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MONGOLIAN ENERGY SECTOR PROJECT

COMPONENT III

USAID PROJECT NO. 438-003

CONTRACT NO. AEP-0438-C-00-3023

FINAL REPORT

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MORRISON KNUDSEN CORPORATION
OPERATIONS & MAINTENANCE GROUP

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SECTION 1.0 EXECUTIVE SUMMARY

1.1 Project Scope and Objectives

The USAID Energy Sector Project (ESP) was initiated in 1992 with the objective of providing critical materials and technical assistance to the Mongolian Energy Sector during the difficult transition from a planned socialist system economy to a free market economy. USAID dedicated $35,000,000 over a three and one half year period to the support program.

The Mongolian Energy Sector, consisting primarily of coal fired power and heating plants and the various coal mines that supply them, was in a very critical state of disrepair following the economic collapse of the Union of Soviet Socialist Republics and other former socialist republics. Coal production and power plant repairs had declined steadily since 1989 so that by 1992 the entire system was on the verge of collapse.

The first year of the project was classified as "emergency" and many of the normal US procurement regulations were temporarily suspended. The critical first year of the project was administered by United Engineers & Constructors (UE&C) and approximately $10,500,000 was expended by them in that year. Morrison Knudsen Corporation (MK) served as a sub-contractor to UE&C during this initial phase, with responsibility for providing support in coal mining.

MK was selected by USAID to administer the program in April 1993 and continuing to 7 November 1995. The original MK contract called for $20,548,847 to be allocated for support over the 30 month period. The actual amount approved in a series of incremental fundings through September 1995, was $20,050,000.

MK was able to organize the effort very quickly as a technical contigent was already present in Mongolia. MK also had a procurement staff in the Boise home office with extensive international procurement and logistics experience. Executive oversight, project administration, logistics and the US procurement effort were established and operated from the Boise, Idaho, headquarters. Project Management, all technical effort, local administration and procurement management were on site in Ulaanbaatar, Mongolia.

After mid-1993 the project was no longer classified as "emergency" and MK adhered to all FAR and USAID procurement regulations including the requirement to purchase all material from US sources when possible. This placed the major burden on the Boise Home Office for all US procurment and the logistic effort involved in efficiently getting the purchased material to Mongolia.

MK's focus was to provide critical material and technical support to the Mongolian Energy Sector, as required, to prevent complete failure of the system.

The scope of the project included support for all coal fired electric generating units and heating plants together with the coal mines that supply them.

1.2 Summary of Project Activities

MK received initial funding of $500,000 in May 1993 to mobilize the support effort and to provide a Value Engineering study which guided the effort for the first heating season of 1993/1994. Incremental funding of $8,000,000 to support the actual effort was approved in late September 1993. Because of the delay in funding MK was authorized to spend approximately $2,100,000 of this initial allocation in procurement from Commonwealth of Independent States (CIS) sources. Over the life of the project, funding approvals did not correspond to either calendar years or fiscal years, therefore part of the calendar year 1993 funding was actually spent in 1993 and part in 1994. MK has tracked and reported expenditures on a calendar year basis. 1993 Expenditures were approximately as follows:

US Procured Material	$	1,040,350	39.17%
CIS Procured Material	$	0	0%
Freight Charges	$	397,458	14.97%
In Country Support	$	59,175	2.23%
Training Programs	$	0	0%
Procurement, Technical Support & Administration	$	1,158,892	43.63%
Total	$	2,655,875	100%

A Task 2 report was prepared by MK and submitted to USAID in September 1993 to define the scope of the project for the succeeding two years. This initial scope was not accepted by USAID and a Task 2 scope of work was developed by USAID in January 1994. This and succeeding correspondence between MK and USAID formed the basis for MK's scope of work from February 1994 to November 1995.

A critical procurement list for the 1994/1995 heating season was developed by the power plants, mines, the Ministry of Energy, Geology and Mining (MOEGM) and MK. This list was completed and approved by all parties early in May 1994. Incremental funding of $6,000,000 to support this effort was approved by USAID in April 1994 and the procurement

effort was implemented immediately with the stipulation from USAID that all procurement would be from US sources.

