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**EVALUATION OF THE ELECTRICITY  
DISTRIBUTION COMMERCIALIZATION  
PILOT PROJECT**

**Contract No CCN-Q-00-93-00152-00  
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Improved Commercial Operation of Energy Sector  
Distribution Companies in Armenia**

*Final Report*

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## EVALUATION OF THE ELECTRICITY DISTRIBUTION COMMERCIALIZATION PILOT PROJECT

### 1 INTRODUCTION

It is the purpose of this report (1) to assess the current electric distribution system in Armenia, (2) to discuss the recent experience that the Hagler Bailly team has gained through its pilot metering and billing project in the Komitas and Ararat distribution areas, and (3) to propose the steps that would be required to put the electric distribution sector on a sound managerial and viable financial basis <sup>1</sup>

Even though considerable progress has been achieved in the electric distribution sector, the distribution companies continue to be plagued by severe cash collection problems. The apparent inability of distribution companies to reach satisfactory collection levels is due to organizational, technical and financial control problems. Hagler Bailly has observed these problems close up in its pilot project at two electricity distribution networks in Armenia. These problems are described and remedial measures are recommended <sup>2</sup>

### 2 BACKGROUND

When the Republic of Armenia assumed title to the electric industry, it inherited an organizational structure that reflected the command performance of the Soviet era. The industry was state-owned and, as in all energy endeavors from the Soviet era, energy was substantially underpriced. Without offsetting capital allocations, this in itself would have caused problems in the industry's ability to properly maintain, let alone expand, the electric distribution system, but the situation was compounded by several seemingly unrelated events. The first strike against the electric sector in general was the earthquake of 1988 that led to the shutdown of the Metzamor nuclear power plant in March of 1989. When Metzamor was shut down, Armenia lost 880 MW of capacity, approximately 25% of the nation's total generating capacity. However, since Metzamor was used as a base-load plant, its removal from the electric power supply arena brought on a reduction of approximately 33% of Armenia's power production.

Following its loss of nuclear power, the second strike against the Armenian power sector was the Azeri embargo that was imposed in 1990. Since essentially all of the fuel for thermal power

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<sup>2</sup> For a full description of the pilot project activities, see the Hagler Bailly report entitled *Electricity Distribution Commercialization Project*

plants had come from or through Azerbaijan, Armenia found itself deprived of its thermal power generating capability. The only power source left in Armenia was its indigenous hydroelectric capacity. Under the circumstances, the Armenian authorities were forced to draw on their hydroelectric power source at a highly accelerated rate that was not sustainable in the long run, as it created severe environmental damage in Lake Sevan, the principal source of Armenia's hydropower. In fact, between 1988/89, its peak period of overall power generation, and 1993, Armenia's hydroelectric power generation tripled to nearly 4,300 GWh.

As a result of the embargo, and reinforced by the achievement of independence in 1991, the regional character of the energy supply and demand pattern was broken. The combined onslaught of the embargo and the disruption of trade across national boundaries brought on a dramatic and sustained decline in economic activity, and especially in industrial activity. The result was large-scale unemployment and impoverishment of the population which left it incapable of making payment on their electric bills.

By 1993, the Northern Caucasus-Trans-Caucasus gas pipeline which had been started in 1983, was completed. It re-established an energy link with the outside world. That, in theory, should have spelled the end of the energy supply problem for Armenia. However, the gas importing authorities were left in a difficult position because of payment difficulties brought on in part by the non-collection problem at home, also, the responsible authorities as well as the consuming public found it difficult to adjust to what they perceived to be inordinately high electric tariffs. Given the inadequacy of cash collections and the resulting shortage of funds with which to pay for imported gas, the government responded in part with barter transactions, and in part by accumulating debt.

Caught between its own supply problems, the public's inability to pay for the electricity it consumed, and the official policy response by the Armenian authorities, the electric utility, Armenergo, completely lost control over supply, billing and revenue collections. This was the time when substantial amounts of electric energy were lost through illegal connections (left lines) that the authorities were unable and at the time perhaps unwilling to deal with. The resulting shortages brought on severe curtailments, to the point that, in 1993, electricity to the residential sector was reduced to two hours per day on a good day and no electricity on some days.

