

# Environmental Monitoring Report

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2018 2<sup>nd</sup> Semestral Report  
March 2019

## ARM: Power Transmission Rehabilitation Project

Prepared by the High Voltage Electric Networks (HVEN) Closed Joint Stock Company(CJSC) for the Republic of Armenia and the Asian Development Bank (ADB).

## **CURRENCY EQUIVALENTS**

(as of 28 March 2019)

Currency unit	–	Armenian Dram (֏)
֏ 1.00	=	\$ 0.0021
\$1.00	=	֏ 485

## **ABBREVIATIONS**

ADB	Asian Development Bank
CEMP	Contractor's Environmental Management Plan
CJSC	Closed Joint Stock Company
EMP	Environmental Management Plan
GoA	Government of Armenia
GRM	Grievance Redress Mechanism
HVEN	High Voltage Electric Networks
IEE	Initial Environmental Examination
IES	International Environmental Specialist
LEEEEC	Liaoning- EFACEC Electrical Equipment Co., LTD
MNP	Ministry of Nature Protection
NEC	National Environmental Consultant
NEIE	Northeast China International Electric Power Corporation
NGO	Non-Governmental Organization
PIU	Project Implementation Unit
PSMC	Project Supervision and Management Consultant
RA	Republic of Armenia
SEU	Social and Environmental Unit
SSEMP	Site-Specific Environmental Management Plan

## **NOTE**

In this report, "\$" refers to United States dollars unless otherwise stated

This environmental monitoring report is a document of the borrower. The views expressed herein do not necessarily represent those of ADB's Board of Directors, Management, or staff, and may be preliminary in nature.

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## PART I - INTRODUCTION

The transmission infrastructure of Armenia was primarily built in the Soviet era. Roughly 70% of the installed equipment at power generation plants has been in operation for more than 30 years, and 50% for more than 40 years. The average age of power transmission assets including substations is 45 years and, distribution assets 32 years. Much of the existing transmission infrastructure has reached the end of its useful life and requires major rehabilitation or replacement to continue reliable operation. Also, nearly 90% of 220-kV overhead lines require rehabilitation, and about 42% of low-voltage substations are in deficient technical condition.

The Asian Development Bank (ADB), assists Armenia in improving the utilization of its energy resources. Subsequently, on September 5, 2014, the Loan Agreement of the Power Transmission Rehabilitation project (PTR) was signed between the Republic of Armenia (Borrower) and Asian Development Bank and the High Voltage Electric Networks CJSC was appointed as the Implementing Agency.

PTR will increase the efficiency of power system operation and reduce transmission losses, which are essential for improving operational energy security and reducing emissions of greenhouse gases. Rehabilitation of existing substations will improve the reliability and quality of power supply to urban and rural consumers, alleviating regional disparities within Armenia and supporting inclusive and sustainable economic development. The project will help to upgrade the national power system operation reliability and efficiency and enhance the transmission capacity.

The project includes three main components: i) expansion of supervision control and data acquisition (SCADA) system, ii) rehabilitation of four existing 220/110kV substations and iii) capacity building and project management. HVENs portion of the projects covers Rehabilitation and Extension of four High-Voltage (HV) Grid Substations. This includes substations Agarak 2, Shinuhayr, Yeghegnadzor and Ararat 2. Agarak 2 (ANNEX B) and Shinuhayr (ANNEX C) substations.

Rehabilitation of the selected substations includes installation of new autotransformers (only in Agarak 2), replacement of obsolete voltage transformers, surge arrestors, circuit breakers, disconnectors, post insulators, steel gantries, towers (supports) and foundations, control & monitoring equipment, protection equipment, batteries and other secondary systems. The rehabilitation of “Agarak 2” and “Shinuhayr” substations was according to the contract planned to be implemented in the period of 2016 up to end-2018.

