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High Voltage Electric Networks

Electricity Transmission Network Improvement Project

Rehabilitation of the Substation of Yerevan Thermal Power Centre



Environmental Management Plan

Final

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Acronyms and Abbreviations

CC	Construction Contractor
CCGT	Combined Cycle Gas Turbine
CE	Construction Engineer
dB	Decibel
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
EMP	Environmental Management Plan
ESRP	Electricity Supply Reliability Project
ETNIP	Electricity Transmission Network Improvement Project
GIIP	Good International Industry Practice
GRM	Grievance Redress Mechanism
HSEMS	Health, Safety, and Environment Management System
HSMP	Health and Safety Management Plan
HSMS	Health and Safety Management System
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IFC	International Finance Corporation
kV	Kilo Volts
MW	Mega Watts
NGO	Non-Governmental Organization
OP/BP	Operational Policies / Bank Procedures
OTL	Overhead Transmission Line
PAP	Project Affected People
PCB	Polychlorinated Biphenyl
PPE	Personal Protective Equipment
RA	Republic of Armenia
SNCO	State Non-commercial Organization
ToR	Terms of Reference
TPP	Thermal Power Plant
USD	US Dollar
WB	World Bank
YTPC	Yerevan Thermal Power Centre

1. Executive Summary

Electricity Transmission Network Improvement Project (the project) is under preparation. The project will finance rehabilitation of the substation at Yerevan TPP, among others. In order to allow for reliable evacuation of the power generated by the modern and efficient Combined Cycle Gas Turbine (CCGT) plant, there is no alternative to the proposed rehabilitation measures. In general, the project intervention at the substation of the Yerevan Thermal Power Centre (YTPC) will imply replacement and extension of electrical equipment and some construction work as well.

The main measures on the electrical side are the replacement of and extension with auto transformers and replacement of and extension with current and voltage transformers. Oil containing circuit breakers will be replaced by Sulfur Hexafluoride (SF₆) circuit breakers. Civil works will include construction of a new station service building and new cable ducts. An important issue is the rehabilitation of the drainage system beneath the oil containing equipment. With this system oil and oil containing waters can be collected and the oil can be separated from the water. Possibly an indoor Gas-insulated Switchgear (GIS) station may be constructed.

Likely main negative impacts of works at YTPC substation include generation of hazardous wastes such as used oil and batteries. The entire part of the rehabilitation activities of the substation will be restricted to the property of YTPC. All of the rehabilitation measures will take place within buildings and fenced areas of the substation. There is no need for any land acquisition outside the existing substation area. Enough space for the additional equipment is available.

The used oils may be treated and reused. Because at present there is no infrastructure for permanent disposal of hazardous waste in Armenia, and neither arrangement for its export does exist, hazardous wastes will be stored on site of YTPC substation.

The replaced generating circuit breakers will be state-of-the-art SF₆ circuit breakers. The amount of SF₆ gas is very small and possible leakages are controlled automatically. Thus the risk of any SF₆ release to the environment is minimal.

The Project will result in a more reliable evacuation of the power generated by the modern and efficient Combined Cycle Gas Turbine (CCGT). An increased stability of the electricity supply, especially if a raising demand is expected, is a positive impact of the Project.

The final draft version of the present Environmental Management Plan (EMP) will be disclosed to the public in English and Armenian versions for sufficient time to allow stakeholders to familiarize with it. In order to ensure that local communities have realistic access to the EMP, it will not only be posted on the website of the Ministry of Energy and Natural Resources (MENR), but will also be delivered in printed copies to the local administration offices and advertisements about their availability will be made. Printed copies will also be provided to relevant stakeholders as representative civil society organizations and to different NGOs, including

Aarhus Center. Received feedback will be incorporated into the final version of the EMP.

In the course of the civil works at YTPC substation unexpected impacts may occur or mitigation measures may not be carried out properly. In order to provide an efficient channel for the local people to voice their concerns, a grievance redress mechanism shall be established and maintained throughout the construction period. The EMP provides an outline of the mechanism for submitting grievance and redressing them.

Most of the costs for mitigation of negative impacts during construction phase are included in the regular construction costs. Extra costs with respect to environmental mitigation are related to additional measures to ensure safe management of the oil wastes, safe storage of scrap metals, as well as quarterly supervision of construction site to be performed by an internationally experienced auditor. Considering a construction period of about 3 years, costs for implementation of the present EMP sum up to 203,500 USD.

An implementation support consultant will be hired by YTPC. This specialist shall monitor the proper implementation of the EMP during monthly supervision at YTPC substation.

The EMP for the rehabilitation of YTPC substation will be integral part of the tender documents and will be included into the design, supply, and installation contract for the rehabilitation.

In summary, if the present EMP is adequately implemented, the YTPC substation may be reconstructed and operated without significant adverse impacts on the natural and social environment.

2. Legal and Regulatory Framework

According to the national environmental legislation of the Republic of Armenia, any activity which may cause environmental impacts needs a positive conclusion of an Environmental Impact Assessment. Environmental impacts of a planned activity or program have to be assessed during the preparation period. The RA Law on Environmental Assessment and Expertise of 2014 carries provisions regarding environmental impact assessment, impacting the environment, and conditions under which causing of such impact is allowed. In this law “Overhead transmission lines of 100 kV and higher voltage” are listed requiring an EIA process however rehabilitation of substations is not on the list.

ETNIP triggers the World Bank’s safeguard policies OP 4.01 *Environmental Assessment* and OP 4.12 *Involuntary Resettlement*. According to OP 4.01, ETNIP is classified as environmental Category B. Activities to be undertaken at YTPC substation also qualify for Category B. The present EMP is prepared following the World Bank’s safeguard policies. The WB/IFC Environment, Health and Safety (EHS) Guidelines also apply and are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). More specifically, EHS Guidelines on Electric Power Transmission and Distribution are applicable to works at YTPC substation.

3. Project Description

The YTPC substation is included in the balance sheet of Yerevan Thermal Power Plant, so legally and financially it belongs to YTPC. As part of the general electricity network system, it must obey some general rules applicable for all Armenian substations. The substation was commissioned in 1963 and served for evacuation of power from the seven thermal units with total installed capacity of 590 Megawatt (MW). In 2010, the Government also commissioned the modern and efficient Combined Cycle Gas Turbine (CCGT) station with 243 MW of installed capacity. The seven older units have not been operated for several years due to low efficiency. The substation is critical for ensuring reliable evacuation of power generated by the CCGT station, which accounts for almost 23% of total annual electricity generation in the country. In case of the failure of the substation at YTPC, it will be impossible to supply the power generated at the plant to several thousands of residential and other customers.

The substation was designed and operated with 220/110/35 kilovolt (kV) switchgears. However, currently it operates only with 110 and 35 kV switchgears since the autotransformer burnt out in 1992. The 110 kV switchgear condition is poor due to dilapidated air circuit breakers, disconnectors, current and voltage transformers, etc. Moreover, the existing equipment cannot be maintained and repaired due to lack of spare parts given that those are no longer manufactured. Steel structures are rusted, eroded and bended. Many foundations are defragmented. The analog control and relay protection equipment is very old and needs to be replaced by new digital systems to ensure improved control.

The YTPC has all needed licenses for Production of Electrical Power and for Production of Thermal Power.

The Ministry of Nature Protection is setting up standards for stack emissions and liquid effluents (see Section **Error! Reference source not found.**). For stack emissions limits e.g. for NO_x are stipulated. In addition, YTPC has to register all kind and amounts of wastes being generated during operation.

The stack emissions are monitored continuously by a Continuous Monitoring System (CMS) (see Photo 10-5). The process waters discharged to River Hrazdan are monitored by an external, independent licensed laboratory (see Section **Error! Reference source not found.**). In addition, the Ministry of Nature Protection is auditing the power plant four times a year for compliance with the standards set.

Workers in YTPC undergo a yearly medical check and are trained regularly in health and safety aspects.

YTPC reports quarterly to the Ministry of Nature Protection about the compliance of monitored parameters with given limit values and sends a list of amounts of waste generated during operation (see Section **Error!**

Reference source not found.) The license obtained by the Ministry of Nature Protection is renewed each year.

All needed licenses for operation are in place. No law suits against YTPC in any respect are ongoing or pending. Since start of power generation of the new combined cycle plant no exceedance of given limit values / standards regarding stack emissions and liquid effluents was recorded (see Appendix V for details).

Currently 24 persons are working at YTPC substation in 4 shifts with 6 persons each.

A visit to YTPC substation was conducted by the Consultant's (*Fichtner*) environmental specialist together with a national environmental expert on 25th September 2014 in order to check the situation at the substation and to take oil samples for PCB analyses (see Photo 4-3). All equipment at the substation will have to be replaced. Equipment as circuit breakers, disconnectors, current transformers, primary and secondary equipment (with related wiring cables), and support structures need replacement because of lack of spare parts, frequent malfunction, and erosion of concrete foundations and steel supports. Possibly an indoor Gas-insulated Switchgear (GIS) station may be constructed. In all analyzed oil samples the concentrations of PCB were below 20 ppm. Thus, the oil is not considered to be PCB-containing oil and can be reused or recycled without any further treatment.

This EMP is developed for works that will include full refurbishment of the substation, including construction of a new control building. The actual control unit of YTPC substation is within the thermal power plant building and will not be demolished within this project.