Calendar year 1994 expenditures were approximately as follows:

US Procured Material	$	4,868,615	49.83%
CIS Procured Material	$	2,058,090	21.07%
Freight Charges	$	715,233	7.32%
In Country Support	$	213,871	2.19%
Training Programs	$	0	0%
Procurement, Technical Support & Administration	$	1,913,832	19.59%
Total	$	9,769,641	100%

Along with continuing technical support, training and administration of the procurement effort, a critical procurement list for the 1995/1996 heating season was developed by MK, the MOEGM and USAID during the fall of 1994. MK requested $7,500,000 in additional funding and began the procurement effort in December 1994, but additional incremental funding was not approved until March 1995 so that the procurements could actually be made. This incremental funding was in the amount of $3,500,000 with $1,500,000 held in reserve by the USAID representative. This was significantly less than requested and it was necessary to eliminate many items from the original critical list. Since the MK contract was scheduled to end in 1995, it was also necessary to delete any procured items which could not be shipped from the US in time to arrive before the scheduled contract end on November 7, 1995.

Because of the time frame required for US source procurement, MK based the procurement effort on approval of $4,500,000 in funding with assurance from USAID that the additional $1,000,000 would be approved when required. This additional funding of $1,000,000 was approved in September 1995 and the calendar year 1995 funding was employed approximately as follows:

US Procured Material	$	4,061,882	52.74%
CIS Procured Material	$	821,227	10.66%
Freight Charges	$	433,261	5.63%
In Country Support	$	236,866	3.08%
Training Programs	$	587,683	7.63%
Procurement, Technical Support & Administration	$	1,797,428	23.36%
Total	$	7,701,481	100%

All USAID funding to the Energy Sector Project over the 30 month period was employed approximately as follows:

US Procured Material	$	9,970,847	49.54%
CIS Procured Material	$	2,879,317	14.31%
Freight Charges	$	1,545,952	7.68%
In Country Support	$	509,912	2.53%
Training Programs	$	587,683	7.63%
Procurement, Technical Support & Administration	$	4,633,286	23.00%
Total	$	20,126,997	100%

The procurement funds were allocated approximately as follows:

Material Procured for Mines (including freight)	$ 6,822,195	42%
Material Procured for Power Plants (including freight)	$ 7,209,913	45%
Additional Support to Mines	$ 428,100	3%
Additional Support to Power Plants	$ 1,614,800	10%
TOTAL	$ 16,075,008	100%

In addition to the procurement of critical material, MK, under the USAID program, provided valuable day-to-day support to all areas of the Mongolian Energy Sector. This daily support was focused primarily at Power Plant #3 as this power plant had the most critical requirements and was one of the most important elements in preventing a major failure.

Formal training programs were conducted during the course of the project in the following areas:

- English Language Training
- Management and Supervision
- NDE Failure Evaluation
- Rotating Equipment Failure Analysis
- Project Management
- Overburden Blasting Methods
- Welding Procedures
- Computer and Software Usage
- Inventory Control and Accounting

These formal training programs are described in detail in later sections of this report.

1.3 Project Accomplishments

The USAID Energy Sector Project has provided urgently needed supplies, spare parts and tools to assist the Mongolians in preventing a major failure in the heating and electric supply during three very severe winters.

The project has also provided valuable training and technical support which has helped to begin a change in attitude for many individual Mongolians regarding equipment

maintenance, management, work habits, efficiency and safety. These accomplishments will become apparent over the coming years and assist Mongolia in developing a self sustaining Energy Sector in the future.

MK personnel provided valuable help to the MOEGM in preparing presentation materials for two International Donor Conferences. These presentations resulted in attracting interest and tangible support for the Energy Sector from various donor countries and organizations.

MK and USAID personnel conducted many presentations and tours for a variety of representatives from various countries and organizations to make them aware of the critical needs of the entire Mongolian Energy Sector. This has resulted in a much greater international awareness of the critical situation regarding the energy sector.

1.4 Recommendations

MK personnel have been involved in the USAID ESP since mid-1992 and have had the opportunity to observe and work with all areas of the Mongolian Energy Sector. Many things remain to be done in all areas, but specific items suitable for further USAID assistance have been identified. Specifically:

- Extension of the present ESP Project
- Assist Rural Diesel Electric Plants
- Economic Evaluation of Diesel Power Stations
- Renewable Energy Evaluation
- Evaluation of Rail Overburden Equipment
- Provide Training and Equipment for Inventory Control
- English Language Training
- Maintenance Training
- Provide Work Shop Tools & Supplies
- Provide Cross Training in the United States

SECTION 2.0 INTRODUCTION

Mongolia was the first of the former Russian satellite states to declare independence and state a decision by the Mongolian people to pursue a course of democracy and a free market economy. Shortly after that declaration, the US Secretary of State visited Mongolia to determine how the United States could assist their country with that course of action.

