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ENERGY DATA COLLECTION AND ANALYSIS
MINISTRY OF ENERGY AND FUEL
REPUBLIC OF ARMENIA

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1. Background

This report responds to a specific requirement under Phase I of the referenced USAID Contract that stipulates the submission (in 5 copies) of "a report assessing the current status of energy data collection and analysis, the need for an MEF MIS, and expected difficulties in installing such a system such as aging phone lines, power interruptions, etc."

In Armenia, responsibility for all supply and demand aspects of energy resides in the Ministry of Energy and Fuel. This includes the task of monitoring current sources and uses of energy and, during the lingering energy crisis, of allocating these resources in accordance with a national priority system that has been established by a special inter-ministerial committee created for that purpose.

In the past, the Republic of Armenia, which is currently 90% dependent on imported energy to fuel its economy, has been receiving natural gas and liquid fuels from Azerbaijan. That source has been cut off due to a dispute and armed confrontation (currently at cease-fire stage) over Nagorno Karabakh. The only other available supply line, through Georgia, has been subject to frequent disruptions because of internal disputes and payment difficulties in the transit country.

The Government of Armenia has resorted to draconian energy measures to keep the economy afloat. This includes cutting off most district heating systems in the country and shutting down non-essential industries and services. Essential industries and services include activities deemed indispensable for survival, such as hospitals and bakeries, as well as export industries manufacturing goods that are needed and accepted abroad to pay for imported energy through barter arrangements. In addition, all natural gas deliveries to households have been discontinued and essentially all of the imported natural gas is being used for electric power generation. Households had to switch to electricity for cooking and heating, but the available supply of electricity forced curtailment of deliveries to households, at times to as little as one hour per day. Overall, the combined energy consumption by households and industry has declined by about 73% from 1988 to 1992.

2. Objectives

The current energy crisis has forced the Ministry of Energy and Fuel into the business of allocating available fuels on a daily basis, in addition to the more conventional role of energy policy making. As a result, two kinds of energy information systems are needed. One to respond to the Ministry's daily need to know what kinds and amounts of energy are available for energy allocation purposes. This is more of an operational data collection effort that resembles that of a corporate entity, and its use will likely be abandoned once the border disputes are resolved and energy resumes a more plentiful and reliable supply pattern. Nevertheless, at this moment the population of Armenia is suffering from severe energy shortages, and the use of a real-time system to alleviate the pain is absolutely mandatory.

The second energy information system that is needed in Armenia is more conventional and forward-looking. That system will establish a data base that the Ministry of Energy and Fuel will need for long-term policy making. The system will develop energy data balances for the country at recurring intervals, either monthly or quarterly; it will monitor energy prices as needed for regulatory purposes; it will establish demand and supply patterns in the country for various individual fuels, and by consuming sector; it will note changes in those patterns as the Nation undergoes its metamorphosis from central controls to a market economy; and it will provide feed-back to the Ministry regarding the direction, and possible changes in direction, it may wish to impose in the development of its energy policy.

3. Current Status - Energy Data Collection

Five different entities have dealt with the collection of energy data in the recent past: The Ministry of Energy and Fuel itself, under the direction of Dr. Yuri Orbelian, as well as four Western consulting firms: Decon/Kantor, under the leadership of Dr. Wolfram Schwarzer; BCEOM under Mr. Albert Zweering; Lahmeyer International, headed by Mr. Engelbertus Oud, and Moret, Ernst and Young, an International accounting firm. These will be discussed in the listed order.

A. The Ministry of Energy and Fuel

Dr. Yuri Orbelian is the Government Official charged with the collection, storage and dissemination of national energy data. The institutional entity that formally runs the energy data operations is called Armgasproject. It is located at some

distance from the Ministry and it consists of a number of highly trained computer experts whose tools include various free-standing PCs. Armgasproject does not currently have a LAN system.

We arranged several work sessions at Armgasproject to discuss with Dr. Orbelian and his staff what his Institute currently has on hand by way of an energy data system. As it turns out, Dr. Orbelian's Institute has developed a sophisticated monitoring system of daily energy supplies. That system has been loaded onto several free-standing PCs, each of which has a self-contained section of the overall system. There are some 50 sub-programs, each of which is capable of producing somewhere between 2 and 15 data tables. Of the 50 sub-programs, some 15 deal exclusively with Armenian energy information. The reason for allocating the overall system to several computers is that they do not have a LAN system, and the individual computers do not have sufficient memory to handle the entire system on one unit. Still, the system works. It is the backbone of the Country's energy crisis management efforts. A description of the overall system and sample tables are being prepared by Armgasproject.