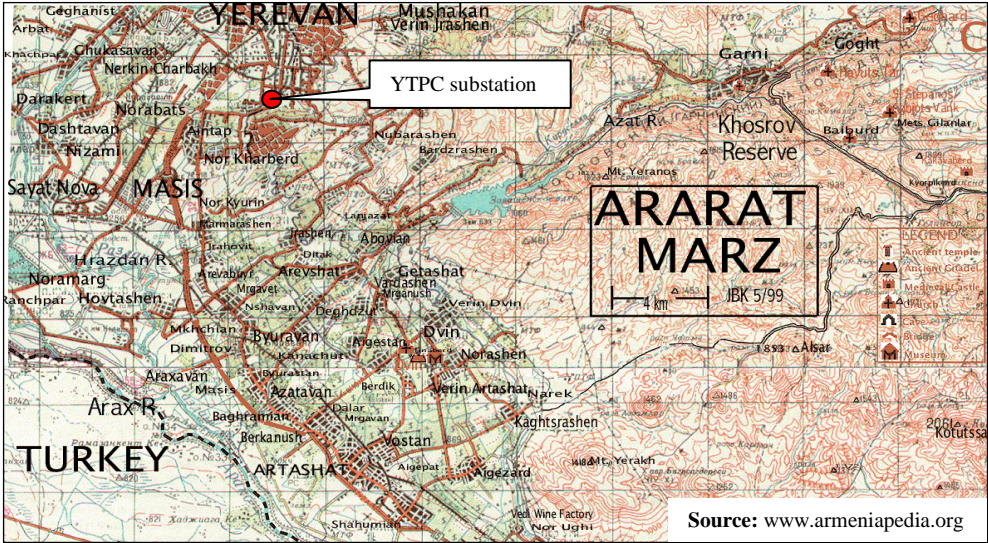
All demolishing /construction works will be done within the existing fenced areas. Extension of the substation site is not foreseen. The access road to the substation is in good condition and may be used also for transport of heavy equipment (see Photo 3-1).



Photo 3-1: Access road to YTPC substation YTPC site

Considerable amounts of waste will be generated by dismantling of old substation equipment. Main potentially hazardous wastes will be old batteries and used oil. Domestic, sanitary and construction waste may be disposed of at the Yerevan landfill based on a written agreement with local authorities. Scrap metal may be sold by YTPC for recycling purposes to specialized companies (e.g. Open Joint Stock Company *ASCE Group*, Charentsavan). Until disposal or recycling, wastes will be stored at YTPC substation site under relevant conditions and security provided (e.g. concreted and banded floor, roofing etc.).

The YTPC substation is situated near to the 2010 commissioned Combined Cycle Gas Turbine (CCGT) station in the south of Yerevan city (see Map 3-1).



Map 3-1: Location of the YTPC substation

4. Baseline Data

Health and Safety at Substation

In general, due to lack of money, health and safety standards are not fully met at the substation. Substation buildings have poor illumination (inside and outside), poor regulation of inside temperature (too hot in summer and too cold in winter), and substandard ventilation. The existing drainage system appears to be also in a bad condition.

At all substations in Armenia the same health and safety (H&S) system is applied. Responsible for safety aspects (inspection and training) is the 'Safety Engineering and Reliability Service' of the state-owned company Yerevan Thermal Power Centre. Substation staff attends monthly meetings dedicated to communicating updates on H&S regulations. Staff is subject to examination on awareness of H&S rules. Ledgers of conducted tests and their results are kept on file.

At all substations medical first aid kits are available. According to the staff, these kits are inspected and renewed regularly. However, the kits were found to be in a very poor condition (see Photo 4-1). A defibrillator was not available at the substation.



Photo 4-1: Poorly equipped first aid kit, as available at the control room of YTPC s/s

Fire walls between transformers are not installed and a sprinkler system around transformers is not in place. This means that in case of a transformer fire, the fire could spread to other equipment and cooling of a burning transformer would not be possible. In the control building sufficient fire-fighting equipment is available. Most of the fire extinguishers are regularly maintained and checked and are in a good condition. The extinguishers are mostly powder based and suitable for fighting fire in electrical installations (see Photo 4-2).



Photo 4-2: Fire extinguisher (powder) inside control building at YTPC s/s

Basic personal safety equipment, as helmets, gloves, tools for working under high voltage are available at the substation and are used by the substation staff. Metal clad clothes to protect workers from electric fields when working under high voltage are not available.

Running water is available at YTPC substation. The substation is connected to the water supply system of Yerevan city. However, the hygienic situation in general is bad.

With respect to maximum permissible field strength allowed for workers' exposure, the former USSR formula to calculate the exposure time of workers is used in Armenia, which is equivalent to the thresholds specified in the Guidelines for Limiting Exposure to Time-Varying Electric and Magnetic Fields, published by the International Commission on Non-Ionizing Radiation Protection. The formula is:

$$T_{[\text{hrs}]} = (50/E) - 2$$

E = electric field [kV/m]

This means that the exposure time in an electric field of 25 kV/m is 0 hrs. Working in an electric field of 25 kV or more is not allowed without special protecting clothing. The details for the exposure time are laid down in the 'Regulations (rules) of technical safety for exploitation of electrical equipment' (2nd issue Moscow, Energoatomizdat, 1988). However, no electric / magnetic field metering device is available at the substation.

Waste Management

All wastes ever generated have been stored at the substation site over decades. Thus, old equipment such as circuit breakers, ceramic parts and steel parts as well as old batteries and used oil not suitable for further use are stored all on the substation site, which provides sufficient room for storage. They are on the balance of YTPC.

In order to collect oil and / or oily waters from leaking equipment or in case of a transformer fire, normally a drainage system fitted with oil separators is installed below the substation site. The oily waters from this drainage system are collected in underground tanks which are emptied if needed. However, a functioning drainage system is missing at the substation at present.

In former times, PCBs have been widely used as coolants and lubricants in transformers, capacitors, and other electrical equipment, because PCBs possess good insulating properties and are fire retardant.

The rehabilitation project planned for YTPC substation includes replacement of old autotransformers, voltage and current transformers and circuit breakers. All this equipment contains oil. In order to decide what environmentally sound approach for removal, neutralization or elimination of PCB containing waste is, different samples of oil of the inspected substation were taken (see below and Section 10 - Appendix II) and analyzed for PCB in a certified German laboratory (certification see Section 10 – Appendix III). The results of the analyses are given in Table 4-1.

Table 4-1: Concentration of total PCB in oil samples taken at s/s YTPC

Location	Equipment	Date	PCB ppm
s/s YTPC	Transformer	07 Oct 2014	16,1
s/s YTPC	Circuit breaker	07 Oct 2014	5,9
s/s YTPC	Stored oil	07 Oct 2014	< 0,1

In all analyzed oil samples the concentrations of PCB were below 20 ppm. 50 ppm is the threshold of PCB content; above this value specific measures would be triggered. Following Stockholm and Bern Conventions, relevant EU Directives (e.g. 75/439/EEC) and U.S. EPA recommendations oil with a PCB concentration of less than 50 ppm is not considered to be PCB-containing oil and can be reused or recycled without any further treatment¹.



Photo 4-3: Taking of oil samples from oil storage site at s/s YTPC

¹ See also UNEP, Guidelines for the Identification of PCBs and Materials Containing PCBs, August 1999

5. Environmental Impacts and Their Mitigation

The proposed rehabilitation of YTPC substation will have various environmental impacts. The EMP covers a set of measures that need to be taken to ensure that the negative impacts from the rehabilitation of YTPC substation are avoided or minimized.

. Protected areas are not affected by the project. The most significant impacts arise during the construction phase. They can be traced back to wind and water erosion, dust, vehicle and equipment movement, the potential for spills, improper waste disposal, handling of hazardous substances and SF₆, and power shortage during construction.

The rehabilitation activities will be restricted to the property of YTPC - buildings and fenced plots of the substation. There is no need for any land acquisition outside the existing substation area. Enough space for the additional equipment is available at the substation site. The access to substation site is possible by asphalted roads broad enough to take in also heavy equipment.

The biggest threat arising from works at the substation is the generation of potentially hazardous wastes such as used oil and old batteries. The potential hazardous waste will be stored on-site until proper disposal or recycling facilities are developed or an agreement for waste disposal will be developed.

During operation phase, environmental impacts from electric and magnetic fields (EMF) are not expected, because the substation will be constructed following state of the art technology. The internationally used standards for workplaces and for the public outside the substation will not be exceeded (see Section 10 – Appendix IV). SF₆ leakages are very unlikely and will be continuously monitored by YTPC.

Beside domestic wastes generated by the workers, considerable waste will be generated by dismantling of old equipment. Thus, following main wastes being potentially hazardous will come up:

- old batteries
- used oil (about 297 t)
- old scrap metals like iron / steel / copper (about 818 t)
- ceramics

It has to be mentioned, that all hazardous wastes, generated during the construction phase such as old batteries, used oil, scrap metals etc. are subject to passportization (registration) and control, in accordance with the Articles 12 and 13 of the RA Law on Waste, RA Government Decision N 2291-N (adopted on 09.12.2005) and Decision N47-N (adopted on 19.01.2014). Recycling, neutralization, storage, transport and disposal of hazardous waste are subject to licensing in accordance with Article 43 of the RA Law on Licensing.

