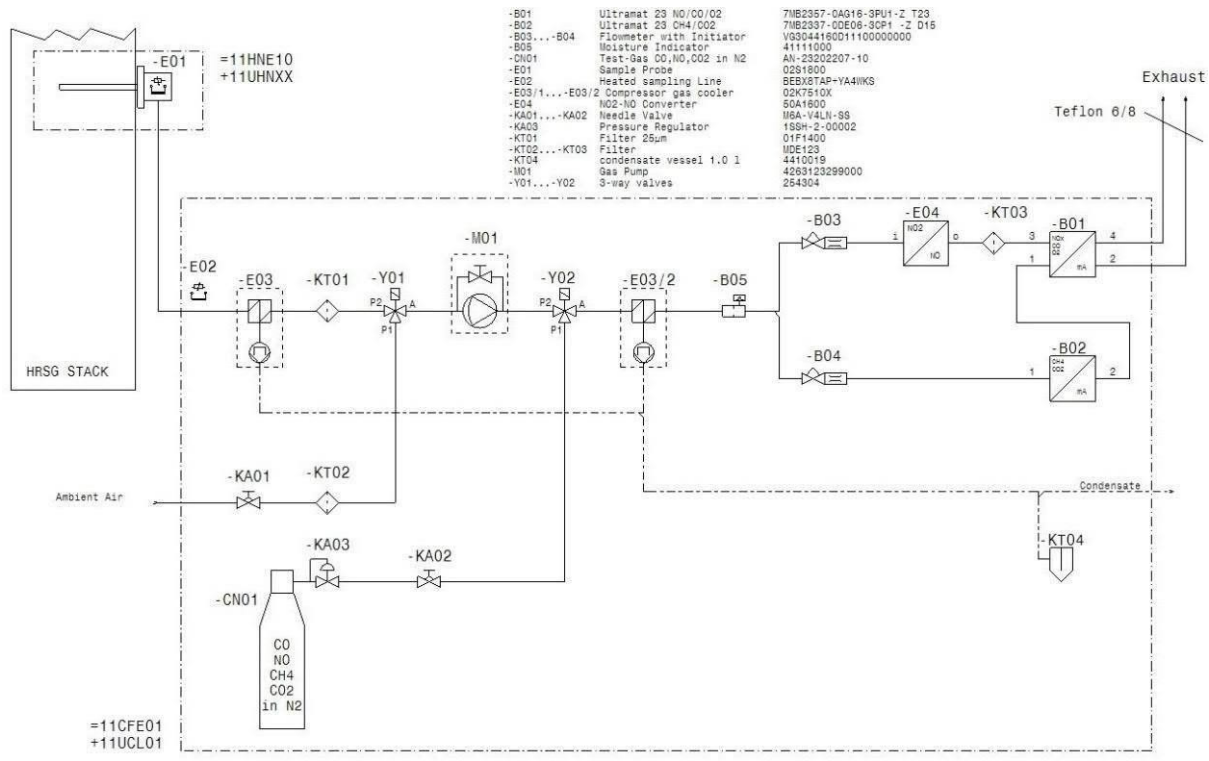
- Sampling
- Air conditioning
- Research / analysis
- Evaluation of emission data

Sampling of exhaust gases is carried out using heated probes and heated sampling lines (flexible pipes). The bulk of the associated equipment is located outside the examination chamber. The gas sampled in the chamber is first conditioned (drying, lowering the temperature, removing particles, etc.). For this purpose, it passes through appropriate filters to remove dust particles and heat exchangers (gas cooler) to condense moisture. Prior to NO analysis, the NO<sub>2</sub> components are further reduced to NO via a thermal catalytic converter. Thus, the total sum of NO and NO<sub>2</sub> (= NO<sub>x</sub>) is calculated as NO by the monitoring system.

Automatic switching sampling devices are installed in the chimney of the Heat Recovery Steam Generator (HRSG) depending on the operation mode of the plant.

The opacity meter as well as the pressure and temperature sensors are installed directly in the chimney. The measurement is automatically switched off and on depending on the operation of the gas turbine.

The system is fully automated. Measured data and certain status signals are transmitted to the T3000 and the Emissions Evaluation Computer (EMI-PC). The entire process is monitored and controlled by a programmable logic controller (SIMATIC S7-1200). To simplify the operator's work, a text display (operator panel) is integrated, which shows the current state of the system and facilitates troubleshooting.



**9.2.2. Background pollution**

The placement of observation points and the frequency of monitoring at each facility is determined based on the complexity of the conditions of the environmental components.

Considering the conditions of the environment and the area of the thermal power plant, the monitoring can be limited to the production area and the zone in the immediate vicinity.

Monitoring stations are planned to be placed under the chimney and outside the fence to assess changes in the quality of the air basin.

Form of monitoring: survey and records, sampling and analyses.