As a result of the Secretary's visit, the US pledged $50 million in aid to assist in the transition. This aid is administered by the USAID organization. Approximately $10 million was provided immediately to assist in a solution of a grave cash crisis of the Mongolian government. Approximately $5 million was used in support of various economic and advisory programs. A commitment was made for $35 million to be dedicated to support of the Energy Sector. The initial USAID support effort began in 1992 with United Engineers and Constructors being selected to administer the contract. At that time, MK was involved only as a subcontractor to UE&C to assist in support of the coal mines. In April 1993, USAID selected MK as the primary contractor to replace UE&C. MK then chose the firm of Burns & Roe Engineering (BRE) to provide support with power station engineering.

The Energy Sector of Mongolia consists of six coal fired electric and heat generating plants, a large number of small diesel powered generating plants and coal fired heating plants in the various provincial villages and towns (soums). Three of the coal fired power stations are located in Ulaanbaatar and supply all of the electricity, heat and steam for the capitol. There are also four major coal mines which supply all of the coal to the generating stations.

Ulaanbaatar is the capitol city of Mongolia and contains approximately one third of the entire population of Mongolia. A major failure here in electric and heat generation during the severe winter would result in widespread human suffering and loss of life. With this in mind, USAID and MK agreed that the major support effort should be concentrated on the power stations and coal mines that supply Ulaanbaatar. The power stations involved are Power Plant #2, Power Plant #3 and Power Plant #4. The coal mines which supply these power stations are Sharyn Gol mine, Baga Nuur mine and Shivee Ovoo mine.

A Value Engineering study was conducted in 1993 as a joint effort by USAID, MK and the MOEGM to determine needs and to establish primary objectives for the USAID effort. This study determined that critical items required by the Energy Sector totaled approximately $130 million dollars. This far exceeded the available USAID funding so the list went through two stages of reduction to establish the most critical needs and the best use of funds. The priority list was then reduced to approximately $30 million. A report documenting the results of this study was given to USAID in July 1993 and served as the basis for the MK/USAID procurement and technical assistance program for the 1993/1994 heating season.

Similar, though less formal, Value Engineering studies were performed by MK, USAID and the MOEGM prior to each heating season. These studies were used to develop the critical procurement list and training programs to guide the MK effort for that season.

In view of the many short term needs and limited USAID funds, it was further decided in January 1994 that the USAID effort could not meet the critical needs of all three power stations and three mines that serve Ulaanbaatar. USAID and MK then agreed to focus primarily on Power Plant #3 and the Sharyn Gol mine with limited support for Power Plant #4 and the mines at Baga Nuur and Shivee Ovoo. This agreement was documented in the Task 2 letter agreements between USAID and MK. The Task 2 documents became the basis for the MK/USAID effort for the 1994/1995 and 1995/1996 heating seasons.

With USAID approval, limited aid was also provided to Power Plant #2 and to the power station at Choibalsan in eastern Mongolia during the 1995/1996 heating season because of the extremely critical needs there.

SECTION 3.0 PROJECT FINANCIAL

3.1 Contract and Modifications

The effective date of the contract between MK and USAID was April 23, 1993 and was signed on April 28 and May 7, 1993. The contract was a fixed fee (term type) approved for total costs of $19,692,523 plus a fixed fee of $856,324. The contract total amount was $20,548,847.

The contract was governed by various FAR regulations and MK was unable to exceed the funds obligated on the contract without approval of the Contracting Officer as provided in the General Provisions clause entitled "Limitation of Funds" (FAR 52.232-22).

The initial incremental funding of $500,000 was granted by USAID's Contracting Officer on May 3, 1993 with additional Amendment Modification of the Contracts completed as follows:

MOD. NO.	DATE	AMOUNT	CONTRACT TOTAL	PURPOSE
1	20 Sep 1993	$ 0	$ 500,000	Revise contract admin office, contract payment office and CTO
2	22 Sep 1993	$ 8,000,000	$ 8,500,000	Engineering services and procurement of commodities
3	29 Sep 1993	$ 100,000	$ 8,600,000	Engineering services and procurement of commodities
4	22 Apr 1994	$ 6,000,000	$ 14,600,000	Engineering services and procurement of commodities
5	28 Dec 1994	$ 950,000	$ 15,550,000	Support of program activities
6	20 Mar 1995	$ 3,500,000	$ 19,050,000	Funding through 30 Sep 1995
7	20 Sep 1995	$ 500,000	$ 19,550,000	Funding through 30 Nov 1995
8	22 Sep 1995	$ 500,000	$ 20,050,000	Funding through 30 Nov 1995

As of the date of this writing, MK has submitted a request to USAID for increased contract funding in the amount of $262,129 to cover the cost of non-destructive evaluation which was approved by the OAR/M and we are awaiting reply.