Table 5-1: List of installed oil containing equipment at s/s YTPC following information gained by YTPC

Equipment description	Quantity	Weight [kg]	Oil [kg]	Total weight [kg]	Total oil [kg]
110 kV Switchyard					
Current transformer	57	340	100	19,380	5,700
Current transformer	36	209	49	7,524	1,764
Current transformer	6	265	75	1,590	450
Voltage transformer	6	470	100	2,820	600
Transformer ТДЦ-200000/110/18	2	143,000	44,610	286,000	89,220
Transformer Т10 ТРДН-32/110/6,6/6,6	1	52,100	24,000	52,100	24,000
Transformer ТДЦ-80,110/6	1	69,500	40,000	69,500	40,000
Transformer Т4 ТД-80/110/6	2	78,000	26,000	156,000	52,000
Transformer ТРДН-25/110/6,6	2	47,200	20,000	94,400	40,000
Transformer ТДТГ-75/110/35/6	1	109,000	37,300	109,000	37,300
Total 100 kV				798,314	291,034
35 kV Switchyard					
SPDT switch	8	2,410	800	19,280	6,400
Voltage transformer	2	86		172	
Total 35 kV				19,452	6,400
Total s/s Yerevan				817,766	297,434

The analyses for PCB revealed that the oil in transformers / circuit breakers is not polluted with PCB (see Section 0). However, YTPC does not plan to reuse the old oil and will store it at the substation area until final disposal.

At YTPC substation site a special area will be prepared where the old oil can be stored safely. This area will be sealed and surrounded with a concrete bund to exclude soil / groundwater pollution even if the tanks are leaking. The place will be roofed to minimize corrosion of the tanks. An existing oil storage site is shown in Photo 5-1.

For oil storage special tanks will be used. These tanks will be double walled and fitted with suitable possibilities to take out the oil for reuse purposes. The dimension of the tank(s) will be big enough to take over the intended 297 t, the oil already stored at the substation site, and also future intentions. It is recommended to use several tanks of about 25 m³ to reduce the risk in case a tank starts leaking.



Photo 5-1: Oil storage site at s/s YTPC

The storage of oil batteries will be done at the substation site using existing facilities at the substation where old batteries are already stored or newly constructed storage facilities. The batteries will be stored in a way that access is possible to every single battery in case they start to leak. Stock piling of batteries will be avoided. The room has an effective ventilation system in case sulfuric acid leaks from the batteries. Substation staff permanently oversees safety of storage and will adhere to this practice in future.

The storage of metals like iron / steel and copper will be done on a graveled area on the substation site, large enough for the intended 818 t and the scrap metal already stored at the substation site.

5.1 Environmental Mitigation during Construction Activities

Almost all mitigation measures have to be implemented during the construction phase. Managing hazardous waste storage facilities on-site will be an important measure for mitigating operation phase risks.

In summary, if the proposed EMP will be fully implemented, it can be concluded that the proposed rehabilitation and modernization of s/s YTPC, can be constructed and operated without having significant adverse impacts on the ecological and social environment.

Table 5-2: Summary of Mitigation Measures during Construction Activities concerning Soil and Water Pollution

Mitigation measures to be applied during construction phase		
Issue for Mitigation: Soil and Water pollution		
Mitigation measures (considering EHS-Guidelines: Water and Sanitation, Wastewater and Ambient Water Quality, Waste Management, Hazardous Material Management)	Responsible Party	Budget for implementing (USD)
Regular maintenance of all vehicles and machines at regular service stations, if possible	Construction Contractor	Included in construction costs
Maintenance and re-fueling of the construction equipment only on sealed and enclosed areas		
Store all liquid materials (e.g. fuel, engine oil, etc.) and lubricants in locked tanks and on sealed and roofed areas		
Store construction material as bags of cement etc. in containers in order to avoid rinsing out		
Provide proper sanitation facilities with hand-washing facilities in adequate number, separately for men and women		
Train workers in appropriate sanitation practices		
Design bunds around and oil collecting system beneath transformers to prevent contamination of soil and groundwater		
Train transporters and workers in spill prevention and control especially in handling of oil and fuel		
Provide proper equipment (as drip pans) and implement procedures to handle transformer oil		
Provide spill-control materials to drivers and workers, in order to clean up spills, if necessary		
Report and respond to spills promptly and train workers in how to report		
Remove contaminated soil if spills occur and handle as hazardous waste		
Collect contaminated spill materials and manage as hazardous waste		

Table 5-3: Summary of Mitigation Measures during Construction Activities concerning Waste Management

Mitigation measures to be applied during construction phase		
Issue for Mitigation: Risks from Waste		
Mitigation measures (considering EHS-Guidelines: Water and Sanitation, Wastewater and Ambient Water Quality, Waste Management, Hazardous Material Management)	Responsible Party	Budget for implementing (USD)
CC will have to clarify with local authorities, where different kind of wastes may be disposed of	Construction Contractor Local authorities	Included in construction costs

Mitigation measures to be applied during construction phase		
Issue for Mitigation: Risks from Waste		
Mitigation measures (considering EHS-Guidelines: Water and Sanitation, Wastewater and Ambient Water Quality, Waste Management, Hazardous Material Management)	Responsible Party	Budget for implementing (USD)
Development of Waste Management Plan within the HSE Management Plan considering following principles: (i) waste management hierarchy of avoidance-minimization-reuse-treatment-disposal; (ii) segregation of waste; (iii) minimization of construction waste by good technical planning; (iv) training of staff	Construction Contractor	Included in construction costs
Implementation of a Waste Management System		
Train workers in handling and disposal of recyclable, sanitary, solid, liquid and hazardous waste		
Maintain records of all wastes disposed of onsite and record GPS coordinates and dimensions of waste disposal sites		
Segregate hazardous waste and store in suitable drums or containers in secure facilities (fitted with roofs, concreting, bunds etc.), and clearly identify hazardous waste		80,000 (storage sites)
Dispose of oil-contaminated soil in adequate storage facilities (see above) or landfills		Included in construction costs
Store used oil in suitable tanks and at proper areas at substation site (see Section 0) including storage of already existing oil onsite		15,000 (storage sites)
Store batteries onsite in suitable storage sites (see Section 0) including batteries already stored onsite		
Store scrap metal (iron, steel, copper, etc.) onsite for later recycling through YTPC (see Section 0) including material already stored onsite		

Table 5-4: Summary of Mitigation Measures during Construction Activities concerning Handling of SF₆

Mitigation measures to be applied during construction phase		
Issue for Mitigation: Handling of SF₆		
Mitigation measures (considering EHS-Guideline: Air Emissions and Ambient Air Quality)	Responsible Party	Budget for implementing (USD)
Fit the SF ₆ switch gears with automatic gas leakage detection systems	CE (reflected in design), Construction Contractor	Included in construction costs
Installation of the SF ₆ breakers must be done by trained and skilled personnel	Construction Contractor	
Equipment for maintenance and handling of SF ₆ must be supplied from the manufacturer		
Apply relevant general guidelines for handling SF ₆		

Table 5-5: Summary of Mitigation Measures during Construction Activities concerning Employee Health and Safety

Mitigation measures to be applied during construction phase		
Issue for Mitigation: Risks for Employee Health and Safety		
Mitigation measures	Responsible Party	Budget for implementing (USD)
Development of an HSE Policy for the construction phase, in advance of construction activities	Construction Contractor	Included in construction costs
Development of an HSE Management Plan for the construction phase (shall include Waste Management Plan), in advance of construction activities		
Installation of an HSE Management System (HSEMS) during the construction phase		
Provide proper sanitation facilities with hand-washing facilities in adequate number, separately for men and women		
Implementation of health and safety workshops for construction workers		
Installation of warning signs “Danger of Electrocutation” at towers, substations etc.		
Consider possible occurrence of poisonous snakes during working. Workers shall wear e.g. thick gloves when opening old ducts etc.		
Provide workers with appropriate protective equipment (PPE) (dust, noise, etc.)		
Hire only accredited workers for specific jobs, such as working at heights, handling large equipment and machinery, handling hazardous material, which required highly specialized training. Train workers accordingly in regard to working at heights, electrical safety, vehicular safety, handling of hazardous materials, PPE, use of first aid and rescue techniques, emergency response, poisonous snakes etc.		
Provide first aid kits and fire extinguishers at all Project sites and in all vehicles		
Forbid alcohol and other drugs at construction sites		
Assure transfer of injured workers to hospitals in the case of serious accidents		
Identify area emergency responders, hospitals, and clinics, and provide advance notice of Project activities		
Implement programs for medical screening, health and safety monitoring, and reporting		
Limit occupational exposure to EMF by use of shielding materials, and train workers accordingly		
Record all accidents and incidents		

Table 5-6: Summary of Mitigation Measures during Construction Activities concerning Public Health and Safety

Mitigation measures to be applied during construction phase		
Issue for Mitigation: Risks for Public Health and Safety		
Mitigation measures (considering EHS-Guideline: Community Health and Safety)	Responsible Party	Budget for implementing (USD)
Ensure that traffic is not interfered by construction through proper traffic management	Construction Contractor	Included in construction costs
Notification of the public on upcoming construction, in advance of construction period		
Public education and outreach efforts to provide information about hazard awareness, upcoming construction activities, safety measures, reporting unsafe conditions and environmental impacts, in advance of construction period		
Inform population along public roads in advance in case of transporting heavy equipment		
Wash tires of machinery and vehicles prior to leaving work site in muddy conditions		
Provide adequate security measures to prevent accidents and injury (e.g. keeping speed limits on public roads, grounding objects)		
Provide adequate security to prevent public access to the substations, work sites, hazardous materials and waste		
Erect fire walls between or at new transformers foreseen in switchyard of s/s YTPC to prevent spreading of fire in case of an accident		

Table 5-7: Summary of Mitigation Measures during Construction Activities concerning Noise