Dr. Orbelian's short-term energy crisis management system is run from a FoxPro database. The Institute is currently planning to convert the system to Microsoft Access, the data base software that will be part of the proposed Ministry LAN system. Their plan is to load the system on the Ministry LAN system after installation, so that the entire system resides in one secure place and operates under one data base. My feeling is, subject to discussion with other interested parties at the Ministry and with the LAN installation team, that Dr. Orbelian needs no particular help with the existing crisis management system, except for some facilitating and training function during the transition process. The plan would be to assist Dr. Orbelian and his staff in familiarizing themselves with Microsoft Access, an advance copy of which they are now installing on one of their PCs. The overall system conversion will be done one sub-program at a time while they are still on individual PCs, prior to loading the entire system onto the Ministry LAN system. Meanwhile, they can continue to make their daily production runs on FoxPro as long as they like, and they can switch individual sub-programs to Microsoft Access, with FoxPro running in the background, until they become comfortable with the converted subsystems.

The story is quite different as regards a general policy-oriented data base. Such a data base, for all practical purposes, does not exist except for pioneering work that was done by BCEOM and Lahmeyer International and that will be discussed later in this report. Existing energy information collected by the Government, other than that needed for daily fuel allocations, is scattered over several Governmental Institutions inside and outside the Ministry of Energy and Fuel,

and it is incomplete. As far as we can see, there has never been a systematic attempt, prior to the arrival of Western consulting firms, to establish a consolidated national energy balance. For example, no regularly scheduled monthly, quarterly, or yearly energy data reports of any kind are currently prepared for the Ministry of Energy and Fuel.

A data base specifically designed to develop and maintain the Nation's energy balances is urgently needed. Without such an energy data base, the development of a rational and credible national energy policy would be difficult, if not impossible. This is the area where the bulk of USAID's assistance on energy data will be needed.

The overall energy data base approach as tentatively agreed to by the Government of Armenia is ideal: the existing daily crisis management system works well and needs no additional work other than conversion to Microsoft Access. It will be handled under the leadership of Dr. Orbelian and his staff, with some guidance by Merklein & Associates staff.

In contrast, the broad monthly (or quarterly) data base that must be developed from scratch has essentially no old baggage to salvage; its conceptualization and development will take place under the leadership of Merklein & Associates.

B. Decon/Kantor (Dr. Wolfram Schwarzer)

This is the first and most massive of the three Western energy studies that have been prepared in the recent past. Funded by the Commission of the European Communities (CEC), the work is mostly descriptive rather than analytical. Encyclopedic in coverage, it lacks specificity. The study is very generous in its policy recommendations, almost to the point of ignoring budgetary realities. Be this as it may, and apart from the Firm's discussion emphasizing the need for an energy data MIS system which will be dealt with later in this report, Decon/Kantor did not do a detailed analysis of the existing data structure, nor did it make an attempt to develop a data base of its own. It simply noted the need for such a base, suggested what it might contain, and moved on to other energy recommendations. Accordingly, and unlike the two studies that follow, the Decon/Kantor study did not develop any energy data building blocks for use in the construction of an Armenian National energy data base.

C. BCEOM (Mr. Albert Zweering)

The highly respected BCEOM report, written by Mr. Albert Zweering and funded by the CEC, is noted for its sensible policy recommendations. Many of these

recommendations are being accepted by the Government of Armenia, including the establishment of an Energy Policy Center where, at first under Mr. Zweering's leadership, but later by Armenian policy officials, different policy scenarios will be investigated and submitted to Ministry Officials for evaluation and possible acceptance. This Center is likely to be the principal user of the energy data base to be developed through our MIS system.

Mr. Zweering undertook to develop a tentative energy balance for Armenia for the years of 1988 and 1991. The data developed in this and other efforts include the following balances:

- In the Agricultural Sector, the consumption of gasoline, diesel, mazut (residual fuel oil), natural gas, electricity, and heat.

- For the Nation as a whole, the production and consumption of primary energy, and the end-use consumption of energy, based on the following types: coal, oil products, LPG, natural gas, district heat, hydro, nuclear, and thermal electricity.

- Imports of gasoline and coal.

- In the electricity sector, the consumption of residual fuel and natural gas in thermal power plants, gross electricity production by thermal, nuclear, and hydro-power plants, electricity imports and exports, electricity losses, and electricity consumption in various sectors, including the industrial, residential, agricultural, transportation, and service-commerce-administration sectors.

- In the fossil fuel sector, the consumption of various oil products, including aviation fuel, gasoline, kerosene, diesel fuel, stove fuel, residual fuel, bunker fuel, and lubricating oil, as well as LPG , coal, and coke.

- Energy prices, including electricity, coal, kerosene, natural gas, LPG, and gasoline prices.