MK has complied with contractual requirements that apply, as follows:

- Section B.1 through B.7, Total Cost, Indirect Cost Rates and Level of Effort.
- Section C.1 through C.8, Description/Specification/Work Statement.
- Section D.1 through D.8, Packaging and Marking.
- Section E.1 through E.3, Inspection and Acceptance.
- Section F.1 through F.7, Deliveries or Performance.
- Section G.1 through G.7, Contract Administration Data.
- Section H.1 through H.12, Special Contract Requirements.
- Section I, Contract Clauses

MK has reviewed and submitted voucher invoices to the Cognizant Technical Officer (CTO) for review and approval per section G-1 of the contract.

MK has submitted a total of 27 invoices to USAID since the inception of the contract. The actual invoiced cost total of the contract through September 30, 1995, is $19,319,540 with additional accrued (committed) cost $807,457 bringing the total cost of the present contract to $20,126,997.

MK has also provided a breakdown of the forecasted estimated increase funding mentioned above.

3.2 Project Financial

Actual invoiced cost of the contract through 30 September 1995 is $19,319,540.

The job to date costs are highlighted below from MK's invoice, 3405-10-028, dated October 27, 1995:

Description		Actual	Percent
MK's			
Expatriate Labor Costs	$	1,578,295	8.09%
BHO Labor Costs	$	596,497	3.06%
TDY Expats, Dir Travel & Other	$	554,973	2.84%
In-country (Mongolia)			
Labor	$	112,875	0.58%
Indirect and Other	$	372,802	1.91%
Equipment	$	9,235	0.05%
Subcontracts			
Burns & Roe Subcontract	$	680,290	3.49%
Equipment/Training/Freight			
US Equipment Purchase	$	9,876,444	50.60%
CIS Equipment Purchase	$	2,879,317	14.75%
Training Programs	$	249,021	1.28%
Freight	$	1,543,452	7.91%
Administration			
DPP, Overhead, G&A	$	300,727	1.54%
Fixed Fee	$	766,119	3.92%
Total	$	19,520,047	100%

From the above table we see that approximately 83% of the USAID funds were spent directly with US companies and individuals, approximately 17% was spent in Mongolia and in CIS countries. Of the 17%, approximately 3.5% of this was spent in Mongolia including $180,000 paid out by MK and MK employees for rent, utilities and other office and living expenses.

The contract used (and is using) wire transfer payment procedures, which were implemented by cooperation of USAID and MK personnel.

Table 3-1 shows a comparison of original budget cost versus actual cost and Table 3-2 is a similar comparison after the Task 2 modification and funding modifications were made in the contract.

TABLE 3-1
MONGOLIAN ENERGY SECTOR PROJECT COMPONENT III
ORIGINAL BUDGET versus JOB-TO-DATE ACTUAL COST
FOR PERIOD MAY '93 THROUGH SEP '95

As of 2 November 1995

DESCRIPTION (Revised to Actual USAID Invoiced Amounts)	PROPOSED BUDGET	%	TOTAL '93 - '95	%
MK's:				
Expatriate Labor Costs (Engineer,Procurement, Tech)	$ 1,699,490	8.27%	$ 1,578,295	7.84%
BHO Labor Cost (Procurement, Admin & Support)	$ 294,349	1.43%	$ 596,497	2.96%
Expat's TDY & BHO Indirect Travel & Other	$ 438,219	2.13%	$ 569,973	2.83%
In-country (Mongolia):				
Mongolian Labor	$ 37,600	0.18%	$ 117,875	0.59%
Indirect and Other Costs	$ 329,770	1.60%	$ 382,802	1.90%
Equipment	$ 0	0.00%	$ 9,235	0.05%
SUBTOTAL	$ 367,370	1.79%	$ 509,912	2.53%
Burns & Roe (Engineering/Technical):				
Expatriate Labor Costs	$ 697,508	3.39%	$ 372,387	1.85%
Home Office Support	$ 82,660	0.40%	$ 204,556	1.02%
Indirect and Other Costs	$ 111,188	0.54%	$ 83,609	0.42%
Training (Fire Pro Plant Ground) & Power Plant Roof	$ 0	0.00%	$ 64,738	0.32%
SUBTOTAL	$ 891,356	4.34%	$ 725,290	3.60%
US Equipment Procured/Purchased	$ 14,900,000	72.51%	$ 9,970,847	49.54%
CIS Equipment Procured/Purchased	$ 0	0.00%	$ 2,879,317	14.31%
US/In-country Training Program (Reserve Amt):				
Warehouse/Inventory Training	$ 0	0.00%	$ 52,683	0.26%
MK and B&R NDE Study	$ 0	0.00%	$ 262,000	1.30%
Mining Training Program	$ 0	0.00%	$ 133,000	0.66%
Welder Training Program	$ 0	0.00%	$ 50,000	0.25%
Power Plant Control RN Remodel	$ 0	0.00%	$ 90,000	0.45%
SUBTOTAL	$ 0	0.00%	$ 587,683	2.92%
Freight (Ocean, Air, Inland, Packing Charges)	$ 800,000	3.89%	$ 1,545,952	7.68%
DPP, Overhead, G&A (Administration)	$ 301,739	1.47%	$ 306,909	1.52%
Fixed Fee (Administration)	$ 856,322	4.17%	$ 856,322	4.25%
GRAND TOTAL	$ 20,548,845	100.00%	$ 20,126,997	100.00%