Mitigation measures to be applied during construction phase		
Issue for Mitigation: Noise		
Mitigation measures (considering EHS-Guideline: Noise Management)	Responsible Party	Budget for implementing (USD)
Reduce vehicle speeds (stick to recommended speeds) in populated areas	Construction Contractor	Included in construction costs
Allow truck movements only during daylight, but not between 7 pm and 6 am		
Utilization of low sound power mechanical equipment like bulldozer, air compressor, concrete pumps, excavator, concrete mixer etc. whenever possible		
Regular maintenance and service of building machinery and other during construction works		
Shut down or throttling down of noisy machinery to a minimum		

Mitigation measures to be applied during construction phase		
Issue for Mitigation: Noise		
Mitigation measures (considering EHS-Guideline: Noise Management)	Responsible Party	Budget for implementing (USD)
For workers noise levels shall be kept below 80 dB (A), wherever possible. In case of exceeding this value, hearing protections must be provided to workers and warning signs must be installed		
Noise level may not exceed 55 dB (A) for residents		
Notify nearby residents and businesses at least 24 hours in advance if particularly noisy activities are anticipated	Construction Contractor	Included in construction costs
Conduct noise-generating activities during normal work hours during the day		

Table 5-8: Summary of Mitigation Measures during Construction Activities concerning Air Quality

Mitigation measures to be applied during construction phase		
Issue for Mitigation: Risks for Air Quality		
Mitigation measures (considering EHS-Guideline: Air Emissions and Ambient Air Quality)	Responsible Party	Budget for implementing (USD)
Reduction of speed and limited movement of vehicles	Construction Contractor	Included in construction costs
Maintain vehicles and construction machinery properly, as recommended by suppliers		
Use dust-suppressing water on unpaved roads, e.g. spraying of water with watering trucks in advance of transportation activities		
Cover truck beds with tarps during material transport		
Use dust-suppressing water spray during civil works, where necessary		
Use equipment with dust suction devices in enclosed spaces during civil works, where necessary		
Store and handle material appropriately to limit dust (e.g. protect cement with tarpaulins)		
Avoid unnecessary idling of construction machines and vehicles		
Burning of rubbish onsite must be strictly forbidden		

Table 5-9: Summary of Mitigation Measures during Construction Activities concerning Social Impacts

Mitigation measures to be applied during construction phase		
Issue for Mitigation: Social Impacts		
Mitigation measures	Responsible Party	Budget for implementing (USD)
Develop in advance of construction period and implement a non-discriminatory hiring and wage policy (clearly stating that the company will not discriminate in hiring and salaries based on gender, age, religion, ethnicity or place of origin)	Construction Contractor NGO	Included in construction costs
Prosecute offenses related to payment of wages by sub-contractors strictly		
Prioritize employment of local people for construction works (skilled and unskilled workers)		
Improve recruitment of women for construction works		
Facilitate other economic opportunities for local communities (e.g. providing food services or other supplies to Contractors and workers)		
Health awareness workshops for workers by a specialized NGO		
Zero tolerance for sexual harassment at the work place or in workers' camp / overnight locations		
Strengthen district administrations on gender issues (i.e. receive complaints by women)		
Develop and implement a Grievance Redress Mechanism (see Chapter 7)		

Table 5-10: Summary of Mitigation Measures during Construction Activities concerning Traffic Management

Mitigation measures to be applied during construction phase		
Issue for Mitigation: Risks from Traffic		
Mitigation measures	Responsible Party	Budget for implementing (USD)
Announce start and duration of works through media and signs to the public in advance of construction period	Construction Contractor	Included in construction costs
Use of existing access roads to construction site		
Keep to speed limits in public roads		
Establish rights-of-way, speed limits onsite (20 km/h, walking pace for heavy trucks), vehicle inspection requirements, operating rules and procedures before commencement of construction		
Licensing and training of drivers; improvement of driving skills		
Ensure that industrial vehicle operators are licensed in the safe operation of specialized vehicles, including safe loading / unloading, and load limits		
Maintain vehicles regularly and use manufacturer approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure		
Minimize transport distances by using locally sourced materials, if possible		
Ensure safely design of exits and entrance for vehicles to construction site		
Collaborate with local communities and authorities to improve signage, visibility and overall safety of roads, particularly along stretches located near schools or other locations where children may be present, in advance of construction period		
Collaborate with local communities on education about traffic and pedestrian safety, in advance of construction period		
Coordination with emergency responders		

5.2 Environmental Mitigation during Operation and Maintenance

Table 5-11: Summary of Mitigation Measures during Operation and Maintenance Activities concerning Employee and Public Health and Safety

Mitigation measures to be applied during operation and maintenance period		
Issue for Mitigation: Employee and Public Health and Safety		
Mitigation measures	Responsible Party	Budget for implementing (USD)
Develop a Health and Safety Management Plan (HSMP) and implement an Health and Safety Management System (HSMS) for operation and maintenance of s/s YTPC	YTPC	Development of an HSMP for the operational phase (to be set up by YTPC), is recommended

Table 5-12: Summary of Mitigation Measures during Operation and Maintenance Activities concerning Handling of SF₆

Mitigation measures to be applied during operation and maintenance period		
Issue for Mitigation: Handling of SF₆		
Mitigation measures (considering EHS-Guideline: Air Emissions and Ambient Air Quality)	Responsible Party	Budget for implementing (USD)
Circuit breakers fitted with automatic leakage detectors	YTPC	Included in operational costs
Regular control of SF ₆ fill level		
Follow international used guidelines for SF ₆ gas handling		

5.3 Monitoring during Construction Activities

Table 5-13: Monitoring during Construction Activities

Activity / Impact	What (Is the parameter to be monitored?)	Where (Is the parameter to be monitored?)	How (Is the parameter to be monitored?)		When (Define the frequency / or continuous?)	Who (Is responsible for monitoring?)
			Method	Indicator		
Soil and Water Pollution (Part 1)	Regular maintenance of all vehicles and machines at regular service stations, if possible	Construction sites at YTPC substation	Inspection of maintenance records	All vehicles and machines adequately maintained	Regularly during construction	YTPC External expert
	Maintenance and re-fueling of the construction equipment only on sealed and enclosed areas		Visual inspection of maintenance and re-fueling areas	No unsuitable areas used for maintenance and re-fueling		
	Store all liquid materials (e.g. fuel, engine oil, etc.) and lubricants in locked tanks and on sealed and roofed areas		Visual inspection	All materials adequately stored		
	Store construction material as bags of cement etc. in containers in order to avoid rinsing out			Adequate number of sanitation facilities separately for men and women; and in proper condition		
	Provide proper sanitation facilities with hand-washing facilities in adequate number, separately for men and women		Inspection of training records	All workers trained accordingly		
	Train workers in appropriate sanitation practices		Visual inspection	All transformers fitted with bunds and oil collecting system		
	Design bunds around and oil collecting system beneath transformers to prevent contamination of soil and groundwater			Inspection of training		
	Train transporters and workers in					

Activity / Impact	What (Is the parameter to be monitored?)	Where (Is the parameter to be monitored?)	How (Is the parameter to be monitored?)		When (Define the frequency / or continuous?)	Who (Is responsible for monitoring?)
			Method	Indicator		
	spill prevention and control especially in handling of oil / fuel		records	accordingly		
Soil and Water Pollution (Part 2)	Provide proper equipment (as drip pans) and implement procedures to handle transformer oil	Construction sites at YTPC substation	Inspection of equipment	Equipment provided	Regularly during construction	YTPC External expert
	Provide spill-control materials to drivers and workers, in order to clean up spills, if necessary			Number of spill reports		
	Report and respond to spills promptly and train workers in how to report		Inspection of spill reports, and training records	All workers trained accordingly		
	Remove contaminated soil if spills occur and handle as hazardous waste		Inspection of spill reports and storage areas	All contaminated materials adequately stored		
	Collect contaminated spill materials and manage as hazardous waste					
Waste Management (Part 1)	CC will have to clarify with local authorities, where different kind of wastes may be disposed of	Construction sites at YTPC substation	Control of written agreement	Written agreement provided	In advance of construction works	YTPC External expert
	Development of Waste Management Plan within the HSE Management Plan		Control of Waste Management Plan	Waste Management Plan developed		
	Implementation of a Waste Management System		Control of Waste Management System	Waste Management System implemented	Regularly during construction	
	Train workers in handling and disposal of recyclable, sanitary, solid, liquid and hazardous waste		Inspection of training records	All workers trained accordingly		
	Maintain records of all wastes disposed of onsite and record GPS		Control of waste data sheets	Records in proper condition		

Activity / Impact	What (Is the parameter to be monitored?)	Where (Is the parameter to be monitored?)	How (Is the parameter to be monitored?)		When (Define the frequency / or continuous?)	Who (Is responsible for monitoring?)
			Method	Indicator		
	coordinates and dimensions of waste disposal sites					
Waste Management (Part 2)	Segregate hazardous waste and store in suitable drums or containers in secure facilities (fitted with roofs, concreting, bunds etc.), and clearly identify hazardous waste	Construction sites at YTPC substation	Visual control of storage areas at substation	All hazardous materials and scrap metal stored in appropriate storage areas	Regularly during construction	YTPC External expert
	Dispose of oil-contaminated soil in adequate storage facilities (see above) or landfills					
	Store used oil in suitable tanks and at proper areas at substation site including storage of already existing oil onsite					
	Store batteries onsite in suitable storage sites including batteries already stored onsite					
	Store scrap metal (iron, steel, copper, etc.) onsite for later recycling including material already stored onsite					
Handling of SF ₆	Fit the SF ₆ circuit breakers with automatic gas leakage detection systems	SF ₆ circuit breakers at YTPC substation	Visual inspection	All SF ₆ circuit breakers fitted with automatic gas leakage detection system	Once after installation	YTPC External expert
	Installation of the SF ₆ breakers must be done by trained and skilled personnel			Installation done by skilled personnel		
	Equipment for maintenance and handling of SF ₆ must be supplied from the manufacturer			All equipment supplied from manufacturer		