The Construction Contractor of the project are Liaoning-EFACEC Electrical Equipment Co., LTD (LEECC) & Northeast China International Electric Power Corporation (NEIE) JV and the supervision consultant company is the CESI S.p.A.

According to ADBs Environmental Safeguard Categories<sup>1</sup> the project is classified as category "B". This indicates that any potential adverse environmental impacts of the project are site-specific, few if any of them are irreversible, and mitigation measures can be designed more readily than for category A projects which are more likely to have adverse environmental impacts.

## 1.1 CONSTRUCTION ACTIVITIES AND PROJECT PROGRESS DURING REPORTING PERIOD

In the framework of the project, reconstruction works of the Agarak-2 substation started in February 2017 and Contractor's Environmental Management Plan (CEMP) of reconstructed site was approved on February 09, 2017. The CEMP of reconstruction site of "Shinuhayr" substation is approved by HVEN CJSC in January 2017 and the start of reconstruction works was in June 2017.

Civil works at "Agarak-2" and "Shinuhayr substations are behind schedule. The delays are due to poor site works organization. The works of subcontractor at the "Agarak-2" substation was suspended from July 2018 up to November 2018 due to financial problems between the Contractor and Sub-contractor. No (civil) works were implemented at the substation during this period. Civil works at the Shinuhayr continued.

The progress of works (in accordance with the works schedule) that are performed so far at both of the substations is presented in the table below.

**Table 1: Cumulative Progress of Works in "Agarak-2" and "Shinuhayr" Substations**

Substation	Actual
Agarak-2	78%
Shinuhayr	41%

The more detailed list of construction activities that were implemented during the reporting period are presented in ANNEX A.

<sup>1</sup> See ADB's website for more elaboration on ADB's safeguard categories, available at: <https://www.adb.org/site/safeguards/safeguard-categories>

## 1.2 ENVIRONMENTAL SAFEGUARDS STAFFING

The Ministry of Energy and Natural Resources (MENR) as the executing agency and High Voltage Electric Networks (HVEN) Closed Joint-Stock Company (CJSC) as the project implementing agency are responsible for the implementation of the project. As agreed jointly between the borrower and ADB, and in accordance with Government and ADB's policies and procedures, HVEN is responsible for the implementation of substation rehabilitation components of the project.

HVEN CJSC carries out day-to-day management of project execution and monitoring of relevant project activities. This includes periodic review, preparation of review reports identifying issues and action plans and their timely submission to ADB. HVENs team includes a Social and Environmental Specialist who oversees all environmental aspects of the project and is responsible for preparation of project monitoring reports.

HVEN employs one turnkey contractor to perform final design, procurement, installation, and testing and commissioning of concerned equipment at existing substations of Agarak 2, and Shinuhayr. The Contractor's Environmental Team is responsible for implementation of the EMP, as well as for preparation and implementation of CEMP and SEMP, monitoring of construction activities and reporting.

