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**PILOT PROJECT PLAN TO UPGRADE  
THE METERING OF THE SHAUMIAN-2  
TRANSMISSION SUBSTATION IN ARMENIA**

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*Final Report*

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## **PILOT PROJECT PLAN TO UPGRADE THE METERING OF THE SHAUMIAN-2 TRANSMISSION SUBSTATION IN ARMENIA**

### **1 INTRODUCTION**

This brief report provides an overview of the pilot project to replacement the commercial and some limited amount of internal meters at the Shaumian-2 substation. This transmission substation is part of the high voltage electric system. Specifically, the following aspects of the process are discussed:

- ▶ Background,
- ▶ Substation description,
- ▶ Project objective,
- ▶ Environmental considerations,
- ▶ Hagler Bailly and ARMTRANS duties

### **2. BACKGROUND**

Based upon discussions with USAID staff, Hagler Bailly made a proposal to the Ministry of Energy to completely replace 48 existing induction meters with electronic meters at the Shaumian-2 substation. The purposes of this proposed pilot were several:

- ▶ To assess the performance of US made electronic programmable meters at the transmission network, prior to a possible large scale procurement and meter replacement program to be funded by USAID, a technology choice for the larger procurement will take place later following more detailed analysis, specification and evaluation of the performance of the metering equipment,
- ▶ To train ARMTRANS employees in this technology prior to subsequent larger procurement and implementation,
- ▶ To test working conditions and implementation steps so that a larger scale effort could move forward more efficiently and more quickly, this is especially critical for the software to be used to efficiently process the data available from the new meters,

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- ▶ To demonstrate to Armenian authorities, including the Ministry of Energy, the commitment of USAID to support the remetering proposal put forward by the Government of Armenia

Following review of Hagler Bailly's proposal, the Ministry of Energy agreed to conduct this technology demonstration at the Shaumian-2 substation. Following that, Hagler Bailly staff met with the ARMTRANS representatives for the following purposes:

- ▶ To discuss meter equipment and other substation details,
- ▶ To specify the roles of both Hagler Bailly and ARMTRANS,
- ▶ To develop the implementation steps required for successful implementation.

All participants agreed in principle to the process. It was agreed that Hagler Bailly will develop the schedule of implementation and the roles of each organization for this demonstration project. Hagler Bailly also visited the Shaumian-2 substation to assess any program implementation difficulties as well as environmental conditions at the substation.

### 3. SUBSTATION AND METERING EQUIPMENT DESCRIPTION

The Shaumian-2 substation, located in the Shaumian district in the Western section of Yerevan, handles power flows at the following voltage levels: 220/35/10 kV. Overall, according to ARMTRANS staff, the facility handles about 20% of all electricity generated in the country.

Originally, Hagler Bailly was informed that there were 48 induction meters, each installed together with voltage and current transformers. However, upon further inspection, it became clear that 55 meters need replacement. These meters, which include both internal and commercial meters, have varying degrees of accuracy, typically below what would be required to ensure correct measurements of power flows. Meters are both one- and two-directional with 39 one-directional meters and 16 two-directional meters needing replacement.

The expected distribution of the replacement involves the following:

10kV replacement – 31 commercial meters (one-directional),

110 kV replacement – 17 internal meters (8 one-directional, 9 two-directional),

220 kV replacement – 7 internal meters (7 two-directional)

The goal of this pilot project is to conduct a replacement of all 55 existing induction meters with electronic meters with an accuracy of 0.2 percent. Existing current and voltage transformers will be used without any changes together with new electronic meters. Ideally, current transformers

could also be replaced to help improve the metering accuracy even further. However, these items were not procured due to the timing considerations involved and the understanding that current transformers may be replaced at a later time as part of the USAID funded metering upgrade project. Failure to replace the current transformers does not jeopardize project objectives because the primary objectives are to test the new metering equipment's performance, train staff and work through the implementation steps required to support a larger effort.