Finally, in 1996, 24 hour-per-day service was restored. The resumption of around-the-clock electric power deliveries was made possible in part by reactivating, in November of 1995, at least part of the Metzamor nuclear power plant, and in part by imposing stricter controls and making a serious assault on theft of electricity. The restoration of all-day electric deliveries was achieved, even though total power generation in 1996 was less, by 90 GWh, than what it had been in 1993. However, while power deliveries were being normalized, collections remained unsatisfactory, at 20% of total sales. Because of the earlier uncontrolled and unbalanced distribution pattern through illegal lines, 80% of the distribution facilities (cables and transformers) were burned up, forcing the Government to spend enormous sums to repair and

replace the damaged equipment. In retrospect, it was probably a policy mistake to emphasize generation rather than controlling consumption patterns (left lines) and collection issues.

In 1995, one of the two nuclear reactor units, unit number 2, was reactivated, gas was freely flowing into Armenia, and the hydropower sector was run at excess capacity. In short, there was no longer a physical energy supply problem in the electric sector. As mentioned, this did nothing to alleviate Armenergo's problems in making payment for the importation of natural gas and nuclear fuel. That was the year when the Government made a policy decision to give serious thought to the collection problem. The first attempt was Decision Number 113 of the Government issued in March of 1995. This Decision was reinforced and translated into detailed instructions by order of the Ministry of Energy. That order brought on the re-organization of the distribution division of the electric monopoly Armenergo. It created a number of daughter enterprises in the distribution sector, originally approximately 50 of them. These daughter enterprises were given the responsibility of improving revenue collection. This was the first step in a number of decisions that affected the structure and commercial operations of the electric distribution sector.

The next major step was a Decision of the Ministry of Energy in late 1995 to unbundle the distribution sector and to remove it from the control of Armenergo. This involved the conversion of the daughter enterprises into state enterprises which became independent legal entities reporting directly to the Minister of Energy. That period coincided with the decision to re-focus attention on collections by installing master meters in private neighborhoods and residential apartment blocks. Block billing was based on the master meter, with individual apartment bills determined on the basis of the individual apartment meters already in place. A collecting agent (or so-called "financially responsible person") was appointed to contractually receive and assume responsibility for the electricity at the master meter and to make collection from the individual apartment meters, with a 7-10% profit span in the event of 100% collections.

As long as the master meter reading reasonably coincided with the sum of the individual apartment meters, there was no problem. Since this event took place at a time when electricity was restored to a 24-hr basis, the public readily accepted this change. Given the public's excitement at having electric power around the clock, collection was increased to 60% of residential billings. However, after the euphoria had waned, the public again reverted to its old non-payment habits and to illegal electricity taps, with master meter readings increasingly at odds with individual block consumption. As a result, collections receded again below the temporary peak of 60%.

At that point the decision was made to remove the individual apartment meters from inside the apartments to common areas in building blocks and to make them tamper-proof. Even though on the face of it this was an important step forward, in practice, this had only a limited impact on improving collections which nevertheless rose to 70%. One problem with this policy was that the relocation of meters remained in the private domain. As a result, no thought was given to securing the lines when moving the meters, so that the system at large remained open to

tampering. During this entire period, the collection system featuring the “financially responsible person” remained in place.

While these changes in metering and billing practices took place, the Government introduced a new organizational approach to the electric sector. On the distribution side, the distribution companies (which by that time had grown in number to 63) were consolidated into 11 companies, one for each Gavar (administrative region) in the country. This was in conflict with the recommendations of foreign consultants (World Bank and USAID) who had suggested somewhere between three and five distribution companies. Eventually, the view of the foreign advisors prevailed, and the number of electric distribution companies was reduced to four in mid-1998.