*Table 9.1. Monitoring program*

Monitored environment	Sampling location	Measured parameters	Method of measurement	Responsible	Period or frequency of execution
flue gases	Chimney	NO <sub>x</sub> , CO, CH <sub>4</sub> , CO <sub>2</sub> and O <sub>2</sub>	Automatic analyzers	TPP staff	Regular

Air basin	Near the chimney (подфакельные)	CO, NOX	passive sampling	Certified laboratory	Quarterly
Air basin	Outside the fence	CO, NOX	passive sampling	Certified laboratory	Quarterly
Noise	Adjacent to the compressor station in TPP area	Noise level	Portable sound meter	TPP staff	On request



*Environmental Monitoring Plan*

<i>Planned activities by stages</i>	<i>Possible environmental impacts</i>	<i>Recommended mitigation measures</i>	<i>Event Manager</i>	<i>Event costs, thousand drams</i>
<i>Operation stage of the plant</i>				
Operation of Thermal Power Plant	a/ pollution of atmospheric air	<p>During the operation of gas turbine equipment, monitor the readings of automatic measuring devices in the technological unit and flue gas system, which will allow monitoring thermal processes and the content of nitrogen dioxide and carbon monoxide in flue gases.</p> <p>Organize monitoring of production and nearby areas according to the monitoring program given in table 8.1 of this report</p>	RENCO Group, ArmPower CJSC, certified laboratory	Investment costs
	b/ Waste management	<p>Install trashes in different parts of the production area and in the administrative building</p> <p>Ensure regular transportation of household waste to the appropriate landfill</p> <p>The transformer hub is equipped with an emergency stand, which will ensure the collection of the entire volume of spilled oil, and scheduled filtering and oil change will be carried out by a licensed company.</p>	ArmPower CJSC sanitary service ArmPower CJSC	1200.0 /annual/  Operation costs
	c/ Noise	<p>Provide cover for compressor motors to reduce noise level</p> <p>Check regularly and if necessary adjust pump motors</p> <p>Organize noise measurements of production areas according to the monitoring program given in table 8.1 of this report. There should be first aid medical boxes in the area of the thermal power plant.</p>	ArmPower CJSC  ArmPower CJSC	8000
	d/ Pollution of water resources	Control the movement and collection of spills,	ArmPower CJSC	Operation costs

<i>Planned activities by stages</i>	<i>Possible environmental impacts</i>	<i>Recommended mitigation measures</i>	<i>Event Manager</i>	<i>Event costs, thousand drams</i>
	e/ Work security, working conditions	<p>Ensure the uninterrupted operation of the neutralization unit in the basin of production effluents</p> <p>Monitor stormwater catchment performance during floods</p> <p>Calibrate the effluent basin pH analyzer regularly</p> <p>Staff must have access to drinking water and toilets, and the necessary conditions for taking food and rest.</p> <p>There should be first aid medical boxes in the area of the thermal power plant.</p> <p>Staff should be provided with uniforms and necessary personal safety equipment.</p> <p>The use of safety equipment must be taught, supervised and enforced. The work safety maintenance system must provide for supervision, instruction, training and knowledge verification.</p> <p>There should be fire safety equipment in the area of the thermal power plant: fire extinguishers, shovels, automatic sound and light alarm devices.</p>	ArmPower CJSC	<p>Operation costs</p> <p>Operation costs</p> <p>Operation costs</p>
	f/ Social aspects	<p>Warning panels should be installed in high voltage areas</p> <p>Organize regular meetings with leaders and residents of affected communities</p> <p>Notify affected residents of all major events</p>	ArmPower CJSC	Operation costs
<i>Closure of thermal power plant</i>				

<i>Planned activities by stages</i>	<i>Possible environmental impacts</i>	<i>Recommended mitigation measures</i>	<i>Event Manager</i>	<i>Event costs, thousand drams</i>
Completion of thermal power plant works, dismantling and demolition of buildings and equipment	Environmental pollution and garbage	<p>Before the completion of the works of the thermal power plant, draw up and agree with Yerevan Municipality a program of closure measures</p> <p>Inventory the available materials and reagents and transport them to the warehouses of the respective licensed companies</p> <p>Organize the dismantling and demolition of buildings and equipment with the participation of specialized organizations</p> <p>Improve and green the area</p>	<p>ArmPower CJSC</p> <p>Yerevan Municipality</p>	<p>20000.0</p> <p>According to the closing action plan estimate</p>

The total cost of environmental measures will be: 9,200,000 AMD in the operation phase, 20,000,000 AMD in the closing phase.