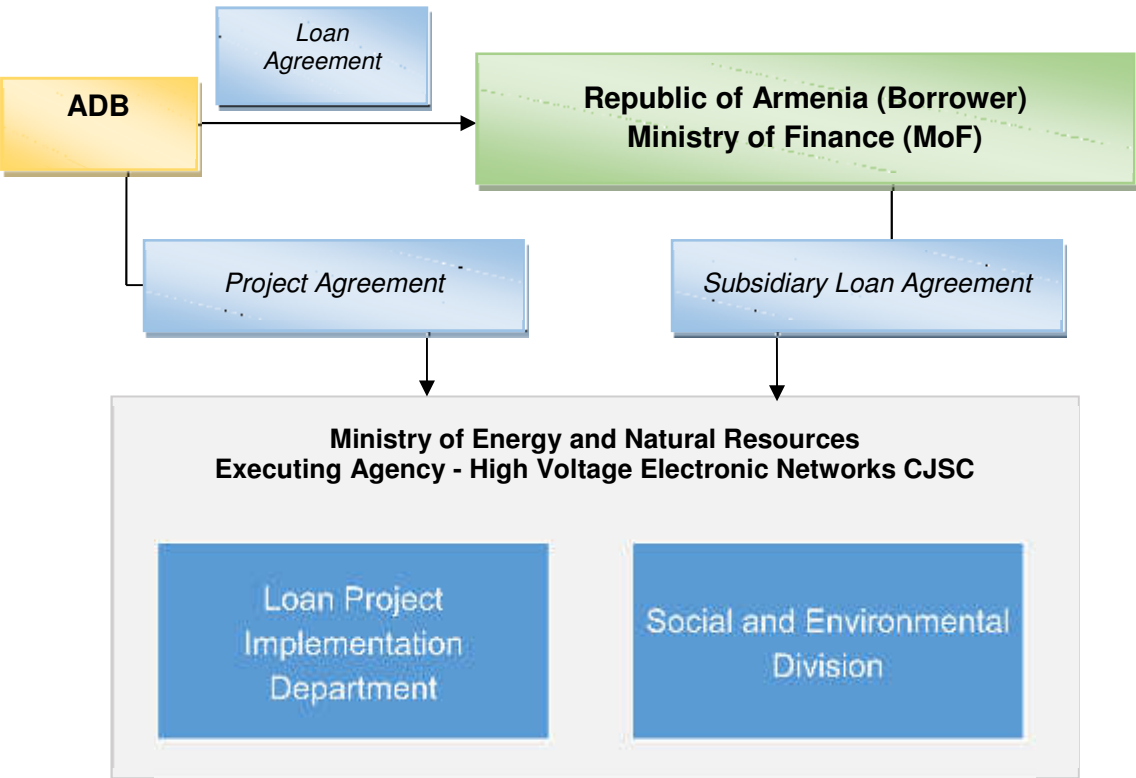
HVEN recruited a Project Supervision and Management Consultant (PSMC) who is providing Technical Assistance to the PIU in the management and reporting of the project. International Environmental Specialist of the PSMC is responsible for supervising the construction works in relation to environmental and, in particular, supervising and reporting on the Contractor's performance during the implementation of the EMP.

## 1.3 PROJECT ORGANIZATION AND HVEN TEAM

HVENs Social and Environmental activities are implemented by HVENs Social and Environmental unit (SEU). The department is responsible for overseeing the work of the contractor and PSMC in safeguards compliance. The SEU reviews MPR reports and oversees the implementation of EMPs and training and capacity-building activities. The SEU prepares bi-annual and annual environmental monitoring reports and submits to ADB.

Mr. Armen Grigorian leads the SEU and oversees the compliance of the project with ADB's Environmental Policy and RA Legalization. He is a full-time employee since May 2017. Mr. Grigorian is assisted by Rayisa Babayan.

**Figure 1:** Structure Diagram of the Agencies Involved in Investment Program



#### 1.4 THE PSMC ENVIRONMENTAL TEAM

All mitigation measures during construction have to be implemented by the contractor and these are monitored by the PSMC. To ensure the smooth implementation of CEMPs International Environmental Specialist (IES) is employed by the PSMC. Mrs. Nicoletta Cremonesi is the IES. She has worked with us until May 19, 2017. She was responsible for the provision of consultation on international best practices on environmental safeguards. Currently, the position of the IES is vacant.

#### 1.5 THE CONTRACTOR’S ENVIRONMENTAL TEAM

Mrs. Irina Esayan – is the Contractor’s Local Environmental Specialist. She is responsible for the site monitoring visits, preparation of monthly environmental reports and if necessary for updating the CEMP.

## PART II - ENVIRONMENTAL MANAGEMENT COMPLIANCE WITH NATIONAL SAFEGUARDS

To comply with Armenia's national safeguard system and legislation, the Contractor obtained necessary permits and licenses for construction activities accordingly for both construction and for dumping site. These permits are presented in ANNEXES F and G.

