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CONTOURGLOBAL®

Environmental Services

Assessment of the Environmental and Social Compliance of the Vorotan Hydropower Cascade, Armenia

Hazardous Substances Assessment Report

Final Version

FICHTNER

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0	21.10.2015	Draft Hazardous Substances Assessment Report	Paulsch/Back	von Büren
1	03.11.2015	Final Hazardous Substances Assessment Report	Paulsch/Back	von Büren
2	03.12.2015	Final Second Hazardous Substances Assessment Report	Paulsch/Back	von Büren

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1. Executive Summary

In August 2015, ContourGlobal Hydro Cascade CJSC acquired Vorotan Complex of Hydroelectric Power Stations CJSC. ContourGlobal contracted FICHTNER, Stuttgart to prepare an Assessment of the Environmental and Social Compliance of the Vorotan Hydropower Cascade, including a Health and Safety Regulatory Compliance Assessment Report, an Environmental Liability Assessment Report, a Hazardous Substances Assessment Report and a Gap Analysis Report.

1.1 Legal Framework

Amongst the principles embedded in the Armenian regulatory framework of waste management is protection of human health and environment from adverse effects of waste (RA Law "On Waste", article 6, part 1, point a). This principle is implemented by the mechanisms provided by the legislation.

The main legal acts are as follows:

- RA Law "On Waste" (2004);
- RA Law "On Refuse Collection and Sanitary Cleaning"
- RA Government Decision No 874-N “On Approving the List of Hazardous Wastes of the Republic of Armenia” dated 20 May, 2004
- RA Government Decision No 47-N “On Defining Procedure for Waste Passportization” dated 19 January, 2006
- Order No 19-N of RA Minister of Nature Protection “On Defining the Form of Sample Passport of Waste” dated 2 February, 2007
- Order No 342-N of RA Minister of Nature Protection "On Approving the List of Industrial (Including Mining) and Consumption Waste Generated in the Territory of the Republic of Armenia" dated 26 October, 2006
- Order N 430-N of RA Ministry of Nature Protection “On Defining the List of Waste Classified by Risk Level” dated 25 December, 2006
- Order No 112-N of the Ministry of Nature Protection dated 22 August, 2002
- Order N 20-N of the Minister of Healthcare "On Defining Sanitary Rules and Norms N 2.1.7.001-09 “Hygienic Requirements to the Management of Hazardous Waste and Storage and Transportation of Hazardous Chemical Substances" dated 26 October, 2009.

1.2 Project Description

The Vorotan Complex of Hydroelectric Power Stations is a complex of three hydroelectric power stations (Spandaryan, Shamb, and Tatev HPPs) with an overall capacity of 404.2 MW and an average annual power generation of 1.16 billion kWh. The Vorotan Cascade is among the main power generation complexes in Armenia, providing both peak and base load generation, and performing grid stabilization services. The complex is located in the eastern part of Syunik region of the Republic of Armenia,

some 240 km to the south-east of Yerevan. Vorotan Cascade is located at the Vorotan River. It is comprised of four reservoirs (Spandaryan, Angeghakot, Tolors, and Shamb/Tatev Reservoirs), the Tatev Daily Regulation Reservoir, and the named Hydropower Plants.

The Cascade has a total head of 1,223 m. The design of the Vorotan Cascade began in 1954, construction started in 1961. In 1970 the first power station, Tatev HPP, was put into operation, followed by Shamb HPP in 1978 and Spandaryan HPP in 1989.

1.3 Baseline

1.3.1 Basic studies

The Hazardous Substances Assessment Report is based on the following reports:

- Burns and Roe Enterprises (1999): Environmental Assessment of Vorotan Cascade Rehabilitation Project, prepared for Hagler Bailly, submitted to US Agency for International Development. October 1999.
- Norplan (2013): ContourGlobal Vorotan Cascade of Hydropower Plants - Technical, Environmental and Hydrological Due Diligence. March 2013.
- IFC (2015): Vorotan Hydros - Environmental & Social Review Summary (published online).

1.3.2 Waste management in Armenia

About 60 landfills (dump sites) can be found in the country. The waste management sector in Armenia is regulated by the “Law on Waste” and by 30 legal acts driving from it, but there are no capacities for recycling, neutralization, and elimination of hazardous waste. Solid waste management is poorly organized in Armenia. Most of the solid waste is dumped in provisional dump sites and landfills without any segregation or recycling. Solid waste including hazardous waste is generally not disposed of in accordance with internationally accepted practices. Waste is either burned or just dumped. This is also true for the Municipal Waste Dumping Site at Goris.

The current situation concerning waste management at Vorotan Cascade installations in general is bad. All wastes ever generated have been stored at site since decades. Thus, old equipment as old circuit breakers, ceramic parts and steel, but also old batteries and oil not suitable for further use are stored somewhere at the site. In addition, a functioning drainage system is missing at all Vorotan sites.

1.3.3 PCB in oil of substation equipment

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.

In general, the acute toxicity of PCB is small, but looking at the chronic effects a high toxic potential of PCBs has to be stated. Especially when burned, PCBs can be turned into highly toxic and carcinogenic furans (PCDF) and dioxins (PCDD). Therefore, special care has to be lead on this issue.

According to the United States Environmental Protection Agency (US-EPA), a transformer is 'a transformer that contains PCB' if the concentration of PCBs is higher than 500 ppm. Oil containing between 50 ppm and 499 ppm PCBs is considered to be polluted with PCB and specific methods for disposal are necessary (e.g. specific incineration plants). According to EU Directive 59/96/EC amended with 596/2009/EC, to Basel and to Stockholm conventions oil containing less than 50 ppm PCB is not considered to be PCB polluted.

1.4 Field Investigation, Observed Gaps, and Measures

1.4.1 Methodology

The field survey was conducted from 28th September to 2nd October 2015 by two Fichtner Health, Safety and Environmental (HSE) Specialists partly together with a Health and Safety Specialist and an Environmental Specialist from ContourGlobal. Mr. Artsrun Mirzatunyan attended the field survey as representative of the government of RA. During this site visit, installations like dam sites, power houses, water outlets etc. were inspected and relevant authorities were consulted. Attention was turned to health, safety and environmental (HSE) relevant aspects.

Outcome of the field survey is a list of measures to solve the most obvious problems related to health, safety and environmental aspects. The implementation of all listed measures is directed to fulfill Armenian legal requirements. This is also true for compliance with IFC Performance Standards, World Bank EHS Guidelines, etc.

Where possible, single cost estimates are given; in other parts estimated lump sums have been calculated. These cost estimates (lump sum prices) also include all measures not being listed in detail. In order to cover other uncertainties, which might come up during the rehabilitation works, a high percentage of miscellaneous/contingencies (30%) was taken.

The catalogue of measures was developed to raise the HSE standards being applied and bring them as close as possible to an internationally acceptable level. This also includes the compliance with Armenian standards.

Because of the tight time frame a real bill of quantities for all needed measures during this field survey was not performed. For the HSE Specialists it was also not possible to assess the general quality of buildings and structures, e.g. the quality of concrete and in which extent the buildings or parts of building are dilapidated in a sense that the proposed measures cannot be implemented because of principal structural (statical) problems. For assessment of the quality of equipment, technical installations and electrical devices see the Consultancy Services for the Rehabilitation of the Vorotan Cascade Hydropower Plants, Fichtner 2012.

The costs were calculated under the precondition that local workforces are used as much as possible. These local workforces shall be trained by international ContourGlobal staff how to perform needed rehabilitation works (e.g. not to patch but replace equipment if needed). In addition, where possible, needed equipment shall be purchased in Armenia or from neighboring countries.

Some of the measures as the purchase of new PPE for the staff are already on the way but the costs are also given within these reports as agreed. The same applies for some of the rehabilitation measures e.g. at HPP Shamb and HPP Tatev main buildings which are already included in the Consultancy Services for the Rehabilitation of the Vorotan Cascade Hydropower Plants, Fichtner 2012.