Activity / Impact	What (Is the parameter to be monitored?)	Where (Is the parameter to be monitored?)	How (Is the parameter to be monitored?)		When (Define the frequency / or continuous?)	Who (Is responsible for monitoring?)
			Method	Indicator		
	Apply relevant general guidelines for handling SF ₆			Relevant guidelines applied		
Employee Health and Safety (Part 1)	Development of an HSE Policy for the construction phase, in advance of construction activities	Construction sites at YTPC substation	Inspection of relevant documents	HSE Policy developed	In advance of construction works	YTPC External expert
	Development of an HSE Management Plan for the construction in advance of construction activities			HSE Management Plan developed		
	Installation of an HSE Management System (HSEMS) during the construction phase			HSE Management System implemented		
	Make sure that all workers have a health insurance		Inspection of workers' health documents	All workers have health insurance		
	Provide proper sanitation facilities with hand-washing facilities in adequate number, separately for men and women		Visual inspection	Adequate number of sanitation facilities separately for men and women; and in proper condition		
	Provision of HIV /AIDS protection equipment for workers		Interviews	Protection equipment provided		
	Implementation of health and safety workshops for construction workers		Inspection of workshop records	Workshops implemented		
	Installation of warning signs "Danger of Electrocutation" at towers, substations etc.		Visual inspection	Warning signs installed		
	Provide workers with appropriate protective equipment (PPE) (dust, noise, thick gloves against snake bites etc.)		Inspection of accident records	All workers provided with PPE		
	Provide first aid kits and fire		Interviews	First aid kits and fire		

Activity / Impact	What (Is the parameter to be monitored?)	Where (Is the parameter to be monitored?)	How (Is the parameter to be monitored?)		When (Define the frequency / or continuous?)	Who (Is responsible for monitoring?)
			Method	Indicator		
	extinguishers at all Project sites and in all vehicles		Visual inspection	extinguishers provided		
Employee Health and Safety (Part 2)	Train workers in regard to working at heights, electrical safety, vehicular safety, handling of hazardous materials, PPE, use of first aid and rescue techniques, emergency response, poisonous snakes etc.	Construction sites at YTPC substation	Inspection of training records	All workers trained accordingly	Regularly during construction	YTPC External expert
	Forbid alcohol and other drugs at construction sites		Inspection of incident records	No workers found under influence of alcohol or other drugs		
	Assure transfer of injured workers to hospitals in the case of serious accidents		Inspection of accident records	Workers transferred to hospital in case of serious accidents		
	Identify area emergency responders, hospitals, and clinics, and provide advance notice of Project activities	Area emergency responders	Interviews	Area emergency responders informed about Project activities	In advance of construction works	
	Implement programs for medical screening, health and safety monitoring, and reporting	Construction sites at YTPC substation	Inspection of records	H&S programs implemented	Regularly during construction	
	Limit occupational exposure to EMF by use of shielding materials, and train workers accordingly		Interviews	Shielding materials in place		
	Record all accidents and incidents		Inspection of training records	All workers trained accordingly		
		Inspection of records	Recording implemented			
Public Health and Safety (Part 1)	Ensure that traffic is not interfered by construction through proper traffic management	Residents living near YTPC substation	Inspection of complaints	No complaints from residents	Regularly during construction	YTPC

Activity / Impact	What (Is the parameter to be monitored?)	Where (Is the parameter to be monitored?)	How (Is the parameter to be monitored?)		When (Define the frequency / or continuous?)	Who (Is responsible for monitoring?)
			Method	Indicator		
	Notification of the public on upcoming construction		Interviews	Public informed about upcoming construction	In advance of construction	External expert
Public Health and Safety (Part 2)	Public education and outreach efforts to provide information about hazard awareness, upcoming construction activities, safety measures, reporting unsafe conditions and environmental impacts, in advance of construction period	Residents living near YTPC substation	Interviews Inspection of complaints	Public accordingly informed No complaints	In advance of construction Regularly during construction	YTPC External expert
	Inform population along public roads in advance in case of transporting heavy equipment	Residents along public roads	Inspection of complaints and accident records	No complaints from residents; no accidents	Regularly during construction	
	Provide adequate security measures to prevent accidents and injury (e.g. keeping speed limits on public roads, grounding objects)	Residents living near YTPC substation				
	Provide adequate security to prevent public access to the substations, work sites, hazardous materials and waste	Construction sites at YTPC substation	Visual inspection Inspection of records	Security measures implemented No incident records		
Noise (Part 1)	Reduce vehicle speeds in populated areas	Residents living near YTPC substation	Inspection of complaints	No complaints from residents		Regularly during construction
	Allow truck movements only during daylight, but not between 7 pm and 6 am					
	Utilization of low sound power mechanical equipment like bulldozer, air compressor, concrete pumps, excavator, concrete mixer etc. whenever possible	Construction sites at YTPC substation	Visual inspection Inspection of complaints	Low sound equipment used No complaints from residents		
	Regular maintenance and service of		Inspection of	Equipment regularly		

Activity / Impact	What (Is the parameter to be monitored?)	Where (Is the parameter to be monitored?)	How (Is the parameter to be monitored?)		When (Define the frequency / or continuous?)	Who (Is responsible for monitoring?)
			Method	Indicator		
	building machinery and other during construction works		maintenance records	maintained		
Noise (Part 2)	Shut down or throttling down of noisy machinery to a minimum	Construction sites at YTPC substation	Inspection of complaints	No complaints from residents	Regularly during construction	YTPC External expert
	For workers noise levels shall be kept below 80 dB (A), wherever possible. In case of exceeding this value, hearing protections must be provided to workers and warning signs must be installed		Instrumental measurement in case of particularly noisy activities	Noise level below 80 dB (A); if noise levels higher than 80 dB (A): workers fitted with PPE and warning signs installed		
	Noise level may not exceed 55 dB (A) for residents	Residents living near YTPC substation	Instrumental measurement in case of complaints	Noise level below 55 dB (A)		
	Notify nearby residents and businesses at least 24 hours in advance if particularly noisy activities are anticipated		Interviews	Residents informed in advance		
	Conduct noise-generating activities during normal work hours during the day	Construction sites at YTPC substation	Inspection of complaints	No complaints from residents		
Air Quality (Part 1)	Reduction of speed and limited movement of vehicles	Construction sites at YTPC substation	Inspection of complaints	No complaints from residents	Regularly during construction	YTPC External expert
	Maintain vehicles and construction machinery properly, as recommended by suppliers		Inspection of maintenance records	Equipment regularly maintained		
	Use dust-suppressing water on unpaved roads, e.g. spraying of water with watering trucks in advance of transportation activities	Unpaved roads used for transport	Inspection of complaints	No complaints from residents		
	Cover truck beds with tarps during material transport	Construction sites at YTPC substation				
	Use dust-suppressing water spray					

Activity / Impact	What (Is the parameter to be monitored?)	Where (Is the parameter to be monitored?)	How (Is the parameter to be monitored?)		When (Define the frequency / or continuous?)	Who (Is responsible for monitoring?)
			Method	Indicator		
	during civil works, where necessary					
Air Quality (Part 2)	Use equipment with dust suction devices in enclosed spaces during civil works, where necessary	Construction sites at YTPC substation	Visual inspection	Dust suction devices used where necessary	Regularly during construction	YTPC External expert
	Store and handle material appropriately to limit dust (e.g. protect cement with tarpaulins)			Appropriate storage		
	Avoid unnecessary idling of construction machines and vehicles			No unnecessary idling		
	Burning of rubbish onsite must be strictly forbidden			No rubbish burned		
Social Impacts (Part 1)	Develop and implement a non-discriminatory hiring and wage policy	Construction sites at YTPC substation	Inspection of complaints	No complaints	Regularly during construction	YTPC External expert
	Prosecute offenses related to payment of wages by sub-contractors strictly					
	Provide adequate workers' accommodation near construction site	Workers' accommodation	Visual inspection	Workers' accommodation in proper condition		
	Prioritize employment of local people for construction works	Construction sites at YTPC substation		Percentage of local people employed		
	Improve recruitment of women for construction works			Percentage of women employed		
	Facilitate other economic opportunities for local communities	Residents living near substation	Interviews	Other economic opportunities established		
	Health awareness workshops for workers by a specialized NGO	Construction sites		Inspection of workshop records		
Zero tolerance for sexual harassment at the work place or in	Construction sites and overnight	Inspection of complaints		No complaints		