### 3. PILOT PROJECT

In an effort to demonstrate ways to improve the metering, billing and collection practices, Hagler Bailly, in association with CMP International, designed and implemented a pilot project. The components of the pilot include:

- ▶ install or replace inaccurate revenue meters at end user sites,
- ▶ install accurate revenue meters on apartment building common loads that were previously unmetered, such as stair lighting, elevators and water pumps,
- ▶ install accurate meters and instrument transformers at distribution substations on the incoming feeders supplied by Armenergo, these meters are also designed to be more tamper-proof (e.g., electronic programmable meters),
- ▶ seal all meters in the pilot areas with individually numbered and registered meter seals,
- ▶ develop and implement billing software to process record and store energy consumption, meter and customer information,
- ▶ build in to the metering, billing and collections software various components designed to improve internal financial controls and support improved business processes (e.g., permit billing cycles, innovative rate structures, unalterable audit databases to identify unauthorized changes to data, high/low meter reading checks to indicate unusual meter readings),
- ▶ install computer and communications equipment on which to operate the billing software and to transport billing information,
- ▶ procure and train staff in the use of modern meter testing equipment to permit more frequent testing and calibration of meters,

- ▶ develop and implement a meter testing and calibration program to test, calibrate and seal each meter in the pilot project areas

At this time, a definitive impact evaluation of the project cannot be completed as the results need to be monitored for a longer period of time and the pilot is ongoing. Nonetheless, a number of important conclusions can be drawn. These include:

- ▶ *The need for a metering, billing and collection system is critical and the project team's model developed for the pilot projects fully meets the needs for the power sector.* The metering, billing and collection software is ideally suited for implementation in an environment such as Armenia's, it may also be useful for other NIS,
- ▶ *In those areas where the project team's recommendations have been fully implemented and followed, collections can reach levels exceeding 90%.* In the Komitas network, collections have reached levels exceeding 90% for those areas where the metering, billing and collection system has been installed and management improvement recommendations are being followed.
- ▶ *Equipment cannot replace sound management practices.* Another lesson learned from this pilot is that the success or failure of the project does not depend on the equipment but on a change in business practices. There has been a tremendous amount of remetering activities that have taken place in Armenia both prior to and during the pilot project such as master metering and relocation of individual meters to common controlled locations. Nonetheless, these will have little effect on the situation if they are not supported by strong and competent managerial practices.
- ▶ *The success of the pilot continues to be hindered by Ministry and Government decisions affecting the power sector.* The most obvious example of this is the policy requiring reading of all meters on the last day of the month. This decision means that the full capability of the metering, billing and collection system cannot be fully utilized (the system is designed to handle billing cycles and rotate meter readers). Further, dramatic decreases in the collection results were witnessed during the election period due to lack of effective enforcement of disconnection practices during that time period.

Further, there are a number of process related improvements that can be suggested should similar projects be considered in the future:

- ▶ *Reliance on local counterparts to undertake specific measures to support the pilot projects is problematic.* During the pilot, commitments to design and install equipment were made by the counterparts and joint agreements related to cost sharing were signed. Ultimately, the counterparts have not been able to meet their commitments. As a result, design work as well as installation have proceeded much slower than planned. In some cases, major changes to the project design have had to take place to account for the inability of the counterpart organizations to meet their earlier commitments.

- ▶ *The objectives of the pilot program must be restated time and again* In this project, it was often the case that the counterpart organizations attempted to change the objectives of the pilot. For instance, at first, the Ministry of Energy encouraged rapid equipment procurement of three phase metering equipment to be spread nationwide, thus avoiding a pilot project approach altogether and focusing only on the equipment procurement side of the project. Similarly, there were requests to allocate significant portions of the budget to commodity procurement for winter heating needs in the sector. Others however viewed the pilot project as more “research oriented” and were willing to see procurement of equipment and project approaches designed to address specific questions such as those pertaining to the level of technical losses in the system. The obvious lesson from the pilot activities is that there simply needs to be a continual restatement of the purpose and objectives of the pilot to keep a proper focus for all organizations involved.
- ▶ *The tradeoffs between phased rather than full scale “roll out” of the pilot needs to be carefully assessed* This pilot project was designed as a large scale pilot encompassing roughly six percent of all metered consumers in the nation. The effort associated with such a large pilot means that there will certainly be a slower paced implementation effort than may otherwise be the case. There is a clear tradeoff that needs to be determined upfront, to either compromise and accept a much smaller pilot or to fully design a large scale effort recognizing that in the end, the latter approach will be more comprehensive and reach more consumers but the first approach offers the opportunity to demonstrate results earlier.