- Estimates of the numbers of cooking stoves, water heaters, and heating stoves.

- Gross domestic product information for the Republic of Armenia.

- Various specific fuel balances, including heat production, LPG balances, residual fuel balances, natural gas balances, and oil balances.

This was a first attempt and, given the state of Armenia's energy data then at hand, the balance was necessarily less than complete. Indeed, Mr. Zweering's purpose in setting up a first energy balance was to identify and document existing energy data gaps, of which he found many. The most notable of these relate to inaccurate tracking of private-sector liquid fuel imports, inability to monitor electricity consumption in households where substantial amounts of electricity are delivered through illegal and untraceable lines, inconsistent recording of heat versus electricity production in cogeneration projects, and incomplete accounting for in-house electricity production in manufacturing firms.

Still, an important first step has been taken in Mr. Zweering's study toward the establishment of a consistent national data base. We plan to use and expand his work to include all years from 1988 to the present and to capture additional variables. The latter process will be set in motion upon completion of the LAN installation, but it will take years to bring it to a satisfactory closure. The decision to retain as much as possible of Mr. Zweering's work is in accordance with Vice Minister Galustian's earlier request along these lines.

D. Lahmeyer International (Mr. Engelbertus Oud)

Of equally high quality as the BCEOM study, the Lahmeyer study, funded by the EBRD and written by Mr. Oud, deals mostly with the electric sector. Like Mr. Zweering, Mr. Oud worked on an energy balance, with particular emphasis on electricity production. Mr. Oud also emphasized the need to expand and improve on the existing energy data base in Armenia.

The Lahmeyer study goes beyond a mere description of the electric sector. It develops detailed recommendations for expanding the Armenian power generation system, drawing on engineering and capital investment issues, as well as on current and projected electricity production and consumption data. Thermal power plants, existing and new hydro-power plants, the re-commissioning of the nuclear power generator Medzamor 2, geothermal and wind power plants are all taken into consideration in this work.

To arrive at meaningful electric power recommendations, the Lahmeyer study spends a great deal of effort on developing production data for individual power plants and on developing power consumption for the major industrial users in the country. The study also develops a series of technical data on plants and

related issues, including, for example, water level drops in Lake Sevan and in other lakes that are feeding major hydro-power plants, and it spends considerable effort on the issue of separating heat and electricity production in thermal power plants, an area where data inaccuracies are particularly pronounced.

Like the BCEOM study, much of the material developed by Mr. Oud will be incorporated in the energy data base to be developed in the MIS system of the Ministry of Energy and Fuel.

E. Moret, Ernst and Young

Moret, Ernst & Young is an international accounting firm that has worked primarily on analyzing the accounting system of Armenergo. This is an important area, but of more interest to the corporatization and privatization activities of USAID and other organizations, rather than to the Ministry's interest in setting up a governmental MIS and energy data system. Hence, the Moret, Ernst and Young work does not overlap the data efforts described earlier.

4. Current Status - Need for an MEF MIS

The Ministry of Energy and Fuel

Vice Minister Galustian has been given the lead in voicing the Ministry's position concerning the need for, and the desired capabilities of, the energy information MIS system. At a meeting held on December 6, 1994, Dr. Galustian discussed the need for such a system. He pointed out that all preceding Western consultants had emphasized the need for a central energy data base, a view he shares with them, but that none had the authority to spend substantial sums of money on the required equipment. Hence, short of this USAID effort, there is no project now under way, and none in the offing, to achieve such a data base.

Dr. Galustian delineated his perceptions regarding the MIS system requirements for the Ministry. These include the ability for Key Officials of the Ministry to maintain direct, reliable and speedy contacts world-wide, for example with international institutions such as the World Bank or USAID. Regarding the data base itself, Dr. Galustian emphasized its importance by assigning two of the Ministry's most experienced officials to the project (Dr. Yuri Orbelian in the area of computer systems and software design and Mr. Armen Arzumanian in energy data collection), to act on his behalf and to represent his views in the design and installation of the MIS system.

Decon/Kantor

Dr. Schwarzer strongly supports the installation of an energy data MIS system. He mentions that "Management Information Systems as used in Western Enterprises are not in function" and that there is a lack of structured information needed for energy planning, operation and monitoring. The Decon/Kantor team felt so strongly about the need for such a system that they held a two-day seminar in Yerevan on the transfer of Western technology in Management Information Systems. In Dr. Schwarzer's view, such a system should incorporate a data base management system along the lines subsequently suggested in the Merklein & Associates proposal.

In his policy recommendations, Dr. Schwarzer specifically advocates the establishment of an MIS system within the Ministry of Energy and Fuel.