1.4.2 General observation

The following hazardous substances have been identified during the site visit (according to Appendixes of Council Directive 91/689/EEC on hazardous waste):

Sulfuric acid	Sodium hydroxide (solid)
Asbestos	Oils
Gasoline	Diesel
Silica gel	Antifreeze
Glues	Oxygen
Explosive gases	Paints, thinner

The following hazardous wastes have been identified during the site visit (according to Appendixes of Council Directive 91/689/EEC on hazardous waste):

- Waste oils (transformer, turbine, hydraulic, etc.)
- Absorbents, filter materials (including oil filters), wipe cloths and protective clothing contaminated with hazardous substances
- Packaging containing residues of or contaminated by hazardous substances
- Sludge from oil/water separators
- Waste containing oils and other petroleum products
- Insulation and construction materials containing asbestos

- Lead batteries and other batteries containing hazardous materials/substances
- Discarded inorganic or organic chemical substances and mixtures, consisting of or containing hazardous substances
- Disused electrical and electronic equipment containing hazardous materials/substances (asbestos, mercury, etc.)
- Fluorescent tubes and other mercury-containing waste (e.g. lamp bulbs).

As there are no capacities for recycling, neutralization, and elimination of hazardous wastes in the Republic of Armenia (see Section 5.2) all hazardous wastes shall be stored in secure storage areas at the HPP sites. These storage areas shall be lockable, roofed, ventilated, and shall have a concreted and bunded floor. All hazardous wastes shall be securely packed in sealed drums or other suitable containers and clearly identified by labels. Furthermore, Material Safety Data Sheets (MSDS) have to be prepared.

If asbestos has to be disposed of (e.g. heating devices used at dam sites and HPPs, insulation material, asbestos plates in electrical devices, eternit plates, etc.), it shall be stored in concreted, roofed and secured facilities. If asbestos containing material is found but has not to be touched in the course of the working activities (e.g. 6 kV cable pipe at Spandaryan HPP), it is good practice to leave this material as it is.

1.4.3 Water reservoirs

Main gaps observed at the Water Reservoirs / Dam Sites include:

- Dumping of all kind of waste near to reservoirs or river
- Heating devices containing asbestos tubes
- Old lamp bulbs containing mercury

Recommended actions include:

- Clean area and buildings by collecting disposed waste
- Segregate all hazardous wastes and transport to storage areas at HPPs
- Remove old oil from transformers (e.g. Tolors Reservoir, Tatev Daily Reservoir)

1.4.4 Hydropower plants

Main gaps observed at the Water Reservoirs / Dam Sites include:

- Dumping of all kind of waste near to HPPs or river

Recommended actions include:

- Clean area and buildings by collecting disposed waste
- Segregate hazardous waste and store all hazardous wastes securely packed in sealed drums or other suitable containers at lockable, roofed and ventilated storage areas which have a concreted and bunded floor. One storage area at each HPP.

- Label hazardous substances accordingly and install warning signs.
- Prepare Material Safety Data Sheets (MSDS).

1.4.5 Main office building at Goris

Additional hazardous substances are stored in the garages of the main office of ContourGlobal Hydro Cascade in Goris. Recommended actions include:

- Store hazardous wastes securely packed in sealed drums or other suitable containers at lockable, roofed and ventilated storage areas which have a concreted and bunded floor.
- Label hazardous substances accordingly and install warning signs.
- Prepare Material Safety Data Sheets (MSDS).

1.4.6 Analyses of water and oil samples

Water samples were taken during the site visit at the outlet channels of Spandaryan HPP and Tatev HPP. These samples have been analyzed by a certified laboratory in Germany for contents of oil (hydrocarbon oil index) and PCBs. No oil or any PCBs have been found in the water samples.

Oil samples were taken from transformers and circuit breakers at dam sites and HPPs. These samples have been analyzed for PCB contents by the laboratory mentioned above. Results show that none of the tested oil contains PCB. According to EU Directive 59/96/EC amended with 596/2009/EC, to Basel and Stockholm conventions oil containing less than 50 ppm PCB is not considered to be PCB polluted. This oil can be reused or recycled without any further treatment.

1.4.7 Investigation program

From the results obtained from analyses of water and oil samples, it can reasonably be assumed that soil or groundwater in the project area are not contaminated with PCB. Furthermore, the amount of oil leakages is very small and only very small amounts of oil has entered the soil in some very limited parts (e.g. below some small transformers without any retention system as at the daily regulation reservoir). This means that oil will most probably not be found in groundwater (samples of surface water were free of oil). Even if small amounts of oil were found in the groundwater, the consequence would be the same as it is now without analysis. ‘close’ all leakages at the entire Vorotan cascade as soon as possible and store soil heavily impregnated with oil (only found during the site visit at very limited areas as at the daily regulation reservoir below a small transformer, not containing PCB) at a sealed and roofed place as built up for storing hazardous wastes. Taking into account the actual waste management situation in Armenia an appropriate disposal or incineration of oil contaminated soil is not possible for the time being.

1.5 Institutional Framework and Necessities

In order to implement an HSE Management System (HSEMS) an HSE officer responsible for Health, Safety and Environmental issues at the entire Vorotan Cascade shall be employed. This HSE officer shall be experienced in Hazardous Waste Management and will be responsible for monitoring the functionality and condition of all equipment and installations corresponding to Health, Safety and Environmental issues, training of workers and performing public awareness campaigns in villages located near to the Water Reservoirs. He will be responsible for the permanent on-site monitoring of implementation of the measures outlined in this study and shall work in close cooperation with the external internationally experienced auditor.

Regular trainings of staff shall be conducted by the HSE officer including special requirements at dam sites or in HPPs. Besides environmental and H&S aspects these trainings shall include different aspects of handling hazardous substances as identifying hazardous substances/wastes, safe transport and storage of hazardous wastes, labelling of hazardous wastes, meaning of warning signs, preparing Material Safety Data Sheets (MSDS), etc.

Regarding asbestos containing material it is good practice to leave this material as it is (considering also the aspect that there is no proper disposal of this material possible in Armenia for the time being), if it has not to be touched in the course of the working activities. If asbestos has to be removed, according to WorldBank EHS Guideline this shall only by done by trained staff following host country requirements, or in their absence, internationally recognized procedures and stored properly as long as no proper hazardous waste management is implemented in Armenia.

The HSE officer will be responsible for regular monitoring of functionality and condition of all installations at Vorotan Cascade regarding environmental and H&S aspects. Furthermore, aspects regarding hazardous substances and wastes have to be monitored (e.g. correct segregation of wastes, transport and storage of hazardous wastes, labelling of hazardous wastes, presence of warning signs, condition of storage areas, etc.).

The HSE officer is also responsible for conducting awareness campaigns in villages near to Water Reservoirs (see Health and Safety Assessment).

Implementation of the proposed measures shall be monitored by an internationally experienced external auditor. Audits shall be performed four times per year for a period of two years.

1.6 Summary of Costs

Cost for implementation of proposed measures in **Hazardous Substances Assessment Report**:	**80,000 USD**
+ 30 % contingency:	**104,000 USD**
Costs summed up from Health and Safety Regulatory Compliance Assessment Report, Environmental Liability Assessment Report, and Hazardous Substances Assessment Report	**4,683,640 USD**
Total costs including external monitoring over a period of two years	**4,783,640 USD**

Costs for employment of an HSE officer will be about 25,000 USD per year (including costs for the use of cars and infrastructure of ContourGlobal Hydro Cascade CJSC).

The implementation of all listed measures is directed to fulfill Armenian legal requirements. This is also true for compliance with IFC Performance Standards, World Bank EHS Guidelines, etc.

2. Introduction

In August 2015, ContourGlobal Hydro Cascade CJSC acquired Vorotan Complex of Hydroelectric Power Stations CJSC. ContourGlobal contracted FICHTNER, Stuttgart to prepare an Assessment of the Environmental and Social Compliance of the Vorotan Hydropower Cascade, including a Health and Safety Regulatory Compliance Assessment Report, an Environmental Liability Assessment Report, a Hazardous Substances Assessment Report and a Gap Analysis Report.

3. Legal Framework

This Chapter presents the legal framework for management of hazardous waste in the Republic of Armenia (RA).

Following independence in 1991, the environmental legislation of RA was reviewed, with the aim of developing a more comprehensive state policy towards ecological protection and sustainable use. Until today, a number of national laws of RA have been implemented to regulate the protection of the environment.

Amongst the principles embedded in the Armenian regulatory framework of waste management is protection of human health and environment from adverse effects of waste (RA Law "On Waste", article 6, part 1, point a). This principle is implemented by the mechanisms provided by the legislation.

The main legal acts are as follows:

- RA Law "On Waste" (2004);
- RA Law "On Refuse Collection and Sanitary Cleaning"
- RA Government Decision No 874-N “On Approving the List of Hazardous Wastes of the Republic of Armenia” dated 20 May, 2004
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- Order N 430-N of RA Ministry of Nature Protection “On Defining the List of Waste Classified by Risk Level” dated 25 December, 2006
- Order No 112-N of the Ministry of Nature Protection dated 22 August, 2002
- Order N 20-N of the Minister of Healthcare "On Defining Sanitary Rules and Norms N 2.1.7.001-09 “Hygienic Requirements to the Management of Hazardous Waste and Storage and Transportation of Hazardous Chemical Substances" dated 26 October, 2009.