In the reporting period all project activities complied with the relevant national environmental laws and regulations. The CEMPs were prepared by the Contractor and approved. The Contractor ensures that preparation of all CEMP's complies with national pertinent environmental laws and regulations. The Contractor ensures that all necessary communications with local and territorial administrative authorities comply with RA legislation and obtained permits.

### 2.2 COMPLIANCE WITH ADB SAFEGUARDS

In order to safeguard the environmental performance of the project, the implementation of construction activities was supervised to ensure their compliance with EMP requirements. The EMP is prepared in accordance with ADB Environmental Policy and RA legislation.

As PTR is a category "B" project, ADB conducts review missions once a year to check compliance of project activities with ADB SPS requirements. The project is also monitored by ADB's National Environmental Consultant (NEC).

The NEC visit to Agarak-2 and Shinuhayr substations was carried out during 26-27 October 2018. During the visit, the PTR's environmental compliance was reviewed and subsequently main findings and required actions to address any identified issues were shared with HVEN. These meetings also involved representatives of the (sub) contractors. The main findings, recommendations and implemented mitigation activities are presented below:

**Table 2: Results and follow-up of NEC compliance monitoring visit**

Findings and Recommendations	Mitigation Activities
<b>Agarak Substation</b>	
<b>Restart of the construction works</b>	Negotiations happened with the contractor who restarted construction activities in November/December 2018, after a long suspension of works.

<b>Design and construction of an irrigation system.</b>	The Contractor was asked and agreed to design and construct the irrigation pipe/system.
Implementation of asbestos management plan.	The contractor will follow the asbestos management plan and pay particular attention to this once civic works will involve asbestos.
<b>Cleanup of the site from remaining construction waste</b>	The contractor started and will continue the proper cleanup of the construction site during construction process.
<b>Shinuhayr Substation</b>	
<b>Oil PCB tests results</b>	Results of the PCB analysis of existing oils were presented in the project CEMP (none of the samples contained PCBs). Results of any new oils to be provided in the framework of the projects is attached in ANNEX H.
<b>Accumulation of different type of materials (wood, metal, etc.) and Contractor is waiting for HVEN's decision regarding their future use or dumping.</b>	HVEN is discussing the matter internally and with possible external stakeholders to come to a final handover of the dismantled equipment.
<b>Boiling of bitumen on the soil layer.</b>	The Contractor received a written warning on the matter with request to construct/prepare a covered area which will ensure that the bitumen will not come in contact with the top soil in any case.
HVEN's safeguard specialist was advised to implement site visits more frequently for project's sustainable monitoring.	Additional site visits are planned for the coming reporting period.

### 2.3 CONTRACTOR'S COMPLIANCE WITH THE CEMP

The Contractor is guided by the IEE and EMP for the project as a part of the Bid and Contract documents. The Contractor's Environmental Management Plan is prepared by the contractor and elaborates on site environmental management requirements implementation and management, particularly construction impacts mitigation, monitoring and reporting requirements in order to ensure environmental performance. Compliance with CEMP is being regularly monitored and reported.

The final version of Contractor's Environmental Management Plans for Agarak-2 and Shinuhayr substations were prepared by the Contractor and approved by the PIU and PSMC, accordingly February 15, 2017 and February 20, 2017.

## 2.4 ADB MISSION

An ADB missions was carried out during 1 - 5 October 2018. Representatives of the HVEN, as well as the Contractor's participated in the mission visits. HVEN confirmed to the Mission that environmental mitigation measures were in place and rehabilitation activities were monitored and reported upon in semi-annual Environmental Monitoring Reports.

## 2.5 TRAININGS AND AWARENESS RAISING ORIENTATION

The Contractor's Environmental specialist presented to the contractor's team the environmental management plan, environmental requirements, possible negative impacts during construction works, mitigation measures and Grievance redress mechanism in the construction site.