Activity / Impact	What (Is the parameter to be monitored?)	Where (Is the parameter to be monitored?)	How (Is the parameter to be monitored?)		When (Define the frequency / or continuous?)	Who (Is responsible for monitoring?)
			Method	Indicator		
	workers' camp / overnight locations	locations				
Social Impacts (Part 2)	Strengthen district administrations on gender issues (i.e. receive complaints by women)	District administration	Inspection of complaints	Percentage of complaints adequately treated	Regularly during construction	YTPC External expert
	Develop and implement a Grievance Redress Mechanism	Construction sites at YTPC substation	Inspection of grievances	Percentage of grievances adequately treated	Regularly during construction	
	Announce start and duration of works through media and signs to the public in advance of construction period	Residents living near substation	Interviews	Public informed about construction works	In advance of construction	
Traffic Management (Part 1)	Use of existing access roads to construction site	Residents living near substation Construction sites at YTPC substation	Inspection of complaints	No complaints from residents	Regularly during construction	YTPC External expert
	Keep to speed limits in public roads		Inspection of complaints Visual inspection	No complaints from residents Speed limits, inspection requirements, operating rules established	Regularly during construction	
	Establish rights-of-way, speed limits onsite, vehicle inspection requirements, operating rules and procedures before commencement of construction	Construction sites at YTPC substation Construction sites at YTPC substation	Inspection of licensing records	All drivers licensed and trained	Regularly during construction	
	Licensing and training of drivers; improvement of driving skills		Inspection of training records	All vehicle operators trained and licensed	Regularly during construction	
Traffic Management (Part 2)	Maintain vehicles regularly and use manufacturer approved parts to minimize potentially serious accidents caused by equipment	Construction sites at YTPC substation Local communities	Inspection of maintenance records	Vehicles regularly maintained and approved parts used	Regularly during construction In advance of	YTPC External expert

Activity / Impact	What (Is the parameter to be monitored?)	Where (Is the parameter to be monitored?)	How (Is the parameter to be monitored?)		When (Define the frequency / or continuous?)	Who (Is responsible for monitoring?)
			Method	Indicator		
	malfunction or premature failure				construction	
	Minimize transport distances by using locally sourced materials, if possible		Visual inspection	Locally sourced material used, if possible		
	Ensure safely design of exits and entrance for vehicles to construction site			Vehicle exits and entrance designed safely		
	Collaborate with local communities and authorities to improve signage, visibility and overall safety of roads, particularly along stretches located near schools or other locations where children may be present		Visual inspection Interviews	Improvement of overall safety of roads started		
	Collaborate with local communities on education about traffic and pedestrian safety	Local communities		Education program about traffic and pedestrian safety established	In advance of construction	
	Coordination with emergency responders	Emergency responders	Interviews	Coordination established		

5.4 Monitoring during Operation and Maintenance

Table 5-14: Monitoring during Operation and Maintenance

Activity / Impact	What (Is the parameter to be monitored?)	Where (Is the parameter to be monitored?)	How (Is the parameter to be monitored?)		When (Define the frequency / or continuous?)	Who (Is responsible for monitoring?)
			Method	Indicator		
Employee Health and Safety	Develop HSMP and implement HSMS for operation and maintenance of s/s YTPC	YTPC substation	Visual inspection	HSMP developed and HSMS implemented	After construction works are finished	Development and implementation recommended for YTPC
	Erect fire walls between or at new transformers foreseen in switchyard of s/s YTPC to prevent spreading of fire in case of an accident			Fire walls erected		YTPC
Handling of SF ₆	Fill level of SF ₆	Circuit breakers at YTPC substation	Record of fill level	Adequate fill level	Automatically or in regular intervals as specified by the manufacturer of the equipment	YTPC

6. Implementation Arrangements and Reporting Needs

YTPC is one of the implementing entities for ETNIP and will manage all aspects of implementation related to the rehabilitation of YTPC substation, including application of environmental and social safeguard policies.

An implementation support consultant will be hired by YTPC. This consultant will carry out the overall supervision of the implementation of the EMP, reveal and report on non-compliance with the EMP or issues that may arise in the course of construction works that had not been covered in the EMP, develop a time-bound plan of corrective actions to address issues revealed / damage done and recommend it to the administration of YTPC, and follow up to track and oversee progress towards alleviation of problems.

In case of discrepancies the consultant shall implement proper actions to establish compliance with the EMP. If this is not possible and if the discrepancy is considered to be severe, the person(s) in charge shall be empowered to stop the work immediately until compliance is achieved again.

The consultant will also be responsible for conception and implementation of all monitoring activities during the construction phase and provide training to relevant staff of the operator in order to ensure that all monitoring activities for both the construction and operation phases can be executed in an appropriate manner. The consultant shall perform formal monthly field monitoring checks of all active works sites and produce monthly monitoring reports, including photo documentation. Overall, this will require three months' work for monitoring and reporting per year.

An external internationally experienced auditor shall perform quarterly supervision of the implementation of the EMP and monitor the implementation of the mitigation measures. Based on the quarterly supervision and the monthly reports provided by the implementation support consultant, the external auditor will produce narrative analytical quarterly reports on environmental and social performance in the course of rehabilitation of YTPC substation and furnish these reports to the World Bank. The costs for this supervision will sum up to 90,000 USD.

The Construction Contractor shall determine persons being responsible for environmental and social performance at all construction site(s).

7. Grievance Redress Mechanism

The project will use the existing grievance redress mechanism of HVEN, described in the Resettlement Policy Framework (RPF) of the World Bank financed Electricity Supply Reliability Project, which is under implementation. The GRM will be operated by HVEN for both substations (YTPC and Ashnak) and allow project affected people and other interested stakeholders to submit all types of complaints, suggestions, or questions related to the project. HVEN will be responsible for widely advertising the availability of the GRM in the vicinity of both substations (on public billboards, in the vicinity of construction sites, in its offices, etc.), and it will accept complaints submitted via regular mail, email, phone, or as part of in-person meetings. All complaints will be registered by HVEN and a tracking registration number will be assigned to each complainant.

In a first step complaints resolution will be attempted at the community level in a negotiation procedure with an informal mediator and community authorities. If the grievance persists, a grievance form can be submitted at the responsible committee under the responsibility of HVEN. The committee then decides whether to settle or go to court. The decision has to be taken within 15 days. In case of failure of the grievance redress system, the Project Affected People (PAP) can submit their case to the appropriate court of law.

The Committee will be composed of permanent and non-permanent members:

- Permanent members: HVEN, the contractor and a lawyer.
- Non-permanent members: Appropriate marz representative, community representative and NGO representative.

Non-permanent members will be notified of the date and venue of the meeting 10 days before the meeting. Absence of non-permanent members cannot be the reason for the cancellation of the meeting. A lawyer can be represented by one of the permanent members.

YTPC will carry out works that include:

- A staff member responsible for grievance procedure coordination, hereby referred to as grievance coordinator (including first contact, periodical site visiting of mitigation measure to be implemented by contractor);
- A telephone line, e-mail address and contact name on project boards;
- Arbitration of grievances with contractor and PAP.
- Liaison with court.

Community leaders will act as informal mediators in case of complaints. However, PAP have the option to choose a different representative or directly liaison with HVEN staff, responsible for grievance redress. Vulnerable households will have the support of their individual social worker and legal support.

NGOs will monitor grievance redress negotiations, assist with grievance arbitration, raise public awareness. PAP need to be informed that in case of

conflict with the community leader they can address NGO staff to follow up their complaint. NGOs will monitor relationship between PAP and community leader.

The aggrieved person (PAP) is encouraged to proceed in the following way:

- a) Contact the contractor's designated grievance staff during periodical site visits in person or via designated telephone number or the community leader or NGO staff
- b) Lodge complaint and provide information on the case
- c) Agree with the contractor on mitigation measure
- d) Agree with the contractor on time limit for grievance settlement. Grievances have to be settled within two weeks, or otherwise specified in scheduled agreement.
- e) Sign if the mitigation measure has been implemented as agreed
- f) Seek redress from HVEN if not satisfied with above mentioned procedure
- g) Seek redress from World Bank if not satisfied with response by HVEN
- h) Involve appropriate NGOs
- i) Seek redress from court if all else fails.

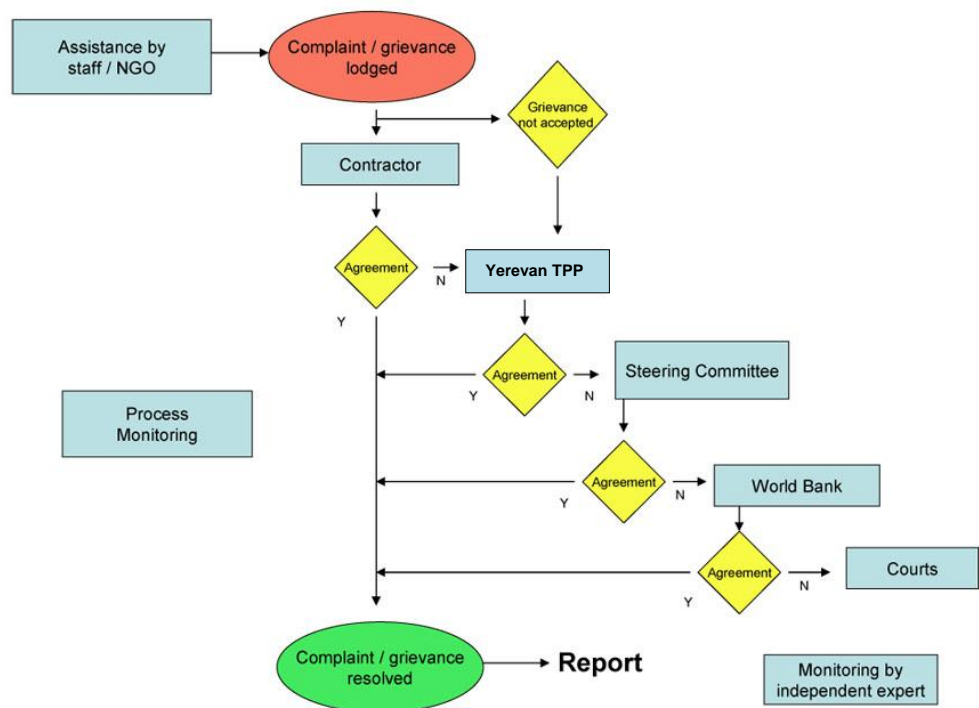


Figure 7-1: Grievance Mechanism Flow Chart

Nevertheless, the above mentioned grievance mechanism does not limit the citizen's right to submit the case straight to the court of law just in the first stage of grievance process. The grievance mechanism is designed to avoid lengthy court procedures.