More details of the main legal acts are given in the expert report in Section 9.1 (Appendix I).

For comparison of the national legislation of the Republic of Armenia with international regulations see the referring Gap Analysis Report.

4. Project Description

In August 2015, ContourGlobal Hydro Cascade CJSC acquired Vorotan Complex of Hydroelectric Power Stations CJSC. Vorotan Complex of Hydroelectric Power Stations (CHPS) is a complex of three hydroelectric power stations with an overall capacity of 404.2 MW and an average annual power generation of 1.16 billion kWh. The Vorotan Cascade is among the main power generation complexes in Armenia, providing both peak and base load generation, and performing grid stabilization services. The complex is located in the eastern part of Syunik region of the Republic of Armenia; some 240 km to the south-east of Yerevan (see Map 1).

Map 1: Location of the Vorotan Complex of HPS in the Republic of Armenia

The Cascade has a total head of 1,223 m. The design of the Vorotan CHPS began in 1954, construction started in 1961. In 1970 the first power station, Tatev HPP, was put into operation, followed by Shamb HPP in 1978 and Spandaryan HPP in 1989.

Vorotan CHPS is located at the Vorotan River. It is comprised of four reservoirs and one Daily Regulation reservoir (see Figure 1). The Spandaryan Reservoir is the upper reservoir of the cascade. Highest water level is at 2,063 m a.s.l.; minimum water level is 2,030 m. The water is directed through an 8.1 km long pressure tunnel and a 2.17 km long penstock to Spandaryan HPP. The discharge from Spandaryan HPP and water from Vorotan River is retained by Angeghakot dam forming the Angeghakot Reservoir. Highest water level is at 1,677.4 m a.s.l.; minimum water level is 1,664.5 m. Water flows from this reservoir via a 10.5 km long gravity fed tunnel to the Tolors Reservoir, which is also fed by the Sisian and Ayri Rivers. Highest water level is at 1,651.5 m a.s.l.; minimum water level is 1,625.5 m. From the Tolors Reservoir, the water is supplied to the Shamb HPP via a 6.9 km long pressure tunnel and a penstock of 1.26 km in length. Below the Shamb HPP is the Shamb Reservoir (also named Tatev Reservoir) which is also fed by water from Laradzor River. Highest water level is at 1,335.4 m a.s.l.; minimum water level is 1,333.8 m. From this reservoir water flows through an 18.4 km long gravity fed tunnel to the Daily Regulation Reservoir of the Tatev HPP, from where the water is directed to Tatev HPP via a 1,900 m long pressure penstock.

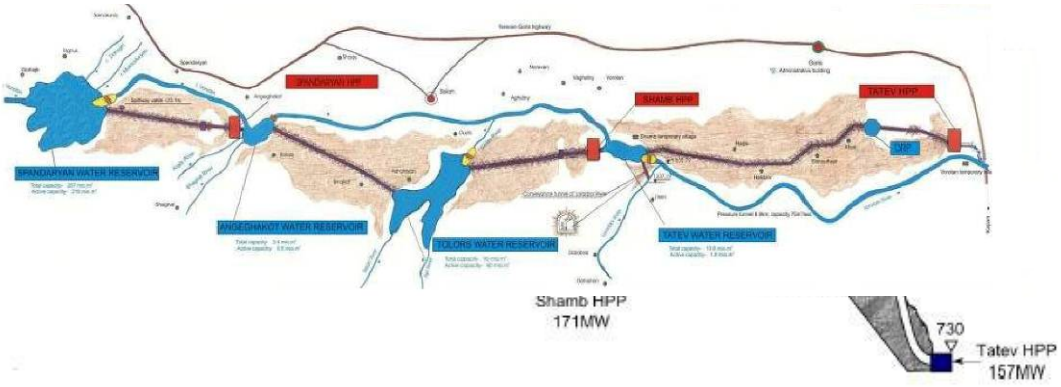


Figure 1: Design of the Vorotan Complex of HPS

The principal characteristics of the three hydroelectric power plants are given in Table 1.

Table 1: Principal characteristics of the HPPs of Vorotan Cascade

Hydroelectric Power Plant (HPP)	Rated Capacity [MW]	Number and Capacity of Units [MW]	Turbine	Water storage [mill. m^3] total / live	Design Head [m]
Spandaryan	76	2 x 38.0	Francis	257 / 218	300
Shamb	171	2 x 85.5	Francis	96 / 80	267
Tatev	157.2	3 x 52.4	Pelton	13.6 / 1.8	552

The power plants of the Vorotan CHPS are connected by 220 kV lines to the main substation Shinuhayr near Goris, except for Tatev which is connected at 110 kV voltage level. Beside this, HPP Shamb and HPP Spandaryan are connected by loop circuits to the 220 kV line between the substations Shinuhayr and Eghegnadzor. From Shinuhayr two 220 kV transmission lines leave to Meghri substation interconnecting to the Iranian grid.

5. Baseline

5.1 Basic Studies

Technical, environmental and social due diligence documents prepared for rehabilitation of Vorotan Cascade Hydropower Plants have been considered:

- Burns and Roe Enterprises (1999): Environmental Assessment of Vorotan Cascade Rehabilitation Project, prepared for Hagler Bailly, submitted to US Agency for International Development. October 1999.
- Norplan (2013): ContourGlobal Vorotan Cascade of Hydropower Plants - Technical, Environmental and Hydrological Due Diligence. March 2013.
- IFC (2015): Vorotan Hydros - Environmental & Social Review Summary (published online)

The Norplan (2013) due diligence report concludes that the environmental management of the Vorotan HPP is not in compliance with ContourGlobal's environmental and social policies and standards. Thus, an Environmental and Social Management System for the Vorotan HPPs shall be developed including an emergency preparedness and response plan. Pollution prevention and control system shall be improved as part of the rehabilitation. Land contamination and hazardous material shall be assessed.

5.2 Waste Management in Armenia

About 60 landfills (dump sites) can be found in the country. The waste management sector in Armenia is regulated by the Law "On Waste" and by 30 legal acts driving from it, but there are no capacities for recycling, neutralization, and elimination of hazardous waste. Solid waste management is poorly organized in Armenia. Most of the solid waste is dumped in provisional dump sites and landfills without any segregation or recycling. Solid waste including hazardous waste is generally not disposed of in accordance with internationally accepted practices. Waste is either burned or just dumped.

In order to change this situation, Armenia is a party of the Basel Convention "On the Control of Transboundary Movements of Hazardous Wastes and their Disposal" since 1999 and the Government of the Republic of Armenia ratified in 2003 the Stockholm Convention "On Persistent Organic

Pollutants". A National Implementation Plan was developed based on the Article 7 of the Stockholm Convention published in 2005. In 2004 the Law "On Waste" was put into force which defines the state policy in the area of waste use, aimed at preventing the harmful impact of waste on the environment and human health, while maximizing its use as a secondary raw material.

However, up to now a suitable recycling system for any waste is not available in Armenia at all. Valuable waste as used oil is sometimes sold to private persons, steel and iron is exported to e.g. Iran for recycling purposes.

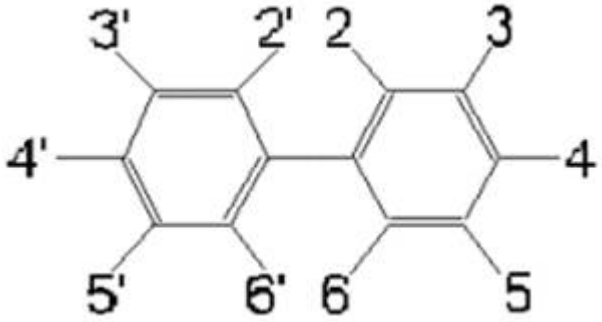
The battery producing company (Battery ELBAT) has planned to build up recycling facilities. The new factory should be able to recycle the sulfuric acid of old batteries for reuse or to neutralize it and melt the lead for reuse in new batteries. However, consultations held with the company in September 2014 revealed, that the planned factory will not be built in near future.

Consequently, the current situation concerning waste management at Vorotan Cascade installations in general is bad. All wastes ever generated have been stored at site since decades. Thus, old equipment as old circuit breakers, ceramic parts and steel, but also old batteries and oil not suitable for further use are stored somewhere at the site. In addition, a functioning drainage system is missing at all Vorotan sites.