TABLE 3-2
MONGOLIAN ENERGY SECTOR PROJECT COMPONENT III
CONTRACT FUNDING versus JOB-TO-DATE ACTUAL COST
FOR PERIOD MAY '93 THROUGH SEP '95

As of 2 November 1995

DESCRIPTION (Revised to Actual USAID Invoiced Amounts)	FUNDING BUDGET	%	TOTAL '93 - '95	%
MK's:				
Expatriate Labor Costs (Engineer,Procurement, Tech)	$ 1,619,774	8.08%	$ 1,578,295	7.84%
BHO Labor Cost (Procurement, Admin & Support.)	$ 599,178	2.99%	$ 596,497	2.96%
Expat's TDY & BHO Indirect Travel & Other	$ 561,428	2.80%	$ 569,973	2.83%
In-country (Mongolia):				
Mongolian Labor	$ 118,554	0.18%	$ 117,875	0.59%
Indirect and Other Costs	$ 366,491	1.60%	$ 382,802	1.90%
Equipment	$ 56,735	0.28%	$ 9,235	0.05%
SUBTOTAL	$ 541,780	2.70%	$ 509,912	2.53%
Burns & Roe (Engineering/Technical):				
Expatriate Labor Costs	$ 368,734	1.84%	$ 372,387	1.85%
Home Office Support	$ 191,791	0.96%	$ 204,556	1.02%
Indirect and Other Costs	$ 82,458	0.41%	$ 83,609	0.42%
Training (Fire Pro Plant Ground) & Power Plant Roof	$ 74,295	0.37%	$ 64,738	0.32%
SUBTOTAL	$ 717,278	3.58%	$ 725,290	3.60%
US Equipment Procured/Purchased	$ 10,021,533	49.98%	$ 9,970,847	49.54%
CIS Equipment Procured/Purchased	$ 2,878,704	14.36%	$ 2,879,317	14.31%
US & In-country Training Program (Reserve Amt):				
Warehouse/Inventory Training	$ 52,683	0.26%	$ 52,683	0.26%
MK and B&R NDE Study	$ 70,654	0.35%	$ 262,000	1.30%
Mining Training Program	$ 133,000	0.66%	$ 133,000	0.66%
Welder Training Program	$ 50,000	0.25%	$ 50,000	0.25%
Power Plant Control RN Remodel	$ 90,000	0.45%	$ 90,000	0.45%
SUBTOTAL	$ 396,337	1.98%	$ 587,683	2.92%
Freight (Ocean, Air, Inland, Packing Charges)	$ 1,550,777	7.73%	$ 1,545,952	7.68%
DPP, Overhead, G&A (Administration)	$ 306,889	1.53%	$ 306,909	1.52%
Fixed Fee (Administration)	$ 856,322	4.27%	$ 856,322	4.25%
GRAND TOTAL	$ 20,050,000	100.00%	$ 20,126,997	100.00%

SECTION 4.0 TRAINING

MK established and administered a number of formal training programs during the project Some of these were short term, bringing specialists from the US for intensive 3 to 4 week courses, others were short term training programs with groups of 8 to 14 Mongolian engineers and managers being sent to the US to observe US operations and methods. These training courses proved very effective in generating the Mongolians interest in the results of efficient management and increased their desire to pursue the methods they observed.

Other training programs were long term and continued throughout the project. Examples of these are the English language instruction courses and hands-on computer hardware and software training. Major training programs that were implemented and funded under the USAID project are outlined in this section.