The World Bank is not directly a part of the Grievance procedure, but should receive reports which complaints were received and how they have been followed up / mitigated.

Special consideration has to be taken for PAP living in remote areas and vulnerable people as complaint mechanisms may be unusual and contact with legal procedures let alone courts of law may appear not very promising from their experience. This would prevent the most disadvantaged persons from addressing their grievance.

Vulnerable PAP (all women headed households and all households below the poverty line) will be entitled to a legal aid / social worker to support them with complaints procedures.

For further details about GRM see the Project related RPF.

8. Information Disclosure, Public Consultation, and Participation

The World Bank policies require that public consultations are held during development of an EIA/EMP. According to these policies, *Fichtner's* environmental and social specialist, together with the national environmental consultant, held meetings at Yerevan city (see Section 10 – Appendix I).

The municipality of Yerevan city was consulted and informed about the upcoming works. In addition, waste disposal possibilities at Armenia and Yerevan were discussed there.

During the visits of the substation workers were also interviewed to hear their personal view of living and working conditions related to substations and power supply.

Major concerns at the substation were the poor illumination outside the substation and inside the buildings, and the poor heating and air conditioning systems to adjust the temperatures in the very cold winters and the hot summers. Solid and liquid waste management are considered being priority issues at YTPC substation and considered as one of the main environmental impacts in general.

The EMP for YTPC - both in English and Armenian languages - was published to solicit public feedback. The timeframe of December 19, 2014 to January 13, 2015 was allowed for expressing concerns and providing comments from concerned persons via regular mail (full address of HVEN was provided), email and corporate telephone number, which was available from 9 AM to 6 PM on business days.

Materials and Methods

The English and Armenian versions of the EMP were posted on the web site of the High Voltage Electric Networks CJSC (http://hven.am/events_34_2.html). Hard copies of EMPs were also submitted to the following state authority: Erebuni Administrative District of the Yerevan city where the YTPC is located. Brief information on rehabilitation works, locations (web site addresses and municipality/administrative district) of disclosed EMP, and HVEN's contact information (including full address, email, telephone number, and contact person's name) were placed at the entrance/fencing of the substation (please see photos) to allow people to express any questions or concerns regarding the documents. The notification was not placed on the wall of the substation, but rather on the entrance of the YTPC because the substation is within the fenced territory of YTPC and not directly accessible or easily visible.

The electronic copies of the EMP were also submitted to the following non-governmental organizations:

- Armenian Aarhus Centers

- “Energy Saving Alliance” Armenian Branch
- “Association of Energy Service delivery Enterprises of Armenia”
- Transparency International Armenia
- Acopian Center for the Environment, American University of Armenia

Conclusion

Over the public consultation period no concerns, questions, or comments have been received on the EMP from any individual or a legal entity. Therefore, this document is considered final in its present iteration.

Photo: Notifications placed at YTPC



9. Costs of Implementation of EMP

Most of the costs for mitigation of the impacts during the construction period of the rehabilitation of YTPC substation are included in the regular construction costs. Extra costs with respect to environmental mitigation are related to additional measures to ensure safe management of the oil wastes, safe storage of scrap metals, as well as quarterly supervision of construction site to be performed by an internationally experienced auditor.

Considering a construction period of about 3 years costs for implementation of the EMP sum up to **203,500 USD** (see Table 9-1).

Table 9-1: Costs for mitigation measures and monitoring

	Phase	Issue	Costs [USD]
Mitigation	Construction	Storage of oil	80,000
Mitigation	Construction	Storage of scrap metals	15,000
Monitoring	Construction	Quarterly supervision of construction site	90,000
Sum			185,000
10 % contingencies			18,500
Total			203,500

10. Appendices

Appendix I: Record of Meetings and Field Visits

Date	Agency / Institution / Company	Place	Name of Person consulted Position	Reason for Visit
24 Sep 2014	HVEN	Yerevan	Aram Petrosyan Deputy Chief Engineer	Kick-off and possible technical measures
25 Sep 2014	YTPC	Yerevan	Hovik.Hovtannisyan General Director Avetik Horkannisyan Deputy Director Tigran Ttikyan Production- Technical Deputy Head	General situation concerning licensing, standards etc.
25 Sep 2014	Substation of YTPC Y	Yerevan	Azat Gosalmyan Head of Electrical Department	Situation at substation, taking of oil samples
27 Sep 2014	Ministry of Nature Protection	Yerevan	Khachatur Khachatryan Head of Legal Department	EIA Process in Armenia
01.10.2014	ELBAT Battery	Yerevan	Telefon call	Battery recycling
01.10.2014	ASCE Group OJSC	Charentsavan	Telefon call	Scrap metal recycling
02.10.2014	Ministry of Nature Protection State non-commercial organization	Yerevan	Henrik Grigoryan Deputy Director	Environmental permitting procedure in Armenia
03.10.2014	Yerevan Municipality Department of Nature Protection	Yerevan	Diana Grigoryan Chief Specialist- Ecologist	Situation at TPP Yerevan and for waste landfilling

Appendix II: Results of Oil Analyses for PCB

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Prüfbericht

Projekt: SIS Ashnak, SIS TTP Yerevan, Armenic

Prüfbericht Nr.	CWA14-030385-1	Auftrag Nr.	CWA-12612-14	Datum	14.10.2014
Probe Nr.			14-141473-01	14-141473-02	14-141473-03
Eingangsdatum			07.10.2014	07.10.2014	07.10.2014
Bezeichnung			SIS TTP Yerevan Circuit breaker	SIS TTP Yerevan Transformer Oil	SIS Ashnak Circuit Breaker
Probenart			Öl	Öl	Öl
Probenahme durch			Auftraggeber	Auftraggeber	Auftraggeber
Probengefäß			PE	PE	PE
Untersuchungsbeginn			07.10.2014	07.10.2014	07.10.2014
Untersuchungsende			13.10.2014	13.10.2014	13.10.2014

Polychlorierte Biphenyle (PCB)

Probe Nr.			14-141473-01	14-141473-02	14-141473-03
Bezeichnung			SIS TTP Yerevan Circuit breaker	SIS TTP Yerevan Transformer Oil	SIS Ashnak Circuit Breaker
PCB Nr. 28	mg/kg	OS	0,41	1,1	0,12
PCB Nr. 52	mg/kg	OS	0,66	0,79	0,79
PCB Nr. 101	mg/kg	OS	<0,1	0,54	0,54
PCB Nr. 138	mg/kg	OS	<0,1	0,2	0,2
PCB Nr. 153	mg/kg	OS	0,11	0,25	0,25
PCB Nr. 180	mg/kg	OS	<0,1	0,34	0,34
Summe der 6 PCB	mg/kg	OS	1,18	3,22	2,24
PCB gesamt (Summe 6 PCB x 5)	mg/kg	OS	5,9	16,1	11,2

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Geschäftsführer:
Hans-Dieter Bossemeyer, Dr. Michaela Nowak
HRB 1953 AG Steinfurt
Zweigniederlassung Walldorf

Prüfbericht Nr. **CWA14-030385-1** Auftrag Nr. **CWA-12612-14** Datum **14.10.2014**

Probe Nr.	14-141473-04	14-141473-05
Eingangsdatum	07.10.2014	07.10.2014
Bezeichnung	SIS TTP Yerevan stored oil	SIS Ashnak Transformer Oil
Probenart	Öl	Öl
Probenahme durch	Auftraggeber	Auftraggeber
Probengefäß	PE	PE
Untersuchungsbeginn	07.10.2014	07.10.2014
Untersuchungsende	13.10.2014	13.10.2014

Polychlorierte Biphenyle (PCB)

Probe Nr.		14-141473-04	14-141473-05
Bezeichnung		SIS TTP Yerevan stored oil	SIS Ashnak Transformer Oil
PCB Nr. 28	mg/kg OS	<0,1	<0,1
PCB Nr. 52	mg/kg OS	<0,1	<0,1
PCB Nr. 101	mg/kg OS	<0,1	0,11
PCB Nr. 138	mg/kg OS	<0,1	<0,1
PCB Nr. 153	mg/kg OS	<0,1	<0,1
PCB Nr. 180	mg/kg OS	<0,1	<0,1
Summe der 6 PCB	mg/kg OS	-/-	0,11
PCB gesamt (Summe 6 PCB x 5)	mg/kg OS	-/-	0,55

Abkürzungen und Methoden

Polychlorierte Biphenyle (PCB)

OS

 EN 12766-1^A

Originalsubstanz

ausführender Standort

Umweltanalytik Altenberge

i.A.