5.3 PCB in Oil of Substation Equipment

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.

These substances consist of two phenyl-rings that can contain different amounts of chlorine molecules in the positions given below:



In general, the acute toxicity of PCB is small, but looking at the chronic effects a high toxic potential of PCBs has to be stated. Especially when burned, PCBs can be turned into highly toxic and carcinogenic furans (PCDF) and dioxins (PCDD). Therefore, special care has to be lead on this issue.

According to the United States Environmental Protection Agency (US-EPA), a transformer is 'a transformer that contains PCB' if the concentration of PCBs is higher than 500 ppm. Oil containing between 50 ppm and 499 ppm PCBs is considered to be polluted with PCB and specific methods for disposal are necessary (e.g. specific incineration plants). According to EU Directive 59/96/EC amended with 596/2009/EC, to Basel and to Stockholm conventions oil containing less than 50 ppm PCB is not considered to be PCB polluted.

The recent report[1] about occurrence of PCB containing oil in Armenia came to following conclusion: According to an inventory in the Republic of Armenia, the total number of transformers is 9,867. The number of oil switches involved in the inventory is 2,574. Total number of collected samples of oil is 2,416; 1,820 samples were analyzed; the rest of analysis is ongoing. From these 1,820 samples, 390 were positive with findings of PCBs. However, a correlation of these findings with equipment to be replaced within this Project was not possible. This is one reason why a special attention was given to this aspect during preparation of the EMP to this rehabilitation Project.

According to personal communication with the Ministry of Nature Protection (Dr Anahit Aleksandryan, January 2014), oil samples from 105 HVEN transformers and from 391 HVEN circuit breakers were analyzed within this study. All oil samples having been analyzed showed only very small concentrations of PCB (all below 50 ppm). Hence, the conclusion of this study (still unpublished) is that the studied HVEN equipment is free of PCB. Nevertheless, the equipment of the Vorotan Cascade will need to undergo a careful oil test for PCBs.

[1] Terminal Evaluation - Technical Assistance for ESM of PCBs and other POPs Waste in Armenia Project GF/ARM/08/002, August 2012

6. Field Investigation, observed Gaps, and Measures

6.1 Methodology

The field survey was conducted from 28th September to 2nd October 2015 by two Fichtner Health, Safety and Environmental (HSE) Specialists partly together with a Health and Safety Specialist and an Environmental Specialist from ContourGlobal. Mr. Artsrun Mirzatunyan attended the field survey as representative of the government of RA. During this site visit, installations like dam sites, power houses, water outlets etc. were inspected and relevant authorities were consulted (see Record of Meetings – Appendix II). Attention was turned to health, safety and environmental relevant aspects. Hazardous substances and wastes were recorded at all sites and interviews with staff regarding waste treatment were conducted. Also, a catalogue of measures was developed to raise the HSE standards being applied and bring them as close as possible to an internationally acceptable level. This also includes the compliance with national, Armenian, standards.

Because of the tight time frame a real bill of quantities for all needed measures during this field survey was not performed. For the HSE Specialists it was also not possible to assess the general quality of buildings and structures, e.g. the quality of concrete and in which extent the buildings or parts of building are dilapidated in a sense that the proposed measures cannot be implemented because of principal structural (statical) problems. For assessment of the quality of equipment, technical installations and electrical devices see the Consultancy Services for the Rehabilitation of the Vorotan Cascade Hydropower Plants, Fichtner 2012.

Outcome of the field survey is a list of measures to solve the most obvious problems related to health, safety and environmental aspects. The implementation of all listed measures is directed to fulfill Armenian legal requirements. This is also true for compliance with IFC Performance Standards, World Bank EHS Guidelines, etc.

Where possible, single cost estimates are given; in other parts estimated lump sums have been calculated. These lump sums are based on the vast experience that Fichtner's Engineering Specialists have gained during decades in many developing countries. Further they rely on findings and observations that Fichtner's Engineering Specialists obtained during a project in 2003 "Substitution to the Nuclear Power through the Development of the Hydropower Capacity of Armenia" (EUROPEAID/112946/C/SV/AM) and during Consultancy Services for the Rehabilitation of the Vorotan Cascade Hydropower Plants in 2012. These cost estimates (lump sum prices) also include all measures not being listed in detail. In order to cover other uncertainties, which might come up during the rehabilitation works, a high percentage of miscellaneous/contingencies (30%) was taken.

The costs were calculated under the precondition that local workforces are used as much as possible. These local workforces shall be trained by international ContourGlobal staff how to perform needed rehabilitation works (e.g. not to patch but replace equipment if needed). In addition, where possible, needed equipment shall be purchased in Armenia or from neighboring countries.

Some of the measures as the purchase of new PPE for the staff are already on the way but the costs are also given within these reports as agreed. The same applies for some of the rehabilitation measures e.g. at HPP Shamb and HPP Tatev main buildings which are already included in the Consultancy Services for the Rehabilitation of the Vorotan Cascade Hydropower Plants, Fichtner 2012.

Overview maps and detailed maps of Water Reservoirs and HPPs of the Vorotan Cascade, based on high resolution (0.5 m) satellite pictures, are given in Appendix III of the Health and Safety Assessment.

6.2 General Observation

The following hazardous substances have been identified during the site visit (according to Appendixes of Council Directive 91/689/EEC on hazardous waste):

Sulfuric acid	Sodium hydroxide (solid)
Asbestos	Oils
Gasoline	Diesel
Silica gel	Antifreeze
Glues	Oxygen
Explosive gases	Paints, thinner

The following hazardous wastes have been identified during the site visit (according to Appendixes of Council Directive 91/689/EEC on hazardous waste):

- Waste oils (transformer, turbine, hydraulic, etc.)
- Absorbents, filter materials (including oil filters), wipe cloths and protective clothing contaminated with hazardous substances
- Packaging containing residues of or contaminated by hazardous substances
- Sludge from oil/water separators
- Waste containing oils and other petroleum products
- Insulation and construction materials containing asbestos
- Lead batteries and other batteries containing hazardous materials/substances
- Discarded inorganic or organic chemical substances and mixtures, consisting of or containing hazardous substances
- Disused electrical and electronic equipment containing hazardous materials/substances (asbestos, mercury, etc.)

- Fluorescent tubes and other mercury-containing waste (e.g. lamp bulbs).

As there are no capacities for recycling, neutralization, and elimination of hazardous wastes in the Republic of Armenia (see Section 5.2) all hazardous wastes shall be stored in secure storage areas at the HPP sites. These storage areas shall be lockable, roofed, ventilated, and shall have a concreted and bunded floor. All hazardous wastes shall be securely packed in sealed drums or other suitable containers and clearly identified by labels. Furthermore, Material Safety Data Sheets (MSDS) have to be prepared.

If asbestos has to be disposed of (e.g. heating devices used at dam sites and HPPs, insulation material, asbestos plates in electrical devices, eternit plates, etc.), it shall be stored in concreted, roofed and secured facilities. If asbestos containing material is found but has not to be touched in the course of the working activities (e.g. 6 kV cable pipe at Spandaryan HPP), it is good practice to leave this material as it is.

6.3 Water Reservoirs

Gaps observed at Water Reservoirs are given in Table 2.

Table 2: Gaps observed at Water Reservoirs, proposed measures and prices

Observed Gaps	Proposed Measure	Estimated price
All kind of waste dumped near to river or reservoir	Clean area and buildings by collecting disposed waste.	Done by trained staff
	Segregate hazardous waste and transport to storage areas at HPPs.	Done by trained staff
	Label hazardous substances accordingly.	Done by trained staff
Heating devices containing asbestos tubes (Photo 1)	Transport to nearest HPP and store there securely.	Done by trained staff
Eternit roof of pit latrine at Spandaryan Reservoir probably containing asbestos (Photo 2)	Transport to Spandaryan HPP and store there securely.	Done by trained staff
Old lamp bulbs containing mercury (Photo 3)	Transport to nearest HPP and store there securely.	Done by trained staff
Old oil from transformers to be removed (e.g. Tolors Reservoir, Tatev Daily Reservoir) (Photo 4)	Transport old oil and oil spilled soil (from Daily Regulation Reservoir) to nearest HPP for secure storage.	Done by trained staff

Photo 1: Old heating device with asbestos tube

Photo 2: Eternit roof of pit latrine probably containing asbestos

Photo 3: Lamb bulb containing mercury

Photo 4: Old leaking transformer without drainage system at Daily Regulation Reservoir

6.4 Hydropower Plants

Gaps observed at Hydropower Plants are given in Table 3.