4.1 English Language

Both MK and USAID had many requests for English language training from all segments of the Energy Sector. All of the established English language instruction required full time attendance over a long time period, but organizations in the Energy Sector required a course that their professionals could attend on a part time basis while still performing their job.

In response to these requests, MK established one English as a Second Language (ESL) class at Power Plant #3 in February 1994, using a professional Mongolian National teacher. A proposal was submitted to USAID to provide at least one expatriate ESL teacher to work with Mongolian professionals to establish training programs at all of the power stations. This proposal was not accepted by USAID, however USAID authorized MK to continue to build the program using Mongolian Nationals as instructors.

The initial program was very successful and well received by power station personnel and in response to additional requests, the program was expanded during 1994 and early 1995 to the present level. There are now three classes at Power Plant #3 and one each at Power Plants #2 and #4. Each class is held for two hours a day, three days a week to allow participants to continue to work at their regular jobs.

The English language training materials purchased for the program included computer software programs as well as printed teaching material and work books. In 1995, three complete computer-based teaching laboratories were purchased. Two of these systems were set up at Power Plant #3 and one was provided to the Mongolian Technical University (MTU). The computers were used in conjunction with the formal language classes and allowed students to use them for practice outside of class hours.

The management of all power stations and coal mines has recognized the need to learn English. A number of assistance programs are now getting underway in the Energy Sector and it has become essential for power station and mine personnel to be able to communicate with the Western engineers and technicians involved in the assistance programs.

This training program has been one of the more enthusiastically received training efforts and has been very successful in helping USAID to attain the overall objectives of the project. It has also been done at a very low cost because of the use of Mongolian National instructors. Total cost of the program has been less than $80,000, including the three language labs purchased.

4.2 Computer Usage

Modern computer systems were one of the essential needs of power plant and mine management. They had some introduction to computer usage and a few Japanese or Korean made computers, but much of the accounting and record keeping was still done by hand in ledgers. This system made periodic reports very cumbersome, difficult to read and often unreliable or meaningless.

Under the USAID program, MK purchased 75 US made computers with inkjet and laserjet printers for use by various organizations in the Energy Sector. They were ordered with the latest versions of software such as Windows, WordPerfect, Excel and Lotus 1-2-3. The MK staff trained key personnel in each organization in the use of these systems and software before the computers were turned over to them. The MK staff continued to support the computers and users after they were turned over.

In response to a request from the USAID representative, MK purchased a complete CAD system to be used for training at the Mongolian Technical University. The MK staff assisted the MTU staff in setting up this system and it is now used extensively in research work and teaching at the University.

4.3 Management and Supervision

The need for management and supervisory training was recognized as being extremely important to the growth of the Energy Sector. Engineers with little or no management and/or supervisory training are placed in positions of supervision and management. In the existing organizational system, personnel without college or university degrees, in other words, those that know how to do the work, cannot progress into the supervisory or management positions. Therefore these positions fall to the inexperienced who not only do not know how to do the work, they are not trained in supervising others to get the work done.

No courses exist in the Energy Sector for supervision and only one management course has been identified. This is a six month, full time course that is conducted once a year for 10 to 20 selected engineers.

Two programs were identified as being beneficial and worth pursuing with the available funding levels: local management seminars and development of a supervision course for the Central Energy System central training facility. Due to the urgent requirements for funding to operate and maintain the power plants, all of these programs could not be realized. Following is a summary of what was planned and accomplished for each of these programs.

4.3.1 Local Management Seminars

An American management series of 24 video taped sessions was available from the library at the US Embassy. The video tapes had been dubbed into Russian which was thought to be acceptable since the majority of the engineers had received their education in the former Soviet Union. An arrangement was made with the library to borrow two tapes per week and a schedule and list of participants for the seminars was developed for the Power Plant #3 staff. With the showing of the first tape it became obvious that the participants level of Russian language proficiency was not adequate to allow them to learn at an acceptable level.

Two plant engineers and the MK engineering staff were assigned, on a rotating basis, to review the tapes prior to the scheduled seminar and to provide a typed summary outline in Mongolian of the particular seminar subject. The assigned engineer would then be the facilitator for the seminar and would periodically stop the tape and lead discussions on the subject matter. At the end of the seminar a closing discussion was held. This means of conducting the seminars proved to be effective and the participants level of awareness of management techniques grew. The discussions were lively and there were generally good questions and comparisons with the current way the management system was working.

The Mongolian summaries of the video seminars were copied and bound together for future use. The program is currently being conducted at Power Plant #4. This program was successful, the cost to implement it was minimal, and it can be conducted again with very little preparatory work.