 Bernhard Füllgrabe
 Dipl. Chemiker
 Sachverständiger Umwelt

Seite 2 von 2


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 Geschäftsführer:
 Hans-Dieter Bossemeyer, Dr. Michaela Nowak
 HRB 1953 AG Steinfurt
 Zweigniederlassung Walldorf

Appendix III: Certificate of the Analytical Laboratory



Deutsche Akkreditierungsstelle GmbH

Beliehene gemäß § 8 Absatz 1 AkkStelleG i.V.m. § 1 Absatz 1 AkkStelleGBV
Unterzeichnerin der Multilateralen Abkommen
von EA, ILAC und IAF zur gegenseitigen Anerkennung

Akkreditierung



Die Deutsche Akkreditierungsstelle GmbH bestätigt hiermit, dass das Prüflaboratorium

WESSLING GmbH

mit den in der Urkundenanlage aufgeführten Standorten

die Kompetenz nach DIN EN ISO/IEC 17025:2005 besitzt, Prüfungen in folgenden Bereichen durchzuführen:

Probenahme sowie physikalische, physikalisch-chemische, chemische und mikrobiologische Untersuchungen von Wässern, Abwässern, Grund- und Fließgewässern, Roh-, Schwimm- und Badebeckenwässern, Eluaten, Böden, kontaminierten Böden, Schlämmen, Sedimenten, Materialproben, organischen Düngemitteln, Bodenverbesserungsmitteln und Substraten, Gärrückständen, Kompost, Bioabfällen, Kraft- und Brennstoffen und Klärschlämmen; Probenahme und Untersuchung gemäß Trinkwasserverordnung mit Ausnahme der radiologischen Parameter; ausgewählte physikalisch-chemische Untersuchungen bei der Wasserprobenahme; Probenahme sowie physikalische, physikalisch-chemische und chemische Untersuchungen von Böden und Klärschlamm im Rahmen der Klärschlammverordnung, Abfällen zur Beseitigung und zur Verwertung, Mineralölen, Mineralölprodukten, Brennstoffen, Althölzern, Sekundärbrennstoffen, Stäuben, Schlacken, Aschen, Bodenluft und Gasen; sensorische, chemische, biologische und mikrobiologische Untersuchungen von Lebensmitteln, Futtermitteln, Bedarfsgegenständen, kosmetischen Mitteln und ausgewählten pharmazeutischen Produkten; Probenahme und molekularbiologische Untersuchungen von Lebens- und Futtermitteln; ökotoxikologische und biologische Untersuchungen von Wässern, Abwässern, Grund- und Fließgewässern, Eluaten von Böden und kontaminierten Böden; Bestimmung (Probenahme und Analytik) von polyhalogenierten Dibenzo-p-Dioxinen und Dibenzofuranen in Wässern, Abwässern, Böden, kontaminierten Böden, Sedimenten, Klärschlämmen, organischen Düngemitteln, Bodenverbesserungsmitteln und Substraten, Kompost und Bioabfällen, Stäuben, Schlacken, Aschen, Abbruchmaterial, Lebensmitteln, Futtermitteln, Aufwuchsmaterialien, bei Emissionen, Immissionen, Arbeitsplatzmessungen und in Innenräumen sowie von Wischproben; Bestimmung (Probenahme und Analytik) von anorganischen und organischen gas- oder partikelförmigen Luftinhaltsstoffen bei Emissionen, Immissionen, Arbeitsplatzmessungen und in Innenräumen; Bestimmung (Probenahme und Analytik) von faserförmigen Partikeln bei Emissionen, Immissionen, Arbeitsplatzmessungen und in Innenräumen sowie in Feststoffen, Stäuben und Böden; Fachmodule Wasser, Boden und Altlasten sowie Abfall; Modul Immissionsschutz

Die Akkreditierungsurkunde gilt nur in Verbindung mit dem Bescheid vom 13.06.2013 mit der Akkreditierungsnummer D-PL-14162-01 und ist gültig bis 13.09.2015. Sie besteht aus diesem Deckblatt, der Rückseite des Deckblatts und der folgenden Anlage mit insgesamt 154 Seiten.

Registrierungsnummer der Urkunde: D-PL-14162-01-00

Im Auftrag

Berlin, 13.06.2013

Andrea Valbuena
Abteilungsleiterin

Siehe Hinweis auf der Rückseite

Appendix IV: Internationally Used Standards / Limit Values Concerning Electric and Magnetic Fields (50 Hz) for the Public and at Working Places

Source	El. Field strength [kV/m]	Magn. Flux density [μ T]
<u>ICNIRP recommended 50/60 Hz</u> Reference levels for exposure to time-varying electric and magnetic fields (unperturbed r.m.s. values) occupational exposure* general public exposure	10 5	500 100
<u>Limit values according to the European Directive 2004/40/EC</u> exposure of workers*	10	500
<u>Limit (r.m.s) value as per 26. BImSchVer 12/96</u> general public up to 24 hours /day	5	100
<u>Limit values as per VDE V 0848 Part 4/A3 at 50 Hz</u> r.m.s. values for equivalent field strength in exposure range 1 for exposure times up to 1 h/d r.m.s. values for equivalent field strength in exposure range 1 for exposure times up to 2 h/d r.m.s. values for equivalent field strength in exposure range 1 for continuous exposure r.m.s. values for equivalent field strength in exposure range 2	30 30 21.32 6.67	4,240 2,550 1,360 424

* exceedance of value requires specific actions

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

Exposure range 1 includes monitored areas, e.g. operating zones, areas monitored by operators generally accessible areas, in which, owing to the operating mode or the length of stay, it is guaranteed that exposure only occurs for a short period of time

Exposure range 2 includes all areas in which not only short-term exposure can be expected, for example: areas containing residential and social buildings, individual residential sites, parks and facilities for sport, leisure and relaxation, operating zones where a field generation is not expected under normal conditions

(ICNIRP=International Commission on Non-Ionising Radiation Protection, BImSchVer=German Bundesimmissionsschutzverordnung, VDE=Verband Deutscher Elektrotechniker e.V., Cenelec=European Committee for Electrotechnical Standardisation)

Appendix V: Institutional Set-up and Performance of YTPC

The YTPC is operating in compliance with all of the technical and environmental regulations in the country. There are no pending litigations and lawsuits and no complaints from the public and other stakeholders regarding its operations and environmental as well as technical performance.

Within an EU Project 2013, the local private company Consecoard LLC did a study involving emissions at new TPP Yerevan and came to the conclusion that the emissions were within the limits of BREF indicators. Particularly, NO₂ indicators were found in the 30-70 mg/Nm³, and CO in the 10-40 mg/Nm³ range, which fully complies with both, the Industrial Emission Directive 2010/75/EU and LCP Directive requirements as well.

The YTPC was constructed around 1960 as a gas/ heavy oil (mazut) fired power plant with an installed capacity of 650 MW. This TPP was closed in 2005. Between 2005 and 2010 no energy was produced on site. In 2010 South Korean GS Engineering and Construction Company commissioned a new combined cycle gas fired power plant adjacent to the old site with an installed capacity of 225 MW.

The YTPC has all needed licenses for Production of Electrical Power and for Production of Thermal Power.

The rules for licensing are stipulated by RA Law on Licensing (HO-193, 30.05.2001). According to the Law, among others the following activities in energy sector are subject to licensing:

- Natural gas transmission, distribution, import, export;
- Electricity production (including the combined production of electricity and thermal energy), transmission, distribution, export, import;
- Thermal energy production, transmission, distribution;
- Provision of electricity and natural gas supply system operator services, Provision of services to energy market.

YTPC got all needed licenses for operation.

The license issuing authority for all these activities is the Public Services Regulatory Commission (www.psrc.am/en/). All the licenses issued by the Commission are available on its web site, but only in Armenian. Details of the licensing in energy field are stipulated by the “Law on Energy”.

The TPP Yerevan is obliged to update its overall running license yearly.

The YTPC has a contract with Electric Networks of Armenia (ENA), the privately-owned power distribution company, to sell the generated power.

According to the information gained during the visit at YTPC (see Section **Error! Reference source not found.**) no law suits against the YTPC are ongoing or pending.

The Ministry of Nature Protection is setting up standards for stack emissions and liquid effluents (see Section **Error! Reference source not found.**). For stack emissions limits e.g. for NO_x are stipulated. In addition, YTPC has to register all kind and amounts of wastes being generated during operation.

The stack emissions are monitored continuously by a Continuous Monitoring System (CMS) (see Photo 10-5). The process waters discharged to River Hrazdan are monitored by an external, independent licensed laboratory (see Section **Error! Reference source not found.**).

Independent from the monitoring results, the tax to be paid by YTPC for emissions will be fixed. In case of exceedances of standards set a multiple of tax compared to the regular ones had to be paid. However, according to the interviews held and according to information gained from the YTPC Management the standards stipulated by the Ministry were never exceeded at any time.

In addition, the Ministry of Nature Protection is auditing the power plant four times a year for compliance with the standards set.

The workers in YTPC undergo a yearly medical check and are trained regularly in health and safety aspects.

YTPC reports quarterly to the Ministry of Nature Protection about the compliance of monitored parameters with given limit values and sends a list of amounts of waste generated during operation (see Section **Error! Reference source not found.**). The license obtained by the Ministry of Nature Protection is renewed each year.

- All needed licenses for operation are in place;
- No law suits against YTPC in any respect are ongoing or pending;
- Since start of power generation of the new combined cycle plant no exceedance of given limit values / standards regarding stack emissions and liquid effluents had to be recorded.

Photographic Documentation



Photo 10-1: Overview about new combined cycle power plant at Yerevan



Photo 10-2: Cooling system



Photo 10-3: View from new to old power plant site



Photo 10-4: Stack with Continuous Monitoring Unit (CMS)



Photo 10-5: Continuous Monitoring Unit (CMS)



Photo 10-6: Process water treatment



Photo 10-7: Outlet of treated process water