The cost of the equipment for this project is approximately \$28,540. This includes \$15,990 for the one-directional equipment, \$9,760 for the two-directional equipment, \$790 for a programmable software license, and about \$2,000 for the laptop PC to collect and process the metering information. Additional costs will include one or two additional meters to provide a working inventory in case a meter should need to be repaired. Also, registered meter seals will be provided so that each meter can be properly sealed.

ARMTRANS staff will handle all installation work including any rewiring or other installation adjustments needed.

In preparation for the project, staff of ARMTRANS received one-week of in-country training from representatives of ABB's Moscow office to ensure that the staff is familiar with the use of the new equipment.

#### 4. ENVIRONMENTAL CONSIDERATIONS

During the site visit, Hagler Bailly inspected the installation area and there were no visible signs of hazards such as transformer oil. The affected environment is an enclosed substation building where meters are installed and substation personnel monitor and control the power flows through the substation.

However, in the process of implementing new electronic meters, ARMTRANS must adhere to environmental and worker safety rules to minimize any adverse consequences resulting from the meter replacement. Some of the rules that are applicable during the implementation are listed below.

ARMTRANS management must observe the following minimum environmental regulation:

- ▶ In case there is PCB type insulation at the substation, it must be handled and disposed of properly.
- ▶ Any scrap components that will be removed from the substation, must be either sent properly recycled or sent to a licensed scrap disposal area as appropriate.
- ▶ Any fluids, such as oils, etc., must be removed in appropriate containers from the substation.

ARMTRANS employees who will be replacing meters must observe the following minimum safety regulations

- ▶ Only employees with relevant training should be working on meter replacement project
- ▶ Employees should be equipped with appropriate measuring devices to detect “live” conduits
- ▶ Any replacement work has to be done on conduits that are disconnected from power
- ▶ Employees should wear appropriate safety gear to prevent electrocution and exposure to hazardous materials

## **5. DUTIES OF HAGLER BAILLY AND ARMTRANS**

Hagler Bailly will perform or arrange for the following tasks

- ▶ Provide training in the use of the metering equipment (already completed),
- ▶ Receive GosStandard certification for the equipment (already completed),
- ▶ Provide 55 meters, licensed software, one laptop PC and registered meter seals,
- ▶ Audit the installations to ensure that the equipment was installed in the proper location,
- ▶ Evaluate the pilot project,
- ▶ Work with staff of ARMTRANS to ensure that data collection and analysis occurs in an efficient manner

ARMTRANS will remain responsible for the following tasks

- ▶ Prepare the substation for remetering, including cabling and cabinets for the installation of the new meters,
- ▶ Observe all applicable safety and technical standards for the equipment installation and install the metering equipment, ARMTRANS will provide Hagler Bailly with a statement that affirms its commitment to the steps shown in the environmental considerations section of this report,
- ▶ Provide accompanied site access to Hagler Bailly and USAID or other US Government personnel, to review the meter installations and ensure equipment was installed in the proper location Hagler Bailly, USAID or other US Government personnel will provide ARMTRANS with at least 48 hours notice of their desire to inspect the site,

- ▶ After implementation and period of operation, ARMTRANS staff in cooperation with Hagler Bailly or other USAID contractors, will provide a comparative assessment of new meters

## 6. CONCLUSION

This project is an important and highly visible effort to improve the metering and billing of electricity on the high voltage system. The impetus for the project was the desire of the Government of Armenia to have USAID fund a large scale remetering project for the Armenian transmission system. This project offers an opportunity to provide a number of benefits. These benefits include significantly higher meter accuracy (most existing equipment has an accuracy of 1-2%, but has also not been tested for a considerable period of time) and coverage of 20% of the nation's electricity flow for a relatively modest investment. Additionally, the new meters are more tamper-resistant and also provide considerably more information to ARMTRANS management on the actual operation of the substation (e.g., the meters record interval data which will be of use for examining substation performance). Importantly, the project provides Hagler Bailly and ARMTRANS with the opportunity to work through all project implementation details prior to the start of the larger anticipated USAID remetering program.