Personnel awareness raising sessions were regularly held regarding health, safety, emergencies and environmental topics, which have been implemented by environmental specialist and chief foreman.

## 2.6 GRIEVANCE REDRESS MECHANISM

For receiving feedbacks, concerns and complaints from the APs, a Grievance Redress Mechanism (GRM), has been established based on ADB's guidelines and policies maintained for the duration of the Project. The Grievance Redress Mechanism is intended to assist aggrieved persons in lodging their complaints and to describe the mechanism designed to redress their grievances in a timely and effective manner. The parties potentially involved in the GRM are the Contractor, Consultant, HVEN and NGOs.

The following are the procedural steps to file a complaint or pose an inquiry on matters relating to project implementation, environmental concerns and other issues regarding the Project.

**Step 1:** The person affected by the Project could raise their suggestions/concerns/complaints first of all to the Contractor's dedicated grievance staff that is an attempt will be made to resolve complaints at the local level. In order to maintain transparency and accountability to affected communities and to make information, assistance and grievance resolution services accessible to the Affected Persons, the Contractor will establish the following GRM as a part of the Project's integral GRM:

- ✓ AP's could approach Contractor's representative (construction foreman, engineer, social or environmental specialist) on-site and/or register their suggestion /complain into the grievance register book kept by Contractor at the field office nearby the RoW.

- ✓ Contractor ensures the provision of contact information (field office location, operating hours, names of responsible contact persons, phone numbers, regular mail and email addresses, etc.) via posters and Project informational boards

**Step 2:** Should the Consultant fail to satisfy the complaint, AP could apply to PIU. All the contact information shall be provided by Contractor on posters and on the Project informational board. Contractor shall provide the necessary explanations and assistance in application to the mentioned entities, if needed through the personal contact with AP.

Finally, the AP can always seek attention and interference of NGOs and the court. However, all the efforts will be made to settle the issues at the Contractor's, the Consultant and PIU level. If not possible, attempts will be made to resolve the issues at the EA level to avoid/minimize litigation as much as possible.

All complaints regardless of the outcome and solutions will be properly documented and made available for review, monitoring and evaluation purposes. the Contractor provided the Complaints Register book to impacted community which is kept at the construction site.

**No complaints were registered during the reporting period.**

### PART III - ENVIRONMENTAL MONITORING

During the reporting period the monitoring activities were carried out according to the Monitoring program developed based on the ADB safeguards and EMP requirements. For the PTR «Rehabilitation of «Agarak-2» and «Shinuhayr» 220/110kV substations» the monitoring program includes:

- Regular monitoring site visits on to check compliance of construction activities in the Agarak-2 and Shinuhayr substations to the EMP requirements
- Unscheduled inspection visits when needed
- Completion of the monitoring checklist and summary of compliances and non-compliances
- Issue the non-compliance notices to the Contractor
- Review of the Contractor's monthly monitoring reports.

Contractor's Environmental specialist has conducted regular Environmental monitoring visits to Agarak-2 and Shinuhayr substations on a monthly basis and provided Environmental Monthly Reports (EMPs) to PIU environmental specialist. The EMPs elaborate upon:

- The status of the construction works and the recorded progress,
- Staff preparedness, mobilization, training and awareness,
- Regular monitoring visits,
- Received complaints,
- Security/safety and accidents report,
- Waste,
- Other environmental and social issues.

During site visits the CES presented the environmental and social requirements of the project, possible negative impacts during construction works, mitigation measures and Grievance redress mechanism in the construction site. Also the responsible individuals involved in the construction works were instructed by the CES to:

1. Strictly observe the safety rules;
2. Follow the fuel and lubricants transporting, charging and storage rules in order to exclude the leakage into the environment. In particular, the foreman was instructed to provide the respective area and ensure lay of sand with the precondition to change and refresh it regularly.

3. Carry out regular dust removal works.
4. Register any possible social issue or complaint raised by the staff members and inhabitants of adjacent areas and inform about it the Contractor's environmental specialist immediately.
5. Register any accident and amount of waste generated during the construction works.