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2. СНиП 1.02.01-85 Инструкция о составе, порядке разработки, согласования и утверждения проектно-сметной документации на строительство предприятий, зданий и сооружений.
3. Инструкция о порядке рассмотрения, согласования и экспертизы воздухоохраных мероприятий и о выдаче разрешений на выброс загрязняющих веществ в атмосферу по проектным решениям. ОНД – 84 – Н
4. “Մթնոլորտի վրա տնտեսական գործունեության հետևանքով առաջացած ազդեցության գնահատման կարգ” հաստատված ՀՀ Վարավարության 2005թ. հունվարի 25-ի N 91 – Ն Որոշմամբ
5. Долгосрочное прогнозирование уровня и возможных отрицательны последствий загрязнения атмосферы, Обнинск 1984г.
6. РД 52.04.186-89. Руководство по контролю загрязнения атмосферы. ГК СССР по гидрометеорологии
7. European Environment Agency. EMEP/EEA air pollutant emission inventory guidebook 2013. NFR: 1.A.1 Energy industries. SNAP: 01 Combustion in energy and transformation industries. 1.A.1.a — Public electricity and heat production
8. “Երևանի ՋԷԿ” ՓԲԸ համակցված ցիկլով էներգաբլոկի վնասակար նյութերի սահմանային թույլատրելի արտանետումների (ՄԹԱ) նորմատիվների նախագիծ. Երևան. 2015

## Annex 1. The results of ground-level concentrations calculation

### 1. Общие сведения.

Расчет проведен на ПК "ЭРА" v3.0 фирмы НПП "Логос-Плюс", Новосибирск в соответствии с положениями документа "Методы расчетов рассеивания выбросов вредных (загрязняющих) веществ в атмосферном воздухе" (МРР-2017).  
Расчет выполнен ООО "Консекоард" (Consecoard LLC)

-----  
| Заключение экспертизы Министерства природных ресурсов и Росгидромета |  
на программу: письмо № 140-09213/20и от 30.11.2020

### 2. Параметры города

ПК ЭРА v3.0. Модель: Разовые

Расчет проводится в соответствии с документом МРР-2017

Название: Ереван

Коэффициент А = 200

Скорость ветра  $U_{mp}$  = 23.0 м/с (для лета 23.0, для зимы 12.0)

Средняя скорость ветра = 1.5 м/с

Температура летняя = 32.4 град.С

Температура зимняя = -3.6 град.С

Коэффициент рельефа = 1.00

Площадь города = 0.0 кв.км

Угол между направлением на СЕВЕР и осью X = 90.0 угловых градусов

### 3. Исходные параметры источников.

ПК ЭРА v3.0. Модель: Разовые

Расчет проводится в соответствии с документом МРР-2017

Город :096 Ереван-26.

Объект :0001 ООО Армпауер.

Вар.расч. :1      Расч.год: 2022 (СП)      Расчет проводился 20.07.2022 10:53  
 Примесь :0301 - Азота диоксид  
 ПДКм.р для примеси 0301 = 0.2 мг/м3

Коэффициент рельефа (КР): индивидуальный с источников  
 Коэффициент оседания (F): индивидуальный с источников

Код

Реж	Тип	H1	H2	D	Wo	V1	T	X1	Y1	X2	Y2	Alf	F	КР	Ди				
Выброс	RoГВС																		
<Об~П>	~<Ис>	~	~	~м	~	~м	~	~м/с	~	~м3/с	~	градС	~	~	~	гр.	~	~	
000101	0001	1	T	65.0		6.0	6.09	172.2	96.0	2389	1241								1.0
1.000	1	16.1700	1.290																

4. Расчетные параметры См, Ум, Хм

ПК ЭРА v3.0. Модель: Разовые

Расчет проводится в соответствии с документом МРР-2017

Город :096 Ереван.

Объект :0001 ООО Армпауер.

Вар.расч. :1      Расч.год: 2022 (СП)      Расчет проводился 20.07.2022 10:53

Сезон :ЛЕТО (температура воздуха 32.4 град.С)

Примесь :0301 - Азота диоксид

ПДКм.р для примеси 0301 = 0.2 мг/м3

Источники				Их расчетные параметры				
Номер	Код	Режим	M	Тип	См	Um	Xm	
-п/п-	<об-п>	<ис>	-----	-----	-----	[доли ПДК]	--- [м/с] ---	----- [м] -----
1	000101 0001	1	16.170000	T	0.159529	3.98	1088.8	
Суммарный Mq = 16.170000 г/с								
Сумма См по всем источникам =					0.159529 долей ПДК			

-----  
Средневзвешенная опасная скорость ветра = 3.98 м/с

5. Управляющие параметры расчета

ПК ЭРА v3.0. Модель: Разовые

Расчет проводится в соответствии с документом МРР-2017

Город :096 Ереван.

Объект :0001 ООО Армпауер.