4.3.2 Supervisory Training

Due to project funding constraints, a formal supervisory training course was not implemented. The plan was to identify and select an existing supervisory training course from those available in the US, bring a representative of the selected training company to Mongolia to supervise converting the program into Mongolian, and train

Mongolian instructors to conduct the classes. This type of training is most certainly required if the Energy Sector is expected to mature to the Western utility level. Supervisory training was done by the two MK power plant engineers on a daily basis in an informal structure.

The MK power plant engineering team consisted of two expatriate engineers and four Mongolian engineers. The 1994/1995 heating season scope of work was divided into seventeen tasks and each of the tasks was assigned to a Mongolian engineer as his primary area of responsibility. Guidance and day- to-day support was provided by the expatriate engineers.

The Mongolian engineers were responsible for:

o Monitoring project schedules and reporting status on each of the tasks in the weekly and monthly reports.

o Preparation of requisitioning documentation and equipment technical specifications to support the tasks to which they were assigned.

o Preparation of engineering modifications to the existing structural supports to accommodate new USAID purchased equipment and communication of those modifications to power plants Managers to ensure their understanding and support.

They attended regular daily tours of Power Plant #3 with both expatriate engineers accompanying them on the tour. The purpose of the tours was to ensure any serious equipment problems, and/or potential fires are brought to the immediate attention of Power Plant #3 Operation Management and quickly corrected. Tours also provided an excellent opportunity to pass on suggestions to Mongolian engineers how to resolve these problems using USA engineering experience and knowledge. The Mongolian engineers and managers have benefitted significantly from these tours in planning, organizing, follow-up and record keeping.

4.4 Power Plant Maintenance

Three areas of maintenance training were identified: welder training, rotating equipment maintenance training, and electrical maintenance training. Due to funding constraints of the project and the lack of proper training facilities, only welders training was implemented.

The Central Energy System (CES) has a central facility to train operators and maintenance workers. This facility is poorly equipped for other than theoretical classroom training. A small, poorly kept welder's training area exists, however, there is no training area with pumps and fans or electrical apparatus, so training in the proper techniques for this type

of maintenance would be difficult to implement. These areas need to be established so that apprentice maintenance workers could have the opportunity to work on actual equipment in a conducive environment without the added pressure of keeping a plant operating.

4.4.1 Welders Training

A welding engineer who was also a qualified welder was located in the MK Engineering, Construction, and Environmental group in Cleveland. A training program was developed to concentrate on two primary areas, first, to provide welder training to 48 of the energy systems welders and, second, to provide seminars to the energy systems welding engineers on current US practices in welding technology, procedures, and techniques.

The CES welders training area was improved by constructing 12 new welding booths with apparatus to allow positioning welding coupons in all welding positions. Complete sets of welders hand tools and protective clothing were procured. Four training sessions of one week each were organized with 12 welders in each session. The first hour in the morning was spent in the classroom reviewing theory and the plan for the day. Five hours each day was spent welding with the instructor demonstrating and developing the welders techniques. The last hour of the day was spent in questions and answers and reviewing the lessons of the day. Due to the old and inferior equipment the welders had to work with, emphasis was placed on improving their skills by using what they had. During the course of the training the welders were exposed to American welding machines which had been purchased for Power Plant #3, and welding electrodes the instructor brought with him. The training was successful and all welders improved their skill level.

Three seminars were held with the energy systems welding engineers. The topics covered were MK's Welding Manual, American Welding Society codes and procedures, advanced welding technology, welder qualification, and welding procedure writing. The differences between the current practices in Mongolia and the US and the rationale behind the development of these areas was discussed, with the need to improve the current practices emphasized.

A final report documenting this training was submitted to USAID.

4.4.2 Rotating Equipment Diagnostics

In August 1994 MK conducted a machinery diagnostics course for 15 rotating equipment specialists from all Ulaanbaatar power plants. Two instructors from Bently Nevada provided hands-on training in vibration monitoring and machinery diagnostics. Mongolian equipment specialists gained confidence in their ability to interpret data,

predict response of rotating equipment in operation and recognize malfunctions such as partial rubs, cracked shafts and fluid induced instabilities. Bently Nevada portable computerized vibration monitoring equipment was purchased under the USAID program for both Power Plant #3 and the CES. All course materials were translated to Mongolian and distributed.

Portable hand held vibration meters and tachometers were distributed to all power plants. Record forms for recording vibration monitoring for all major rotating equipment were developed and put into use at Power Plant #3.