#### 4. CURRENT SITUATION

While the Government’s aggressive stance in improving its collection situation did bring measurable results, to the extent that collections are currently higher in Armenia than in any other NIS country, they are still not enough to solve the industry’s problem of cash starvation. At this moment, about 20% of the delivered electricity remains unbilled (theft) and another 20% is not collected (non-payment). Several forces are at work that prevent billings and collections from reaching satisfactory levels. Perhaps the greatest usefulness of the pilot project is that it has given the project team an opportunity to work closely with distribution utility management and staff and observe, as well as advise on, the practices undertaken in the metering, billing and collection area. Based on this experience, there are a number of problems that continue to plague the power sector. Although these problems are difficult to categorize and are all interrelated, they have been grouped into organizational (internal control), technical, and financial problem areas for purposes of this report.

##### **Organizational Problems**

- ▶ *The continued use of Financially Responsible Persons* Under this system, the Financially Responsible Person (FRP) controls some 500 to 600 customers, with the control variable established by a master meter. This leaves considerable room for manipulation among the individual customers, especially since significant amounts of

- electricity remain unmetered or unbilled such as electricity used in elevators, water pumps and other common facilities
- ▶ *Unregistered Customers* Local offices are responsible for connecting new customers, but there are inadequate controls to make sure these registrations find their way into billings. Hagler Bailly found various instances of unregistered customers.
  - ▶ *Collusion with Customers* This is made possible by a variety of factors including the fact that the FRP is always the same in his service territory and the meters are not tamper-proof. The FRP is in the position of manually adjusting the meters and of splitting the monies saved with the customer. Within limits, he can charge the missing electricity, as reflected on his master meter, to electricity used by unmetered common facilities.
  - ▶ *Insufficient Staff Salaries* The typical salary of a meter reader is US \$16 per month. It is simply unreasonable to expect proper internal control when the meter reader's salary is well below subsistence level.
  - ▶ *Same-Day Meter Readings* Against Hagler Bailly's recommendation, the Ministry of Energy currently requires that all meters throughout the country be read and their readings recorded on the same day of the month. Overlooking the impact this has on staffing levels, it also creates a large number of data errors which make it difficult to assess whether there are in fact large losses occurring or simply data entry errors that require correction.
  - ▶ *Staffing by Political Appointees* Numerous political appointees now hold management positions throughout the electric distribution sector. Although some of them may be good managers, that is probably more the exception than the rule. We have seen how this can affect distribution commercialization. For instance, in one of Hagler Bailly's pilot zones it would be effective to consolidate some of the local offices to improve efficiency and reduce costs. However, the heads of the local offices are appointed by the Ministry and this limits the ability of the director of the enterprise to effectively reorganize the operation.
  - ▶ *Inconsistent Enforcement of Rules* Even though the rules now require that non-paying customers be disconnected, and that people caught stealing be prosecuted, the enforcement of this rule is spotty. Customer debts continue to grow, and no one to date has been taken to court for theft of electricity, even though in some areas theft may reach as high as 70% of delivered power.
  - ▶ *Government Involvement in Operational Procedures* The same-day rule, not very helpful operationally and inadequate in solving the corruption problem in the industry, for example, was imposed by the Government.

- ▶ *Lack of Meter Maintenance Procedures* Meters currently in use are old, but even with those meters sufficient accuracy of consumption records can be gained. In the Baltic Republics, without any significant changes to the distribution infrastructure, collection levels are continuously maintained close to 100%. The Armenian electric distribution companies do not have any routine procedures to test and maintain meters on a revolving basis.