HVENs Social and Environmental Specialist carried out monitoring visits to both substations in October 2018. During the visits possible mitigation measures were discussed with the contractor on-site and detailed instructions were given. Photos of the visits are attached in ANNEX E.

During the reporting period, no complaints were registered, and no accidents were registered on the construction site. No non-compliance notices were issued during the reporting period.

## Part IV - Action Plan for the Next Period

BaSEU on the developed Contractor's Environmental Management Plan the selected general contractor must establish an action plan for every 6 months which will be approved by HVEN and supervision consultant.

### Action plan for the reporting period from Jan to June 2019

N	Action	Time frame	Responsible
1.	Evaluation site visits and assistance to the Contractor in the development of Waste Management Plans and management plans for dump sites in Agarak-2 and Shinuhayr substation, as well as other routine working documents.	Upon Contractor's request	HVEN/PSMC
2.	Preparation, review and approval of Site-specific Environmental Management Plans for waste and dump sites	Upon the need	HVEN/PSMC/ Contractor
3.	Consultancy provided to Contractor's environmental team on ADB Safeguard Policy Statement and Armenian Environmental legislation	Upon the need	HVEN/PSMC
4.	Monitor the Contractor's construction works in Agarak-2 and Shinuhayr substations to ensure the compliance with IEE, EMP and CEMP requirements	By the end of every month started from Jan – June 2019	HVEN/PSMC
5.	Review and approve the Contractor's Monthly progress reports	Monthly during July - December 2018	HVEN/PSMC
6.	Other routine issues like unscheduled site visits, follow up of the detected defects, environmental assessment of re-designs, review and approval of Contractor's documents, etc	Upon the need	HVEN/PSMC
7.	Reporting on environmental safeguards	Bi-annual	HVEN

## ANNEX A: CONSTRUCTION WORKS PER MONTH

Month	Agarak-2	Shinuhayr
<b>July</b>	No Construction Activities were implemented in July.	<ul style="list-style-type: none"> <li>- installation of formwork (oil draining systems),</li> <li>- concrete works (oil draining systems: walls and floor, fireproof reservoir),</li> <li>- basalts facing (storage house, fireproof reservoir),</li> <li>- installation of pumps,</li> <li>- digging ground around the existing basis (220 kV Switchyard gantries),</li> <li>- armoring of the portal bases and surfaces cleaning,</li> <li>- reinforced concrete foundation and hydro-isolation of portals,</li> <li>- coloring metallic parts of portals (220 kV Switchyard),</li> <li>- drilling of round copper rod,</li> <li>- replacement of metallic parts of portals,</li> <li>- plastering works (walls, external concrete fences),</li> <li>- construction of stone fence, 21m,</li> <li>- conducting lighting cables (SCP building),</li> <li>- armoring of the walls with metal mesh,</li> <li>- reinforcing and concreting of the walls and columns,</li> <li>- digging of ground for laying drinking water pipeline and laying the polyethylene pipeline,</li> <li>- digging of ground for laying sewerage pipeline and laying</li> </ul>
<b>August</b>	No Construction Activities were implemented in August.	<ul style="list-style-type: none"> <li>- basalts facing (fireproof reservoir),</li> <li>- digging ground around the existing basis (220 kV Switchyard gantries),</li> <li>- armoring of the portal bases and surfaces cleaning,</li> <li>- reinforced concrete foundation and hydro-isolation of portals,</li> </ul>