BCEOM

In BCEOM's Final Draft Report, Mr. Zweering points to a number of deficiencies of the energy data system presently in use in Armenia, including:

- Low numbers for the transport sector since they only cover State operated transportation;
- An incorrect distinction between residential and tertiary sector energy consumption;
- Questionable fuel allocation policies which are based on former norms of energy demand rather than measured needs;
- Other deficiencies mentioned earlier.

According to Mr. Zweering, "the transition to a more open, market-based economy requires other concepts of energy planning .... a sound energy policy must be developed .... this demands setting up an energy data base." And then again: "To have a clear view regarding the possibilities and impacts of a strong policy on the rational use of energy, several conditions will have to be met. The first is information. Without information on the basic energy flows, analysis of final consumption is not possible. An extensive data base must be established, where information is structurally collected...."

Mr. Zweering then proceeds with a strong recommendation that a special Energy Information Department be established within the Ministry of Energy and Fuel. His action plan calls for the "immediate start of a project which outlines the necessary organization, legislation, and format for a structural data collection process.

Lahmeyer International

Mr. Oud's study is mostly focused on the rehabilitation of the electric sector. Accordingly, it does not specifically recommend the establishment of an energy data system, at least not in the Draft Interim Report that was available at the time of this writing. However, the fact that Mr. Oud built on the energy data developed by his predecessors and that he spent significant time and effort in improving and expanding the data base of the power subsector is a strong, if implicit, indication of his perceived need for an improved energy data base for the country at large.

5. Expected Difficulties in Installing an MIS System.

The technical difficulties of deploying the proposed system are minimal. The system is composed of current and readily available commercial off-the-shelf software products, such as MicroSoft Office. The existing PCs in place at the Armenian Energy Ministry are compatible with the new hardware and software that will be installed. Due to a lack of readily available sources of supply in Armenia, the system design will provide for spares as a critical element of the overall installation. The number of spare components will be based on Vendor supplied Mean Time between Failure statistics for the components, but it will also factor in a modest increase in capacity of 20%.

The expected logistical difficulties are considerable. The system components will be specified, acquired, installed, and fully tested in the United States. Any component that fails testing will be replaced before shipping to Armenia. All system components will be capable of 110 Volt and 220 Volt operation. The power cords to meet the Armenian standards will be acquired in the States and installed in Armenia.

The electrical power in the Armenian Ministry building is subject to outages and brownouts. Uninterruptible power supplies (UPS) and power line conditioners will be specified and acquired for critical components.

The shipping, handling, and storage of a large quantity of system components will be a challenge. The shipping will require special packaging of the components such as crating or shrink wrapping. Crating is preferred in order to ensure safety in handling components and to deter theft. The system will require a staging area in the States to both test the system and package it for shipping,

and it will require a secure storage area in Armenia. It is assumed that no import/export duties will be applied to the system.

Another area of expected difficulty is in the installation of the network infrastructure hardware. This problem has two aspects. One, the building is basically a stone and concrete structure that will require a total on-the-wall wiring solution. Second, no in-country sources were found that could provide the hardware and the services to install the network components to our specifications. The installation will have to be accomplished by US personnel supervising local Armenian labor. All components and supplies will be acquired in the United States.

Another problem with the facilities is the lack of space to set up a central computer room to accommodate the network communications, server operation, and system administration. As of this writing, the Energy Ministry has not identified a secure room with adequate space and power sources, but the Ministry has committed to making such a room available. The system design is such that the placement of the computer room must be within the Ministry itself.

In addition to the power problems, the local telephone service is poor at best. The problems stem primarily from noise on the lines which will adversely affect modem data communications. The problems of in-country data communications will be met using robust modems operating at reduced speeds. This solution is not acceptable for International Data communications requirements of E-Mail and file transfer. For these requirements, a separate dedicated telephone line will be acquired to insure reliable communication.

The expected difficulties in turning the system over to the Armenian Government personnel are minimal. The personnel identified by the Energy Ministry to operate and maintain the system have experience with both PC hardware and software. The personnel are already providing support to stand-alone systems within the Energy Ministry.

6. Next Steps

This and a companion memo on how USAID's activities in this area would fit into similar activities of other organizations are the substance of the first of four Benchmarks of the overall workplan.

The next step (Benchmark 2, Phase I) is the conceptual design of the MEF MIS system including needed hardware, software, design, development, and

expected implementation and training costs and schedules. If approved by USAID and the Government of Armenia, a technical report will follow that will provide a detailed materials list to be used for competitive procurement in the U.S. The installed MIS system, after assembling and testing in the U.S., represents Benchmark 3, to be followed by a shake-down and training period.