### **Technical Problems**

- ▶ *Lack of Spare Meters* If a meter is damaged or removed for testing, the customer may be connected directly and billed, at best, on an assumed average daily basis. This situation has been observed in some cases to go on for months.
- ▶ *Non-Adherence to Existing Technical Standards* While the old Soviet standards which are still in force are not unreasonable, they are universally ignored.
- ▶ *Deterioration of the Electric System* Through neglect over many years, through uncontrolled power surges and burned cables and transformers, the electric distribution system has reached a state of deterioration that makes physical control over power movements very difficult.

### **Financial Problems**

- ▶ *Lack of an Appropriate Information Data Base on Metering and Billing* The data base and computer software currently in use has been designed to support Ministry reporting requirements. The data base is not secure and, therefore, subject to tampering at any time. It is not geared to support activities on all organizational levels with regard to metering and billing.
- ▶ *Control over Cash Flow* In many cases inspectors are permitted to receive cash and sometimes they are required to do so. As a result the distribution companies lose control over cash collections. However, the distribution companies are now in the process of resolving this problem by requiring all customers to make payment in designated banks.

At this time, the Government feels that it has done all it can through organizational changes, and it now proposes to bring about further improvements through the introduction of more advanced technology. However, in light of the problems listed above, Hagler Bailly's opinion is that most of the metering and collection problems still are tied to managerial and organizational deficiencies. Technology will facilitate managerial and financial controls and will improve collection efforts, but to be successful, technology must be reinforced with strong management procedures.

## 5. RECOMMENDED STEPS

There are a number of recommended steps. First, the electric distribution companies need to establish an effective control environment. The institution of the Financially Responsible Person is counterproductive. The collection of bills should be the business of the distribution utility at large, and never of any one individual person. Put differently, collection should be the responsibility of management which is responsible for the proper organization of the business. This means that at least three functions associated with the metering, billing, and collection cycle must be separated. The first of these, meter reading, should be done by a company employee who does not also have the authority to make collection or to disconnect customers. To prevent the likelihood of collusion, the meter reader should be rotated to different service areas on a regular basis. Taking into account the new procedure of making collection through banks, the separation of meter reading and collection is effectively accomplished. Also, the disconnection of non-paying customers has to be done on a consistent basis by technically competent people.

Second, to enforce safe operations and to prevent meter tampering, all meters must be properly sealed with tamper-proof seals. The seals currently in use are not tamper-proof. What is needed is secure and numbered seals that permit tracking through appropriate computer programs. This procedure has been implemented in the pilot project areas.

Third, the current procedure of taking same-day meter readings must be abandoned for the more efficient and universally used method of cycling all operations including the taking of meter readings. The original Ministry intent to calculate losses with precision through same-day readings can be achieved with better accuracy and operational efficiency using cycled readings. This will also enable the distribution company to make better use of its staff, to reduce the work force, and to increase the salaries of the remaining staff.

Finally, the distribution companies need a comprehensive computerized data system that will support the tracking of electricity flows all the way to the individual customer, and which will tie these flows into the financial record of the company through a secure and efficient data base design. Such a data system has been designed and tested by Hagler Bailly and used in the pilot project.<sup>3</sup>

## 6 CONCLUSION

The pilot project for the electricity distribution sector offered an opportunity to be involved directly in the metering, billing and collection process. As demonstrated in the preceding text, Armenia has made progress in improving collections but there is still considerable room for improvement. The insight gained and results seen through the pilot project have been especially useful for the recent work of the USAID/Government of Armenia Experts Working Group on Metering, Billing and Collection. The pilot has demonstrated (and continues to demonstrate) the

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<sup>3</sup> This same system is also undergoing testing at Novosibirskenergo (Russia)

synergy that exists between policy level technical assistance and field level technical assistance. For either to reach their full effectiveness, the project team should be engaged at both levels. The detailed understanding of activities in the field provides insight which helps to further advance the policy level dialogue. Similarly, being engaged at the policy level provides an opportunity to influence the decision-making in a manner to improve the ability of the field level to perform its assignment and achieve the Government's objectives.