		<ul style="list-style-type: none"> <li>- coloring metallic parts of portals (220 kV Switchyard),</li> <li>- plastering works (SCP building),</li> <li>- digging of ground for laying sewerage pipeline and laying the polyethylene pipeline,</li> <li>- digging ground for installing new foundations (220 kV Switchyard gantries),</li> <li>- installing of new foundations (220 kV Switchyard gantries),</li> <li>- installation of reinforced concrete sewage wells,</li> <li>- expansion of cable channels (SCP building),</li> <li>- pumice block partition,</li> <li>- dismantling of the metal structure of the roof (SCP old building),</li> <li>- thermal insulation layer of the roof (SCP old building),</li> <li>- assembling the steel structure of the roof (SCP old building).</li> </ul>
<b>September</b>	No Construction Activities were implemented in September.	<ul style="list-style-type: none"> <li>- reinforcement and concreting of foundation,</li> <li>- coloring the metallic parts of portals,</li> <li>- plastering works,</li> <li>- digging of ground manually for external waterproofing, for borders,</li> <li>- digging ground for installing of the new foundations (110kV Switchyard gantries),</li> <li>- digging of ground for laying sewerage pipeline and laying the polyethylene pipeline,</li> <li>- soil backfill (SPC building),</li> <li>- installing of new foundations (220kV, 110kV, 35kV Switchyard gantries),</li> <li>- installing of new bearings (220kV, 110 kV Switchyard gantries),</li> <li>- preparatory layer for the r/c slabs for AT-3,</li> <li>- painting works (SCP building),</li> <li>- expansion of the cable channels (SCP building),</li> </ul>

		<ul style="list-style-type: none"> <li>- opening entrance of the cable channels (SCP building),</li> <li>- laying of liquid floor (SCP building),</li> <li>- concrete laying (floor, foundation of racks),</li> <li>- installation of fences (open warehouse, near the garage),</li> <li>- partition walls from concrete blocks,</li> <li>- assembling the steel structure of the roof (SCP old building),</li> <li>- installing of metaloplastic windows,</li> <li>- installing of current transformers (110kV, 220 kV Switchyard gantries) and other installation works.</li> </ul>
<b>October</b>	No Construction Activities were implemented in October.	<ul style="list-style-type: none"> <li>- reinforcement and concreting of foundation,</li> <li>- coloring metallic parts of portals,</li> <li>- digging of ground for laying the pipelines,</li> <li>- installing of new foundations (220kV, 110kV, 35kV Switchyard gantries),</li> <li>- installing of new bearings (35kV Switchyard gantries),</li> <li>- opening entrance of cable channels (6kv CDE building),</li> <li>- concrete laying works,</li> <li>- painting of the fences (open warehouse, near the garage),</li> <li>- application of anti-corrosion paint on pipes (fireproof reservoir),</li> <li>- installation of basalt borders (pump station),</li> <li>- backfilling of crushed stone with soil under asphalt,</li> <li>- installing of current transformers (110kV, 220 kV Switchyard gantries) and other installation works (disconnectors, circuit breaker and etc.),</li> <li>- drywall plaster of walls (SCP old building),</li> <li>- partition laying (SCP old building, basement),</li> <li>- walls facing with tuff slabs,</li> </ul>

		<ul style="list-style-type: none"> <li>- walls facing with bazalt slabs,</li> <li>- laying of tuff stone for fences,</li> <li>- installation of barbed wire on fences,</li> <li>- plastering works,</li> <li>- transformers repairing works.</li> </ul>
<b>November</b>	<ul style="list-style-type: none"> <li>- Concreting works,</li> <li>- Installation of concrete foundation under 35kV transformer,</li> <li>- Construction of the concrete drainage channel,</li> <li>- Sand/concrete plastering works (ceiling, walls),</li> <li>- Painting of ceiling and walls,</li> <li>- Installation and painting of metal doors,</li> <li>- Installation of horizontal diaphragms on the upper side of 6kV transformers,</li> <li>- Installation of the sewerage pipe,</li> <li>- Installation of the steel structure for lighting,</li> <li>- Laying of copper wires for grounding,</li> <li>- Installation of portals, supports, circuit breakers and dis-connectors.</li> </ul>	<ul style="list-style-type: none"> <li>- reinforcement and concreting of gantries foundation,</li> <li>- painting of metal structures of portals,</li> <li>- assembling and installing of the portals details,</li> <li>- installing of new foundations (220kV, 110kV, 35kV Switchyard),</li> <li>- installing of new towers (35kV Switchyard),</li> <li>- concreting works,</li> <li>- stone fence brickwork,</li> <li>- plastering works,</li> <li>- Installing of the ground conductor,</li> <li>- Installation of the internal water supply and sewerage points,</li> <li>- Transformers repairing works.</li> </ul>
<b>December</b>	<ul style="list-style-type: none"> <li>- No construction activities were reported in December.</li> </ul>	<ul style="list-style-type: none"> <li>- No construction activities were reported in December</li> </ul>