Table 3: Gaps observed at HPPs, proposed measures and prices

Observed Gaps	Proposed Measure	Estimated price
All kind of waste dumped near to river or HPP (Photo 5)	Clean area and buildings by collecting disposed waste. Segregate hazardous waste.	Done by trained staff
	Store hazardous wastes securely packed in sealed drums or other suitable containers at lockable, roofed and ventilated storage areas which have a concreted and bunded floor. One storage area at each HPP.	60,000 USD (20,000 USD for each storage area at HPPs)
	Label hazardous substances accordingly and install warning signs.	
	Prepare Material Safety Data Sheets (MSDS).	
	Provide adequate spill absorbent material.	
Asbestos plates have been found in electrical equipment at Shamb and Tatev HPPs (Photo 6)	Store asbestos in facilities as described above.	

Observed Gaps	Proposed Measure	Estimated price
Cable ducts at Shamb and Tatev HPP probably contain asbestos		(see above)
Old lamp bulbs containing mercury	Store waste containing mercury in facilities as described above.	
Old batteries to be removed e.g. from Spandaryan HPP (Photo 7)	Store old batteries in facilities as described above.	
Old sulfuric acid at Spandaryan and Tatev HPPs (Photo 8)	Store old sulfuric acid in facilities as described above.	

Photo 5: Dumped waste including hazardous waste

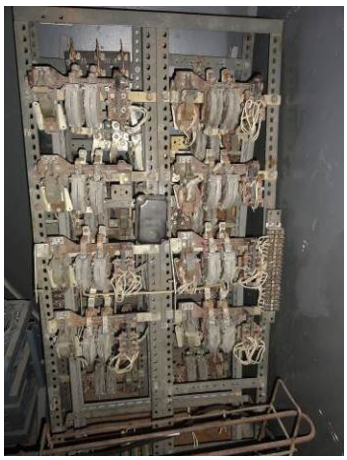


Photo 6: Asbestos plates inside electrical devices

Photo 7: Old batteries to be removed

Photo 8: Old sulfuric acid (approx. 20 l) not properly stored at Tatev HPP

6.5 Main Office Building at Goris

Additional hazardous substances are stored in the garages / warehouses of the main office of ContourGlobal Hydro Cascade in Goris. Gaps observed there are given in Table 4.

Table 4: Gaps observed at main office of ContourGlobal in Goris, proposed measures and prices

Observed Gaps	Proposed Measure	Estimated price
Different kind of material and wastes (including asbestos, sulfuric acid, sodium hydroxide, silica gel, antifreeze, gasoline, oils) are stored in inadequate conditions (Photo 9 to Photo 12)	Segregate all wastes. Dispose of household wastes.	Done by trained staff
	Store hazardous wastes securely packed in sealed drums or other suitable containers at lockable, roofed and ventilated storage areas which have a concreted and bunded floor.	20,000 USD
	Label hazardous substances accordingly and install warning signs.	
	Prepare Material Safety Data Sheets (MSDS).	
Evidence for oil spills from the transformer	Provide adequate spill absorbent material.	

Photo 9: Different substances stored without labelling in rooms without any ventilation

Photo 10: Incorrect storage of asbestos sheets

Photo 11: Incorrect storage of old batteries and sulfuric acid

Photo 12: Incorrect storage of antifreeze

6.6 Analyses of Water and Oil Samples

6.6.1 Water sample analyses

Water samples were taken during the site visit at the outlet channels of Spandaryan HPP and Tatev HPP (Photo 13 and Photo 14). These samples have been analyzed by a certified laboratory in Germany (see Section 9.3 - Appendix III) for contents of oil (hydrocarbon oil index) and PCBs. No oil

or any PCBs have been found in the water samples (for results see Section 9.4 - Appendix IV).

Photo 13: Water sampling at Spandaryan HPP

Photo 14: Water sampling at Tatev HPP

6.6.2 Oil sample analyses

Oil samples were taken from transformers and circuit breakers at dam sites and HPPs (Photo 15 and Photo 16). Theses samples have been analyzed for PCB contents by the laboratory mentioned above. Results from these analyses are summed up in Table 5. For detailed results see Section 9.5 (Appendix V).

Photo 15: Taking oil sample from a transformer at Shamb HPP

Photo 16: Taking oil sample from a circuit breaker at Spandaryan HPP

Table 5: Oil samples taken for PCB analyses and analyses results

No.	Location	Equipment	Date of sampling	PCB [ppm]
1	Spandaryan HPP	Transformer 2 near entrance	28 Sep 2015	n.d.*
2	Spandaryan HPP	Transformer 1	28 Sep 2015	n.d.*
3	Spandaryan HPP	Circuit breaker	28 Sep 2015	n.d.*
4	Tolors Reservoir	Old transformer not used any longer	29 Sep 2015	31.2
5	Shamb HPP	Transformer	29 Sep 2015	n.d.*
6	Shamb HPP	Circuit breaker	29 Sep 2015	n.d.*
7	Shamb HPP	Old stored oil	29 Sep 2015	7.15
8	Daily Regulation Reservoir	Transformer	01 Oct 2015	n.d.*
9	Tatev HPP	Old test transformer	30 Sep 2015	n.d.*
10	Tatev HPP	Transformer	30 Sep 2015	n.d.*

*n.d. = not detectable, means all concentrations of all analyzed PCBs were below the detection limit of 0.2 ppm

From the results in Table 5 it can be seen that none of the tested oil contains PCB. According to EU Directive 59/96/EC amended with 596/2009/EC, to Basel and Stockholm conventions oil containing less than 50 ppm PCB is not considered to be PCB polluted. This oil can be reused or recycled without any further treatment.

6.6.3 Investigation program

As the results of analyses revealed (see Sections 9.4 and 9.5 in Appendix), a PCB problem along the Vorotan Cascade could not be detected. Samples from all HPPs sites were taken (transformer, circuit breakers, old stored oil). These samples have shown in none of the cases PCB concentrations above 50 ppm (in 8 of 10 samples even the technical detection limit for PCB was not reached). Only in two samples traces of PCB could be found: in old oil at Shamb Reservoir and in an old transformer at Tolors Reservoir. The concentrations were 7 ppm and 31 ppm, respectively, resulting from impurities. This does not mean that PCB was used there.

In the water samples taken in HPP Spandaryan and HPP Tatev outlets no oil residues were detected at all and consequently also no PCB.

These findings correspond to FICHTNER's experience gained in many other projects where oil samples were analyzed for PCB in Armenia, but also in other countries of the former USSR. During these investigations,

PCB concentrations higher than 50 ppm have never been found, neither in transformers nor in circuit breakers of medium or high voltage levels.

In most countries, the concentration of 50 ppm PCB in oil is considered to be the threshold of PCB content in oil. Only above this value, specific measures for handling would be triggered. This limit concentration of 50 ppm follows main international recommendations as the Stockholm Convention "On Persistent Organic Pollutants (POPs)", amended in 2009, the Basel Convention "On the Control of Transboundary Movements of Hazardous Wastes and their Disposal" 1992, relevant EU Directives (e.g. 96/59/EC amended by 596/2009/EC) and guidelines of the U.S. Environmental Protection Agency (U.S. EPA).

In Armenia, the PCB issue is regulated by the RA Government Decision N 546-N of 14 May, 2015, "On Approving the Technical Regulation for Lubrication Substances, Oil and Special Liquids". According to clause 3) of point 12 of this Technical Regulation, the lubrication substances, oil and special liquids put in circulation (import and supply in the territory of the Republic of Armenia) must have quality passports that must comprise, among other things, the normative values of safety indicators of the product consistent with the Table 1 of the same Technical Regulation. The requirement for PCB as concentrations in this Table 1 is not more than 50 mg/kg.

The Republic of Armenia ratified the Stockholm Convention 2003 on 29 October 2004. The RA Government adopted Decree No 1483-N "On Fulfillment of the obligations of the Republic of Armenia proceeding from UN Stockholm Convention Signed on 23 May, 2001". The Decree is assigned to the Ministry of Nature Protection to develop measures for fulfillment of Armenia's obligations under the Stockholm Convention and submit to the government.