Вер.расч. :1 Расч.год: 2022 (СП) Расчет проводился 20.07.2022 10:53

Сезон :ЛЕТО (температура воздуха 32.4 град.С)

Примесь :0301 - Азота диоксид

ПДКм.р для примеси 0301 = 0.2 мг/м3

Фоновая концентрация на постах (в мг/м3 / долях ПДК)

Код загр	Штиль	Северное	Восточное	Южное	Западное
вещества	U<=2м/с	направление	направление	направление	направление
-----					
Пост N 001: X=0, Y=0					
0301	0.0270000	0.0270000	0.0270000	0.0270000	0.0270000
	0.1350000	0.1350000	0.1350000	0.1350000	0.1350000

Расчет по прямоугольнику 001 : 4913x2890 с шагом 289

Направление ветра: автоматический поиск опасного направления от 0 до 360 град.

Скорость ветра: автоматический поиск опасной скорости от 0.5 до 23.0 (U<sub>мр</sub>) м/с

Средневзвешенная опасная скорость ветра U<sub>св</sub>= 3.98 м/с

6. Результаты расчета в виде таблицы.

ПК ЭРА v3.0. Модель: Разовые

---

Расчет проводится в соответствии с документом МРР-2017  
 Город :096 Ереван.  
 Объект :0001 ООО Армпауер.  
 Вар.расч. :1 Расч.год: 2022 (СП) Расчет проводился 20.07.2022 10:53  
 Примесь :0301 - Азота диоксид  
 ПДКм.р для примеси 0301 = 0.2 мг/м3

Расчет проводился на прямоугольнике 1  
 с параметрами: координаты центра X= 2398, Y= 1441  
 размеры: длина (по X)= 4913, ширина (по Y)= 2890, шаг сетки= 289  
 Запрошен учет дифференцированного фона с постов для действующих источников  
 Направление ветра: автоматический поиск опасного направления от 0 до 360 град.  
 Скорость ветра: автоматический поиск опасной скорости от 0.5 до 23.0 (Uпр) м/с

Расшифровка обозначений

Qс - суммарная концентрация [доли ПДК]
Сс - суммарная концентрация [мг/м.куб]
Сф - фоновая концентрация [ доли ПДК ]
Сф` - фон без реконструируемых [доли ПДК ]
Сди- вклад действующих (для Сф`) [доли ПДК]
Фоп- опасное направл. ветра [ угл. град.]
Uоп- опасная скорость ветра [ м/с ]

~~~~~|  
 | -Если в расчете один источник, то его вклад и код не печатаются|  
 | -Если в строке Смах=< 0.05 ПДК, то Фоп,Uоп,Ви,Ки не печатаются |  
 ~~~~~|

-----  
 у= 2886 : Y-строка 1 Смах= 0.219 долей ПДК (x= 2253.5; напр.ветра=175)

x= -59 : 231: 520: 809: 1098: 1387: 1676: 1965: 2254: 2543: 2832: 3121: 3410: 3699:  
 3988: 4277:

















Qc : 0.207: 0.202:  
Cc : 0.041: 0.040:  
Cф : 0.135: 0.135:  
Cф` : 0.087: 0.091:  
Сди: 0.121: 0.111:  
Фоп: 272 : 272 :  
Uоп: 4.77 : 4.91 :  
~~~~~

y= 863 : Y-строка 8 Стах= 0.231 долей ПДК (x= 3409.5; напр.ветра=290)

x= -59 : 231: 520: 809: 1098: 1387: 1676: 1965: 2254: 2543: 2832: 3121: 3410: 3699:  
3988: 4277:

-----  
-----:-----:-----:-----:-----:-----:-----:-----:-----:-----:-----:-----:-----:-----:-----  
-----:-----:  
Qc : 0.201: 0.207: 0.213: 0.219: 0.226: 0.231: 0.225: 0.204: 0.180: 0.181: 0.205: 0.226: 0.231: 0.225:  
0.219: 0.213:  
Cc : 0.040: 0.041: 0.043: 0.044: 0.045: 0.046: 0.045: 0.041: 0.036: 0.036: 0.041: 0.045: 0.046: 0.045:  
0.044: 0.043:  
Cф : 0.135: 0.135: 0.135: 0.135: 0.135: 0.135: 0.135: 0.135: 0.135: 0.135: 0.135: 0.135: 0.135: 0.135:  
0.135: 0.135:  
Cф` : 0.091: 0.087: 0.083: 0.079: 0.075: 0.071: 0.075: 0.089: 0.105: 0.104: 0.088: 0.074: 0.071: 0.075:  
0.079: 0.083:  
Сди: 0.111: 0.120: 0.130: 0.141: 0.151: 0.159: 0.151: 0.115: 0.075: 0.077: 0.117: 0.152: 0.159: 0.150:  
0.140: 0.130:  
Фоп: 81 : 80 : 79 : 77 : 74 : 69 : 62 : 48 : 20 : 338 : 311 : 297 : 290 : 286 :  
283 : 281 :  
Uоп: 4.88 : 4.78 : 4.60 : 4.44 : 4.28 : 3.98 : 3.97 : 3.97 : 3.97 : 3.97 : 3.97 : 3.97 : 3.98 : 4.29 :  
4.45 : 4.60 :  
~~~~~

x= 4566: 4855:

---









Фоп: 63 : 60 : 56 : 52 : 46 : 39 : 30 : 19 : 6 : 353 : 340 : 330 : 321 : 314 :  
 308 : 303 :  
 Уоп: 5.06 : 4.89 : 4.75 : 4.65 : 4.51 : 4.42 : 4.34 : 4.27 : 4.27 : 4.27 : 4.29 : 4.37 : 4.43 : 4.55 :  
 4.65 : 4.76 :

~~~~~

----

x= 4566: 4855:

-----:-----:

Qc : 0.201: 0.196:

Cc : 0.040: 0.039:

Cф : 0.135: 0.135:

Cф` : 0.091: 0.094:

Cди: 0.110: 0.102:

Фоп: 300 : 297 :

Уоп: 4.90 : 5.05 :

~~~~~

Результаты расчета в точке максимума ПК ЭРА v3.0. Модель: Разовые  
 Расчет проводится в соответствии с документом МРР-2017  
 Координаты точки : X= 1964.5 м, Y= 285.0 м

Максимальная суммарная концентрация | Cs= 0.2306930 доли ПДКмр |  
 | 0.0461386 мг/м3 |  
 ~~~~~

Достигается при опасном направлении 24 град.  
 и скорости ветра 3.98 м/с

Всего источников: 1. В таблице заказано вкладчиков не более чем с 95% вклада

ВКЛАДЫ ИСТОЧНИКОВ

Ном.	Код	Режим	Тип	Выброс	Вклад	Вклад в%	Сум. %	Коэф. влияния
----	<Об-П>-<Ис>	-----	----	---М- (Mq) --	-С [доли ПДК]	-----	-----	---- b=C/M ---
	Фоновая концентрация Cf`				0.071205		30.9	(Вклад источников 69.1%)

1	000101 0001	1	T	16.1700	0.159488	100.0	100.0	0.009863217
				В сумме =	0.230693	100.0		

~~~~~

7. Суммарные концентрации в узлах расчетной сетки.

ПК ЭРА v3.0. Модель: Разовые

Расчет проводится в соответствии с документом МРР-2017

Город :096 Ереван.

Объект :0001 ООО Армпауер.

Вар.расч. :1 Расч.год: 2022 (СП) Расчет проводился 20.07.2022 10:53

Примесь :0301 - Азота диоксид

ПДКм.р для примеси 0301 = 0.2 мг/м3

| Параметры расчетного прямоугольника No 1 |                        |
|--|------------------------|
| Координаты центра                        | : X= 2398 м; Y= 1441 м |
| Длина и ширина                           | : L= 4913 м; l= 2890 м |
| Шаг сетки (dX=dY)                        | : D= 289 м             |

Запрошен учет дифференцированного фона с постов для действующих источников  
 Направление ветра: автоматический поиск опасного направления от 0 до 360 град.  
 Скорость ветра: автоматический поиск опасной скорости от 0.5 до 23.0 (U<sub>гр</sub>) м/с

В целом по расчетному прямоугольнику:

Максимальная концентрация -----> См = 0.2306930 долей ПДК<sub>мр</sub>  
 = 0.0461386 мг/м3

Достигается в точке с координатами: X<sub>м</sub> = 1964.5 м  
 ( X-столбец 8, Y-строка 10) Y<sub>м</sub> = 285.0 м

При опасном направлении ветра : 24 град.  
 и "опасной" скорости ветра : 3.98 м/с

3. Исходные параметры источников.

ПК ЭРА v3.0. Модель: Разовые

Расчет проводится в соответствии с документом МРР-2017

Город :096 Ереван.

Объект :0001 ООО Армпауер.

Вар.расч. :1 Расч.год: 2022 (СП) Расчет проводился 20.07.2022 10:53

Примесь :0328 - Углерод

ПДКм.р для примеси 0328 = 0.15 мг/м3

Коэффициент рельефа (КР): индивидуальный с источников

Коэффициент оседания (F): индивидуальный с источников

---

| Код         | Реж  | Тип       | N1    | N2   | D   | Wo    | V1     | T     | X1   | Y1   | X2  | Y2  | Alf | F | КР  |
|-------------|------|-----------|-------|------|-----|-------|--------|-------|------|------|-----|-----|-----|---|-----|
| <Об~П>~<Ис> | ~    | ~         | ~м~   | ~м~  | ~м~ | ~м/с~ | ~м3/с~ | градС | ~м~  | ~м~  | ~м~ | ~м~ | гр. | ~ | ~   |
| 000101      | 0001 | 1         | Т     | 65.0 | 6.0 | 6.09  | 172.2  | 96.0  | 2389 | 1241 |     |     |     |   | 3.0 |
| 1.000       | 0    | 0.2400000 | 1.290 |      |     |       |        |       |      |      |     |     |     |   |     |

4. Расчетные параметры См, Ум, Хм

ПК ЭРА v3.0. Модель: Разовые

Расчет проводится в соответствии с документом МРР-2017

Город :096 Ереван.