## ANNEX B: LAYOUT OF THE PROJECT CONSTRUCTION AREA OF AGARAK-2



## ANNEX C: LAYOUT OF SHINUHAYR PROJECT CONSTRUCTION AREA



## ANNEX D: LOCATIONS OF THE SUBSTATIONS SHINUHAYR AND AGARAK-2



ANNEX E: MONITORING PHOTOS



## ANNEX F: CONSTRUCTION PERMIT

[illegible]

## ANNEX G: DUMP SITE PERMIT

[illegible]

## ANNEX H: OIL TEST RESULTS

## 产品质量报告单

QR.SJ.15-03

产品名称 Product Name: U-30℃(通用)变压器油 U-30℃ (General) Transformer base Oil		用 户 (The Consumer): LEEEC	
提货数量 Total Amount:		出厂编号 (The Number Of Leave factory):	
分析项目 Test Items		质 量 指 标 Specification	典型结果 Test Results
<b>一、功能指标</b>			
粘度 Viscosity 40℃,mm <sup>2</sup> /s	≦	12	9.958
-30℃,mm <sup>2</sup> /s	≦	1800	1630
倾点, Pour Point/℃	≦	-40	-45
水分, water content mg/kg	≦	30/40	13
击穿电压, Dielectric Strength kV	≧		
未处理油 not be treated oil		30	58.5
处理后油 oil after treatment		70	≥70
密度 Density (20℃), g/ml	≦	0.895	0.882
介质损耗因素 Dielectric Dissipation Factor (90℃)	≦	0.005	0.0006
<b>二、精制度/稳定性指标</b>			
外观 Appearance		清亮、无沉淀及悬浮物 B&C	清亮、无沉淀及悬浮物 B&C
酸值 acid number, KOH mg/g	≦	0.01	0.009
介面张力 Interfacial Tension		40	45
总硫含量 Total Sulphur content %	≦	0.15	150ppm
腐蚀性硫 Corrosive Sulphur		无腐蚀性 Noncorrosive	无腐蚀性 Noncorrosive
抗氧化剂, Oxidation Inhibitor content %	≧	检测不出 Not detectable	检测不出 Not detectable
金属钝化剂 metal passivator additives		检测不出 Not detectable	检测不出 Not detectable
糠醛化合物, Furfural compound mg/kg	≦	0.05	0.020
<b>三、使用性能指标</b>			
氧化安定性 Oxidation Stability			
总酸值 Total acid number after oxidation, KOH mg/g	≦	1.2	0.4
沉淀物, Subsidence %	≦	0.8	0.35
介质损耗因素 Dielectric Dissipation Factor 90℃	≦	0.500	0.10
<b>四、卫生安全环保 (HSE) 指标</b>			
闪点, Flash Point, (closed) ℃	≧	135	141
多环芳烃(PCA), %	≦	3	≦1
多氯联苯(PCB) PCB (polychlorinated biphenyls) content, %	≦	检测不出 Not detectable	检测不出 Not detectable
备注:			
结论:符合 IEC 60296-2012 标准		签章: 刚和石油(营口)油有限公司	
Others: fit to IEC 60296-2012 standard		2018/11/5	

审核 Identifier: 王萍