From the results obtained, it can reasonably be assumed that soil or groundwater in the project area are not contaminated with PCB. Furthermore, the amount of oil leakages is very small and only very small amounts of oil has entered the soil in some very limited parts (e.g. below some small transformers without any retention system as at the Daily Regulation Reservoir). This means that oil will most probably not be found in groundwater (samples of surface water were free of oil). Even if small amounts of oil were found in the groundwater, the consequence would be the same as it is now without analysis. 'Close' all leakages at the entire Vorotan Cascade as soon as possible and store soil heavily impregnated with oil (only found during the site visit at very limited areas as at the Daily Regulation Reservoir below a small transformer, not containing PCB) at a sealed and roofed place as built up for storing hazardous wastes (see Section 6.2). Taking into account the actual waste management situation in Armenia (see Section 5.2) an appropriate disposal or incineration of oil contaminated soil is not possible for the time being.

7. Institutional Framework and Necessities

In order to implement an HSE Management System (HSEMS) an HSE officer responsible for Health, Safety and Environmental issues at the entire Vorotan Cascade shall be employed. This HSE officer shall be experienced in Hazardous Waste Management and will be responsible for monitoring the functionality and condition of all equipment and installations corresponding to Health, Safety and Environmental issues, training of workers and perform public awareness campaigns in villages located near to the Water Reservoirs. He is responsible for the permanent on-site monitoring of implementation of the measures outlined in this study and shall work in close cooperation with the external internationally experienced auditor.

Regular trainings of staff shall be conducted by the HSE officer including special requirements at dam sites or in HPPs. Besides environmental and H&S aspects these trainings shall include different aspects of handling hazardous substances as identifying hazardous substances/wastes, safe transport and storage of hazardous wastes, labelling of hazardous wastes, meaning of warning signs, preparing Material Safety Data Sheets (MSDS), etc.

Regarding asbestos containing material it is good practice to leave this material as it is (considering also the aspect that there is no proper disposal of this material possible in Armenia for the time being), if it has not to be touched in the course of the working activities. If asbestos has to be removed, according to WorldBank EHS Guideline this shall only by done by trained staff[2] following host country requirements, or in their absence, internationally recognized procedures[3] and stored properly as long as no proper hazardous waste management is implemented in Armenia.

The HSE officer will be responsible for regular monitoring of functionality and condition of all installations at Vorotan Cascade regarding environmental and H&S aspects. Furthermore, aspects regarding hazardous substances and wastes have to be monitored (e.g. correct segregation of wastes, transport and storage of hazardous wastes, labelling of hazardous wastes, presence of warning signs, condition of storage areas, etc.).

The HSE officer is also responsible for conducting awareness campaigns in villages near to Water Reservoirs (see Health and Safety Assessment).

Implementation of the measures proposed in Chapter 6 shall be monitored by an internationally experienced external auditor. Audits shall be performed four times per year for a period of two years.

[2] Training of specialized personnel and the maintenance and removal methods applied should be equivalent to those required under applicable regulations in the United States and Europe (examples of North American training standards are available at: http://www.osha.gov/SLTC/asbestos/training.html)

[3] e.g. E2394 - Standard Practice for Maintenance, Renovation and Repair of Installed Asbestos Cement Products.

8. Summary of Costs

Cost for implementation of proposed measures in **Hazardous Substances Assessment Report**:	**80,000 USD**
+ 30 % contingency:	**104,000 USD**
Costs summed up from Health and Safety Regulatory Compliance Assessment Report, Environmental Liability Assessment Report, and Hazardous Substances Assessment Report	**4,683,640 USD**
Total costs including external monitoring over a period of two years	**4,783,640 USD**

Costs for employment of an HSE officer will be about 25,000 USD per year (including costs for the use of cars and infrastructure of ContourGlobal Hydro Cascade CJSC).

The implementation of all listed measures in Chapter 6 is directed to fulfill Armenian legal requirements. This is also true for compliance with IFC Performance Standards, World Bank EHS Guidelines, etc.

9. Appendix

9.1 Appendix I: Expert Report Regarding Armenian Legislation

As defined by RA Law "On Waste" one of the obligations of legal and physical entities and private entrepreneurs in the area of waste management is to place waste only in the areas specially provided for that by the law (article 20, point b). In addition, RA Law "On Refuse Collection and Sanitary Cleaning" states that refuse collection fee payers amongst other things are also obliged to store and place refuse in places assigned or provided for it (article 20, part 2, point 3).

There are two main types of waste according to the legislation of the Republic of Armenia. The waste can be **hazardous waste** and **Industrial and consumption waste**, which is actually non-hazardous waste (RA Law "On Waste", article 4, points 1 and 4):

- The former is provided by RA Government Decision No 874-N “On Approving the List of Hazardous Wastes of the Republic of Armenia” dated 20 May, 2004;
- The latter is provided by the Order No 342-N of RA Minister of Nature Protection "On Approving the List of Industrial (Including Mining) and Consumption Waste Generated in the Territory of the Republic of Armenia" dated 26 October, 2006.

9.1.1 Industrial and consumption waste

According to the Ministerial Order No 342-N of RA Ministry of Nature Protection industrial and consumption waste is classified into four main categories:

- Organic Waste of Natural Origin,
- Waste of Mineral Origin,
- Waste of Chemical Origin and
- Utility Waste.

In accordance with the article 3 of RA Law "On Refuse Collection and Sanitary Cleaning" industrial and consumption waste are covered by the term "refuse" (non-household refuse). The obligation of legal and physical entities and private entrepreneurs to place waste only in the specially provided areas with respect to industrial and consumption waste is fulfilled through the mechanisms provided by the RA Law "On Refuse Collection and Sanitary Cleaning". Refuse collection is an activity, which means collection, storage, transportation and disposal of refuse generated within settlements in a landfill (RA Law "On Refuse Collection and Sanitary Cleaning", article 3, part 1, point 1) and that is carried out in expense of community budget by either immediately community institutions or an operator chosen for community needs in accordance with procedure established by the legislation on procurement (RA Law "On Refuse

Collection and Sanitary Cleaning", article 8, part 1). Household refuse is collected and stored in places of common use of community specially provided or assigned for that purpose, and in receptacles provided by community or operator i.e. in refuse bins or containers, refuse chambers, with maintenance of defined requirements of sanitary-hygienic rules and norms (RA Law "On Refuse Collection and Sanitary Cleaning", article 10, part 1). The procedure for refuse collection, including the minimum timetable for refuse collection, the places for arrangement of refuse bins or containers, the types and quantity thereof are approved by the community council, further to the submission by the chief of community with maintenance of the requirements of sanitary-hygienic rules and norms defined by the legislation of the Republic of Armenia. Meanwhile, refuse is transported before the container is entirely full (RA Law "On Refuse Collection and Sanitary Cleaning", article 10, part 4). Thus, the obligation of the refuse producers to place waste only in the specially provided areas is fulfilled by placing refuse in places provided by article 10, part 1 of RA Law "On Refuse Collection and Sanitary Cleaning". A waste producer may require the community, operator or organization to reimburse refuse collection expenses incurred in expense of own means as result of improper performance of obligations by refuse collection organizer (RA Law "On Refuse Collection and Sanitary Cleaning", article 20, part 1, point 4).

9.1.2 Hazardous waste

The Article 4 of RA Law on waste defines hazardous waste as waste having physical, chemical and biological characteristics that are or might be dangerous to human health and environment and require special treatment methods, modes and means. RA Government provide lists of hazardous and restricted waste (Article 7 of the Law on Waste) The Ministry of Nature protection develops lists of hazardous and restricted waste, provides the list of waste classified by risk level (Article 8 of the Law on Waste). In fulfillment of obligations defined by the Law on Waste, RA Government on adopted Decision No 874-N “On Defining the List of Hazardous Waste of the Republic of Armenia” and RA Ministry of Nature Protection on 25 December, 2006 issued Ministerial Order N 430-N “On Defining the List of Waste Classified by Risk Level”. The order classifies hazardous waste in four categories and provides documentation format for waste declaration, notification and removal.