Объект :0001 ООО Армпауер.

Вар.расч. :1 Расч.год: 2022 (СП) Расчет проводился 20.07.2022 10:53

Сезон :ЛЕТО (температура воздуха 32.4 град.С)

Примесь :0328 - Углерод

ПДКм.р для примеси 0328 = 0.15 мг/м3

---

| \_\_\_\_\_ Источники \_\_\_\_\_ | \_\_\_\_\_ Их расчетные параметры \_\_\_\_\_ |

---

| Номер  | Код         | Режим | M            | Тип  | Cm                 | Um          | Xm          |
|--|-------------|-------|--------------|------|--------------------|-------------|-------------|
| -п/п-  | <об-п>-<ис> | ----- | -----        | ---- | -[доли ПДК]-       | ---[м/с]--- | ----[м]---- |
| 1  | 000101 0001 | 1     | 0.240000     | T    | 0.009471           | 3.98        | 544.4       |
| ~~~~~  |             |       |              |      |                    |             |             |
| Суммарный Mq =   |             |       | 0.240000 г/с |      |                    |             |             |
| Сумма Cm по всем источникам =                                |             |       |              |      | 0.009471 долей ПДК |             |             |
| -----  |             |       |              |      |                    |             |             |
| Средневзвешенная опасная скорость ветра =                    |             |       |              |      |                    | 3.98 м/с    |             |
| -----  |             |       |              |      |                    |             |             |
| Дальнейший расчет нецелесообразен: Сумма Cm < 0.05 долей ПДК |             |       |              |      |                    |             |             |

5. Управляющие параметры расчета

ПК ЭРА v3.0. Модель: Разовые

Расчет проводится в соответствии с документом МРР-2017

Город :096 Ереван.

Объект :0001 ООО Армпауер.

Вар.расч. :1 Расч.год: 2022 (СП) Расчет проводился 20.07.2022 10:53

Сезон :ЛЕТО (температура воздуха 32.4 град.С)

Примесь :0328 - Углерод

ПДКм.р для примеси 0328 = 0.15 мг/м3

Фоновая концентрация не задана

Расчет по прямоугольнику 001 : 4913x2890 с шагом 289

Направление ветра: автоматический поиск опасного направления от 0 до 360 град.

Скорость ветра: автоматический поиск опасной скорости от 0.5 до 23.0 (Uмр) м/с

Средневзвешенная опасная скорость ветра Uсв= 3.98 м/с

6. Результаты расчета в виде таблицы.

ПК ЭРА v3.0. Модель: Разовые

Расчет проводится в соответствии с документом МРР-2017

Город :096 Ереван.





```

<Об~П>~<Ис>|~~~|~~~|~~м~~|~~м~~|~~м~~|~м/с~|~м3/с~|градС|~~~м~~~|~~~м~~~|~~~м~~~|~~~м~~~|гр.|~~~|~~~
~|~|~~~г/с~~~|~~~~~
000101 0001 1 Т 65.0 6.0 6.09 172.2 96.0 2389 1241 1.0
1.000 0 10.7800 1.290

```

4. Расчетные параметры См, Um, Хм

ПК ЭРА v3.0. Модель: Разовые

Расчет проводится в соответствии с документом МРР-2017

Город :096 Ереван.

Объект :0001 ООО Армпауер.

Вар.расч. :1 Расч.год: 2022 (СП) Расчет проводился 20.07.2022 10:53

Сезон :ЛЕТО (температура воздуха 32.4 град.С)

Примесь :0337 - Углерода оксид

ПДКм.р для примеси 0337 = 5.0 мг/м3

| Источники  |             |       |           | Их расчетные параметры |              |           |             |
|--|-------------|-------|-----------|------------------------|--------------|-----------|-------------|
| Номер  | Код         | Режим | М         | Тип                    | См           | Um        | Хм          |
| -п/п-  | <об-п>-<ис> | ----- | -----     | ----                   | -[доли ПДК]- | --[м/с]-- | ----[м]---- |
| 1  | 000101 0001 | 1     | 10.780000 | Т                      | 0.004254     | 3.98      | 1088.8      |
| Суммарный Мq = 10.780000 г/с<br>Сумма См по всем источникам = 0.004254 долей ПДК |             |       |           |                        |              |           |             |
| Средневзвешенная опасная скорость ветра = 3.98 м/с                               |             |       |           |                        |              |           |             |
| Дальнейший расчет нецелесообразен: Сумма См < 0.05 долей ПДК                     |             |       |           |                        |              |           |             |

5. Управляющие параметры расчета

ПК ЭРА v3.0. Модель: Разовые

Расчет проводится в соответствии с документом МРР-2017

Город :096 Ереван.  
Объект :0001 ООО Армпауер.  
Вар.расч. :1 Расч.год: 2022 (СП) Расчет проводился 20.07.2022 10:53  
Сезон :ЛЕТО (температура воздуха 32.4 град.С)  
Примесь :0337 - Углерода оксид  
ПДКм.р для примеси 0337 = 5.0 мг/м3  
Фоновая концентрация не задана  
Расчет по прямоугольнику 001 : 4913x2890 с шагом 289  
Направление ветра: автоматический поиск опасного направления от 0 до 360 град.  
Скорость ветра: автоматический поиск опасной скорости от 0.5 до 23.0 (U<sub>мр</sub>) м/с  
Средневзвешенная опасная скорость ветра U<sub>св</sub>= 3.98 м/с

6. Результаты расчета в виде таблицы.

ПК ЭРА v3.0. Модель: Разовые

Расчет проводится в соответствии с документом МРР-2017

Город :096 Ереван.  
Объект :0001 ООО Армпауер.  
Вар.расч. :1 Расч.год: 2022 (СП) Расчет проводился 20.07.2022 10:53  
Примесь :0337 - Углерода оксид  
ПДКм.р для примеси 0337 = 5.0 мг/м3

Расчет не проводился: См < 0.05 долей ПДК

7. Суммарные концентрации в узлах расчетной сетки.

ПК ЭРА v3.0. Модель: Разовые

Расчет проводится в соответствии с документом МРР-2017

Город :096 Ереван.  
Объект :0001 ООО Армпауер.  
Вар.расч. :1 Расч.год: 2022 (СП) Расчет проводился 20.07.2022 10:53  
Примесь :0337 - Углерода оксид  
ПДКм.р для примеси 0337 = 5.0 мг/м3

Расчет не проводился: См < 0.05 долей ПДК

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3. Исходные параметры источников.

ПК ЭРА v3.0. Модель: Разовые

Расчет проводится в соответствии с документом МРР-2017

Город :096 Ереван.

Объект :0001 ООО Армпауер.

Вар.расч. :1 Расч.год: 2022 (СП) Расчет проводился 20.07.2022 10:53

Примесь :2754 - Углеводороды предельные C12-C-19

ПДКм.р для примеси 2754 = 1.0 мг/м3

Коэффициент рельефа (КР): индивидуальный с источников

Коэффициент оседания (F): индивидуальный с источников

| Код    | Реж  | Тип       | H1    | H2 | D   | Wo   | V1    | T    | X1   | Y1   | X2 | Y2 | Alf | F | КР  |
|--------|------|-----------|-------|----|-----|------|-------|------|------|------|----|----|-----|---|-----|
| 000101 | 0001 | 1 Т       | 65.0  |    | 6.0 | 6.09 | 172.2 | 96.0 | 2389 | 1241 |    |    |     |   | 1.0 |
| 1.000  | 0    | 0.3500000 | 1.290 |    |     |      |       |      |      |      |    |    |     |   |     |

4. Расчетные параметры См, Ум, Хм

ПК ЭРА v3.0. Модель: Разовые

Расчет проводится в соответствии с документом МРР-2017

Город :096 Ереван.

Объект :0001 ООО Армпауер.

Вар.расч. :1 Расч.год: 2022 (СП) Расчет проводился 20.07.2022 10:53

Сезон :ЛЕТО (температура воздуха 32.4 град.С)

Примесь :2754 - Углеводороды предельные C12-C-19

ПДКм.р для примеси 2754 = 1.0 мг/м3

| \_\_\_\_\_ Источники \_\_\_\_\_ | \_\_\_\_\_ Их расчетные параметры \_\_\_\_\_ |

| Номер  | Код         | Режим | M        | Тип  | Cm                 | Um          | Xm          |
|--|-------------|-------|----------|------|--------------------|-------------|-------------|
| -п/п-  | <об-п>-<ис> | ----- | -----    | ---- | -[доли ПДК]-       | ---[м/с]--- | ----[м]---- |
| 1  | 000101 0001 | 1     | 0.350000 | T    | 0.000691           | 3.98        | 1088.8      |
| ~~~~~  |             |       |          |      |                    |             |             |
| Суммарный Mq =   |             |       | 0.350000 | г/с  |                    |             |             |
| Сумма Cm по всем источникам =                                |             |       |          |      | 0.000691 долей ПДК |             |             |
| -----  |             |       |          |      |                    |             |             |
| Средневзвешенная опасная скорость ветра =                    |             |       |          |      |                    | 3.98 м/с    |             |
| -----  |             |       |          |      |                    |             |             |
| Дальнейший расчет нецелесообразен: Сумма Cm < 0.05 долей ПДК |             |       |          |      |                    |             |             |

#### 5. Управляющие параметры расчета

ПК ЭРА v3.0. Модель: Разовые

Расчет проводится в соответствии с документом МРР-2017

Город :096 Ереван.

Объект :0001 ООО Армпауер.