Article 9 of RA Law "on Waste" provides the authorities of the Ministry of Healthcare. According to the mentioned article the Ministry has authority to develop public health safety requirements to be incorporated into the normative- technical documents on waste management; elaborate sanitary and epidemic rules, norms and hygienic standards aimed at prevention of dangerous and adverse effects of waste on human health in the process of waste production, collection, transportation, storage, processing, recycling, removal, disinfection and landfill; oversee implementation of these requirements;

Based on the mentioned provision among provisions of other legal acts, on 29 October, 2009 the Order N 20-N of the Minister of Healthcare "On Defining Sanitary Rules and Norms N 2.1.7.001-09 “Hygienic Requirements to the Management of Hazardous Waste and Storage and Transportation of Hazardous Chemical Substances"" was issued. The mentioned sanitary rules and norms define the sanitary-hygienic requirements to the management (prevention of waste generation, collection, transportation, storage, processing, reprocessing, recycling, removal, disinfection and landfilling) of hazardous chemical waste and to the storage and transportation of hazardous chemical substances. The management of hazardous chemical waste storage and transportation of hazardous chemical substances is differentiated by I to IV categories of risk level stipulated by the Ministerial Order N 430-N “On Defining the List of Waste Classified by Risk Level”

The scope of regulation of the order includes:

- Sanitary requirements to the temporary storage and transportation of hazardous chemical waste,
- Sanitary-hygienic requirements to the structure and maintenance of facilities concerned with destruction, disinfection and landfilling of hazardous chemical waste,
- Sanitary-hygienic requirements to the placement and structure of hazardous chemical waste stores,
- Requirements to the storage and supply of hazardous chemical substances,
- Requirements to the work safety of the workers of the sphere of hazardous waste and hazardous chemical substances management,

Passportization is required for legal entities and private entrepreneurs that produce hazardous waste. This requirement is based on RA Government Decision No 47-N “On Defining Procedure for Waste Passportization” dated 19 January, 2006. Waste passports are prepared by the heads of organizations and private entrepreneurs and coordinated with the Ministry of Nature Protection that defines the form of sample passport (Ministerial Order No 19-N “On Defining the Form of Sample Passport of Waste” dated 2 February, 2007). Passports are made for all types of hazardous waste that an entity produces. The waste passports are to be approved for all types of hazardous waste. Wastes passports must cover the information as defined by the Decision and are issued in two copies – one for the entity generating waste and the other for the authorized body for filing. The holders of waste passports will have to review the passports in case the waste generator has additional or new information on the given waste.

The legal framework stipulating obligations for legal entities and private entrepreneurs to submit reports consists of RA Government Decrees N 47-N “On Defining Procedure for Waste Passportization ” dated 19 January and Order No 112-N of the Ministry of Nature Protection dated 22 August, 2002. The later approved the forms for administrative statistical data reporting.

9.1.3 Administrative and/or criminal liability

Relevant articles:

- The RA Code of Administrative Violations
  - Article 431: Failure to Organize Timely Refuse Collection, Placing Refuse in Unauthorized Places, Failure to Provide Necessary Conditions for Refuse Collection.
  - Article 2011: Violation of Rules of Transportation and Removal of Hazardous and Other Type of Waste.
  - Article 2012: Illegal Circulation of Hazardous and Other Type of Waste.
  - Article 201.3: Failure to Coordinate Waste Passports.

- The RA Criminal Code
  - Article 284: Violation of the Safety Rules of Handling Hazardous Chemical and Biological Substances and Waste.

9.2 Appendix II: Records of Meetings and Site Visits

Date	Agency/ Institution/ Company	Place	Name of Person consulted Position	Reason for Visit
28 Sep 2015	ContourGlobal Hydro Cascade CJSC	Spandaryan Reservoir Spandaryan HPP Angeghakot Reservoir	Aram Arushanyan Engineer of ContourGlobal Electric Department, Sergey Pogosyan Chief of Spandaryan HPP	Inspection of facilities
29 Sep 2015	ContourGlobal Hydro Cascade CJSC	Tolors Reservoir Shamb HPP Shamb/Tatev Reservoir	Smbat Mkrtchyan Chief of Investment Programs Department, Anush Gharagyozyan Chief of Health and Safety Department, Syoma Avanesyan Chief of Shamb HPP	Inspection of facilities
29 Sep 2015	Sisian Municipality	Sisian	Karen Hovhannisyan Deputy Mayor	Possible concerns about Vorotan Cascade
29 Sep 2015	Uyts Community	Uyts	Avetyan Artak Community Head	Possible concerns about Vorotan Cascade
30 Sep 2015	ContourGlobal Hydro Cascade CJSC	Daily Regulation Reservoir Tatev HPP	Smbat Mkrtchyan Chief of Investment Programs Department, Mamikon Gharagyozyan Hydroworkshop Superintendent, Aram Yolyan Chief of Tatev HPP	Inspection of facilities
30 Sep 2015	Goris Municipality	Goris	Vachagan Adunts Mayor	Possible concerns about Vorotan Cascade
30 Sep 2015	Landfill	Goris		Waste dumping situation
30 Sep 2015	Vorotan Water Users Company	Shinuhayr	Sevada Adamyan	Vorotan River water use for irrigation purposes between HPP Shamb and HPP Tatev

Date	Agency/ Institution/ Company	Place	Name of Person consulted Position	Reason for Visit
01 Oct 2015	ContourGlobal Hydro Cascade CJSC	Spandaryan Reservoir Spandaryan HPP Angeghakot Reservoir	Smbat Mkrtchyan Chief of Investment Programs Department, Sergey Pogosyan Chief of Spandaryan HPP	Inspection of facilities
01 Oct 2015	'Sisian' Water Users Association (WUA)	Sisian	Azazat Tangyan Head of WUA, Tsangtzyan Hamlet Chief Engineer	Vorotan River water use for irrigation purposes between HPP Spandaryan and HPP Shamb
01 Oct 2015	Municipality of Shaghat	Shaghat	Noza Stepanya, Hoyk Ohanyan	Vorotan River water use for irrigation purposes upstream HPP Spandaryan; visit of the water extraction site upstream Spandaryan HPP
02 Oct 2015	Aarhus Centers of Armenia	Yerevan	Silva Ayvazyan Coordinator of Yerevan Aarhus Center, Mary Chakryan PR Manager of Yerevan Aarhus Center	Concerns received from local population and other NGOs about Vorotan Cascade
12 Oct 2015	Regional Environmental Inspectorate, Kapan	Telephone call	Levon Petrosyan Head of the Environmental Inspection, Syunik Region	Possible concerns about Vorotan Cascade

9.3 Appendix III: Certificate of the Analytical Laboratory

DAkkS
Deutsche
Akkreditierungsstelle

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 Hinweise auf der Rückseite

9.4 Appendix IV: Results of Water Analyses

BERATUNG | ANALYTIK | PLANUNG

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Prüfbericht

Wasserprobe

Prüfbericht Nr. **CWA15-028425-1** Auftrag Nr. **CWA-11468-15** Datum **07.10.2015**

Probe Nr.	**15-145567-01**
Eingangsdatum	05.10.2015
Bezeichnung	Wasserprobe Spandaryar
Probenart	Wasser, allgemein
Probenahme durch	Auftraggeber
Probenmenge	ca. 1 Liter
Probengefäß	1 Liter BG
Anzahl Gefäße	1
Untersuchungsbeginn	05.10.2015
Untersuchungsende	07.10.2015

Summenparameter

Probe Nr.			15-145567-01
Bezeichnung			Wasserprobe Spandaryar
Kohlenwasserstoff-Index	mg/l	W/E	**<0,2**

Polychlorierte Biphenyle (PCB)

Probe Nr.			15-145567-01
Bezeichnung			Wasserprobe Spandaryar
PCB Nr. 28	µg/l	W/E	**<0,02**
PCB Nr. 52	µg/l	W/E	**<0,02**
PCB Nr. 101	µg/l	W/E	**<0,02**
PCB Nr. 138	µg/l	W/E	**<0,02**
PCB Nr. 153	µg/l	W/E	**<0,02**
PCB Nr. 180	µg/l	W/E	**<0,02**
Summe der 6 PCB	µg/l	W/E	**-/-**
PCB gesamt (Summe 6 PCB x 5)	µg/l	W/E	**-/-**

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Prüfbericht Nr.	**CWA15-028425-1**	Auftrag Nr.	**CWA-11468-15**	Datum	**07.10.2015**

Probe Nr.	**15-145567-02**
Eingangsdatum	05.10.2015
Bezeichnung	Wasserprobe Tatev
Probenart	Wasser, allgemein
Probenahme durch	Auftraggeber
Probenmenge	ca. 1 Liter
Probengefäß	1 Liter BG
Anzahl Gefäße	1
Untersuchungsbeginn	05.10.2015
Untersuchungsende	07.10.2015

Summenparameter

Probe Nr.			15-145567-02
Bezeichnung			Wasserprobe Tatev
Kohlenwasserstoff-Index	mg/l	W/E	**<0,2**

Polychlorierte Biphenyle (PCB)