Вар.расч. :1 Расч.год: 2022 (СП) Расчет проводился 20.07.2022 10:53

Сезон :ЛЕТО (температура воздуха 32.4 град.С)

Примесь :2754 - Углеводороды предельные C12-C-19

ПДКм.р для примеси 2754 = 1.0 мг/м3

Фоновая концентрация не задана

Расчет по прямоугольнику 001 : 4913x2890 с шагом 289

Направление ветра: автоматический поиск опасного направления от 0 до 360 град.

Скорость ветра: автоматический поиск опасной скорости от 0.5 до 23.0 (Uмр) м/с

Средневзвешенная опасная скорость ветра Uсв= 3.98 м/с

#### 6. Результаты расчета в виде таблицы.

ПК ЭРА v3.0. Модель: Разовые

Расчет проводится в соответствии с документом МРР-2017

Город :096 Ереван.

Объект :0001 000 Армпауер.  
Вар.расч. :1 Расч.год: 2022 (СП) Расчет проводился 20.07.2022 10:53  
Примесь :2754 - Углеводороды предельные C12-  
C-19 ПДКм.р для примеси 2754 = 1.0  
мг/м3

Расчет не проводился: См < 0.05 долей ПДК

7. Суммарные концентрации в узлах расчетной сетки.

ПК ЭРА v3.0. Модель: Разовые

Расчет проводится в соответствии с документом МРР-

2017 Город:096 Ереван.

Объект :0001 000 Армпауер.

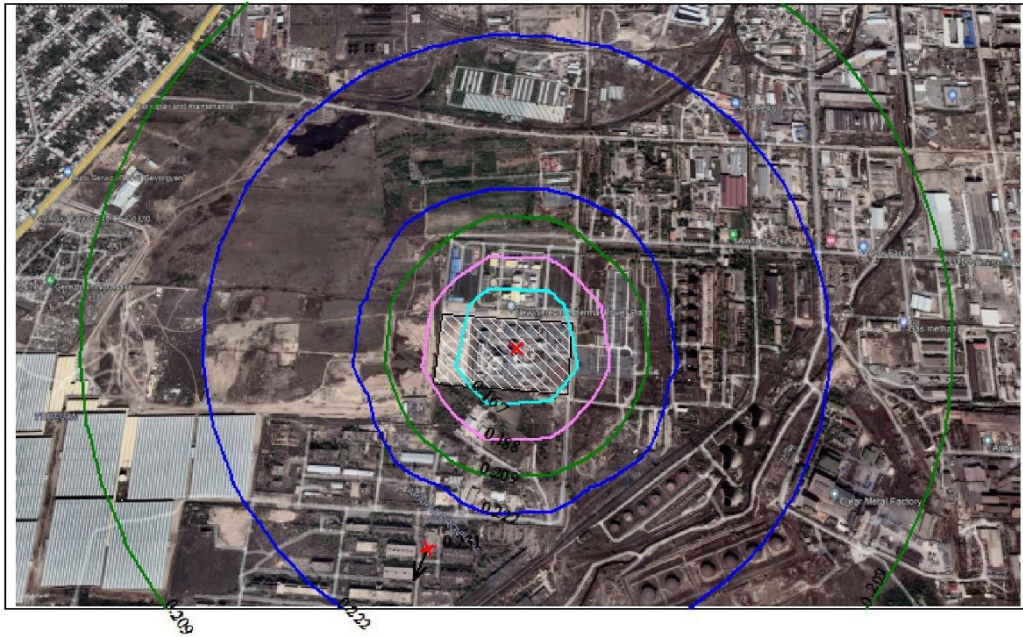
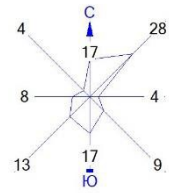
Вар.расч. :1 Расч.год: 2022 (СП) Расчет проводился 20.07.2022 10:53




Примесь :2754 - Углеводороды предельные C12-  
C-19 ПДКм.р для примеси 2754 = 1.0  
мг/м3





Расчет не проводился: См < 0.05 долей ПДК

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Город : 096 Ереван-26  
 Объект : 0001 ООО Армпауер Вар.№ 1  
 ПК ЭРА v3.0, Модель: MPP-2017  
 0301 Азота диоксид



Условные обозначения:  
 Территория предприятия  
 Максим. значение концентрации  
 Расч. прямоугольник N 01

Изолинии в долях ПДК  
 0.167 ПДК  
 0.188 ПДК  
 0.209 ПДК  
 0.222 ПДК



Макс концентрация 0.230693 ПДК достигается в точке  $x= 1965$   $y= 285$   
 При опасном направлении  $24^\circ$  и опасной скорости ветра 3.98 м/с  
 Расчетный прямоугольник № 1, ширина 4913 м, высота 2890 м,  
 шаг расчетной сетки 289 м, количество расчетных точек  $18 \times 11$   
 Расчет на существующее положение.