Probe Nr.			15-145567-02
Bezeichnung			Wasserprobe Tatev
PCB Nr. 28	µg/l	W/E	**<0,02**
PCB Nr. 52	µg/l	W/E	**<0,02**
PCB Nr. 101	µg/l	W/E	**<0,02**
PCB Nr. 138	µg/l	W/E	**<0,02**
PCB Nr. 153	µg/l	W/E	**<0,02**
PCB Nr. 180	µg/l	W/E	**<0,02**
Summe der 6 PCB	µg/l	W/E	**-/-**
PCB gesamt (Summe 6 PCB x 5)	µg/l	W/E	**-/-**

Abkürzungen und Methoden

Kohlenwasserstoff-Index in Wasser/Eluat (GC)	EN ISO 9377-2[A]	Umweltanalytik Walldorf
Polychlorierte Biphenyle (PCB)	DIN 38407 F3[A]	Umweltanalytik Walldorf
W/E	Wasser/Eluat	

ausführender Standort

Umweltanalytik Walldorf
Umweltanalytik Walldorf

9.5 Appendix V: Results of Analyses of Oil Samples

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GefaÖ GmbH - Gesellschaft für angewandte
Ökologie und Umweltplanung
Herr Dr. Roland Marthaler
Impexstraße 5
69190 Walldorf

Geschäftsfeld: Umwelt

Ansprechpartner: B. Füllgrabe
Durchwahl: +49 6227 8 209 20
Fax: +49 6227 8 209 15
E-Mail: bernhard.fuellgrabe@wessling.de

Prüfbericht

Projekt: Vorotan Cascade, Armenia

Prüfbericht Nr. **CWA15-029334-1** Auftrag Nr. **CWA-11793-15** Datum **14.10.2015**

Probe Nr.	**15-149882-01**	**15-149882-02**	**15-149882-03**
Eingangsdatum	12.10.2015	12.10.2015	12.10.2015
Bezeichnung	Probe 1	Probe 2	Probe 3
Probenart	Öl	Öl	Öl
Probenahme durch	Auftraggeber	Auftraggeber	Auftraggeber
Probenmenge	ca. 40 ml	ca. 40 ml	ca. 40 ml
Probengefäß	40 ml HS	40 ml HS	40 ml HS
Anzahl Gefäße	1	1	1
Untersuchungsbeginn	12.10.2015	12.10.2015	12.10.2015
Untersuchungsende	14.10.2015	14.10.2015	14.10.2015

Polychlorierte Biphenyle (PCB)

Probe Nr.			15-149882-01	15-149882-02	15-149882-03
Bezeichnung			Probe 1	Probe 2	Probe 3
PCB Nr. 28	mg/kg	OS	**<0,2**	**<0,2**	**<0,2**
PCB Nr. 52	mg/kg	OS	**<0,2**	**<0,2**	**<0,2**
PCB Nr. 101	mg/kg	OS	**<0,2**	**<0,2**	**<0,2**
PCB Nr. 138	mg/kg	OS	**<0,2**	**<0,2**	**<0,2**
PCB Nr. 153	mg/kg	OS	**<0,2**	**<0,2**	**<0,2**
PCB Nr. 180	mg/kg	OS	**<0,2**	**<0,2**	**<0,2**
Summe der 6 PCB	mg/kg	OS	**-/-**	**-/-**	**-/-**
PCB gesamt (Summe 6 PCB x 5)	mg/kg	OS	**-/-**	**-/-**	**-/-**

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Prüfbericht Nr.	**CWA15-029334-1**	Auftrag Nr.	**CWA-11793-15**	Datum	**14.10.2015**

Probe Nr.	**15-149882-04**	**15-149882-05**	**15-149882-06**
Eingangsdatum	12.10.2015	12.10.2015	12.10.2015
Bezeichnung	Probe 4	Probe 5	Probe 6
Probenart	Öl	Öl	Öl
Probenahme durch	Auftraggeber	Auftraggeber	Auftraggeber
Probenmenge	ca. 40 ml	ca. 40 ml	ca. 40 ml
Probengefäß	40 ml HS	40 ml HS	40 ml HS
Anzahl Gefäße	1	1	1
Untersuchungsbeginn	12.10.2015	12.10.2015	12.10.2015
Untersuchungsende	14.10.2015	14.10.2015	14.10.2015

Polychlorierte Biphenyle (PCB)

Probe Nr.			15-149882-04	15-149882-05	15-149882-06
Bezeichnung			Probe 4	Probe 5	Probe 6
PCB Nr. 28	mg/kg	OS	**<0,2**	**<0,2**	**<0,2**
PCB Nr. 52	mg/kg	OS	**1,25**	**<0,2**	**<0,2**
PCB Nr. 101	mg/kg	OS	**1,76**	**<0,2**	**<0,2**
PCB Nr. 138	mg/kg	OS	**1,7**	**<0,2**	**<0,2**
PCB Nr. 153	mg/kg	OS	**1,19**	**<0,2**	**<0,2**
PCB Nr. 180	mg/kg	OS	**0,34**	**<0,2**	**<0,2**
Summe der 6 PCB	mg/kg	OS	**6,24**	**-/-**	**-/-**
PCB gesamt (Summe 6 PCB x 5)	mg/kg	OS	**31,2**	**-/-**	**-/-**

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Prüfbericht Nr.	CWA15-029334-1	Auftrag Nr.	CWA-11793-15	Datum	14.10.2015

Probe Nr.	15-149882-07	15-149882-08	15-149882-09
Eingangsdatum	12.10.2015	12.10.2015	12.10.2015
Bezeichnung	Probe 7	Probe 8	Probe 9
Probenart	Öl	Öl	Öl
Probenahme durch	Auftraggeber	Auftraggeber	Auftraggeber
Probenmenge	ca. 40 ml	ca. 40 ml	ca. 40 ml
Probengefäß	40 ml HS	40 ml HS	40 ml HS
Anzahl Gefäße	1	1	1
Untersuchungsbeginn	12.10.2015	12.10.2015	12.10.2015
Untersuchungsende	14.10.2015	14.10.2015	14.10.2015

Polychlorierte Biphenyle (PCB)

Probe Nr.			15-149882-07	15-149882-08	15-149882-09
Bezeichnung			Probe 7	Probe 8	Probe 9
PCB Nr. 28	mg/kg	OS	**<0,2**	**<0,2**	**<0,2**
PCB Nr. 52	mg/kg	OS	**0,25**	**<0,2**	**<0,2**
PCB Nr. 101	mg/kg	OS	**0,46**	**<0,2**	**<0,2**
PCB Nr. 138	mg/kg	OS	**0,42**	**<0,2**	**<0,2**
PCB Nr. 153	mg/kg	OS	**0,3**	**<0,2**	**<0,2**
PCB Nr. 180	mg/kg	OS	**<0,2**	**<0,2**	**<0,2**
Summe der 6 PCB	mg/kg	OS	**1,43**	**-/-**	**-/-**
PCB gesamt (Summe 6 PCB x 5)	mg/kg	OS	**7,15**	**-/-**	**-/-**

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Prüfbericht Nr.	**CWA15-029334-1**	Auftrag Nr.	**CWA-11793-15**	Datum	**14.10.2015**

Probe Nr.	**15-149882-10**
Eingangsdatum	12.10.2015
Bezeichnung	Probe 10
Probenart	Öl
Probenahme durch	Auftraggeber
Probenmenge	ca. 40 ml
Probengefäß	40 ml HS
Anzahl Gefäße	1
Untersuchungsbeginn	12.10.2015
Untersuchungsende	14.10.2015

Polychlorierte Biphenyle (PCB)

Probe Nr.			15-149882-10
Bezeichnung			Probe 10
PCB Nr. 28	mg/kg	OS	**<0,2**
PCB Nr. 52	mg/kg	OS	**<0,2**
PCB Nr. 101	mg/kg	OS	**<0,2**
PCB Nr. 138	mg/kg	OS	**<0,2**
PCB Nr. 153	mg/kg	OS	**<0,2**
PCB Nr. 180	mg/kg	OS	**<0,2**
Summe der 6 PCB	mg/kg	OS	**-/-**
PCB gesamt (Summe 6 PCB x 5)	mg/kg	OS	**-/-**

Abkürzungen und Methoden

Polychlorierte Biphenyle (PCB)	EN 12766-1[A]	**ausführender Standort**
		Umweltanalytik Bochum
OS	Originalsubstanz	

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M.Sc. Biogeowissenschaften
Sachverständiger Umwelt und Wasser

DAkkS Deutsche Akkreditierungsstelle D-PL-14162-01-00