The MK staff Mongolian engineers trained Mongolian counterparts in utilization of both vibration meters and record forms. The positive response and initial results were very good.

Extensive training in non-destructive examination (NDE) took place during actual NDE of the high pressure boilers at Power Plant #3. Power plant metallurgists were introduced to USAID purchased ultrasonic flaw detection equipment and associated software. They were actively involved in visual inspection, ultrasonic tube thickness measurements, magnetic particle testing and metallographic replication of various boiler components. New equipment and the expertise gained from working with US specialists will improve boiler tube failure analysis and provide more accurate prediction of boiler tube maintenance and/or replacement requirements.

4.4.3 Health and Safety

Health and safety were very high on the MK training priority. From the first day, the need was emphasized for improvement in basic employee safety such as wearing hard hats, safety glasses and gloves when at work. Some progress was made, however there is a long way to go to achieve US labor discipline regarding safety. To that end, ten video cassettes were purchased covering safety orientation, personal protective equipment, fire prevention, etc. Copies of the training tapes were being dubbed into Mongolian by personnel at the Ulaanbaatar television station, with the intent of distributing them to the power plant safety departments to use as a training tool.

4.5 Mine Maintenance

Regular technical visits and training sessions were carried out for the three major mines. With approval from USAID, other mines and facilities were also visited to assess conditions and determine what support could be provided. On-the-job training was provided at the mines and power plants on the application and installation of the new Flexco belt splicing tools/kits. This item has proved to be one of the most successful

services performed. The capability to quickly splice a conveyor belt, restore it to operation and to have a long splice life has been invaluable.

4.5.1 High Voltage Wiring

American manufactured high voltage trailing cable/motor rewind wire was purchased under the USAID program for the mines. To assist mine personnel with the accurate sizing and application of these materials, MK obtained technical reference documentation for converting standard American wire gauges to metric sizes and conducted training sessions in the use of these conversion charts. MK personnel conducted training sessions explaining the various components of American power cables, individual phase components, ground check/ground monitor functions, hands-on training for constructing high voltage stress cones, terminations and cable splicing. Particular emphasis was placed on high potential testing of power cables, switchgear and motors. MK obtained American cable manufacturers recommended safe testing procedures which were translated into Mongolian and distributed. Training sessions were also conducted on electrical safety, hazard recognition and the proper use and testing of furnished protective equipment.

4.5.2 Drilling & Blasting

Blasting/drilling technology and accessories, modern drilling/blasting technology currently used in Western mines had never been introduced in Mongolia. In cooperation with the Ensign-Bickford Company, which manufactures explosives and initiation systems, current explosive commodities, associated blasting initiating systems resulting in controlled blasting were introduced to Mongolia.

The mines were completely out of explosives and the only option for getting this material from the US was to ship it by air. Using a large Russian Antonov-124 aircraft approximately 100MT of these supplies were delivered to the Ulaanbaatar airport. MK mine personnel and personnel from the Ensign-Bickford Company conducted hands-on training sessions at all three mines. Topics explained were proper selection of burdens and spacings, blast pattern layout, hole depth, stemming, delay sequencing and initiation. Patterns were laid out, drilled, loaded and shot using the new initiation devices. The training and live demonstration was a great success and the benefits of controlled blasting were self-evident. Blasting a large pattern without scattering rock all over the mine was a new concept and was performed without damage to equipment or adjacent facilities and did not require evacuation of all personnel from the area.

The wisdom and logic of introducing these systems probably would not be questioned if it were not for the logistics problems. If the mines are to continue controlled blasting, other shipping methods/logistics and further funds are required.

These devices were reordered by the mines but were not on the approved priority listing for 1995/1996 heating season purchases. The MK Boise procurement staff is presently working with the Sealand Company to solve the logistics problem.

4.5.3 Computer Usage

In order to assist the mines with getting a handle on maintenance managernent, preventive maintenance scheduling/servicing, it was decided a computer based equipment management system was required. Computers and software compatible with the application to be performed were ordered, received and placed into operation.

Training sessions for mine personnel assigned to use these systems was conducted over a period of several weeks and then the computers were distributed to the mines and to the Nuurs Company. Preventive maintenance forms for the different types of equipment were translated into Mongolian and distributed to the mines. MK continued with training and efforts to fully implement the preventive maintenance program. It will take more time, training, effort, understanding and cooperation to compile and maintain permanent equipment records and to ensure maintenance functions are carried out on schedule. Several changes in top staff assignments at the mines were recently made and MK expects improved cooperation within the maintenance departments.

4.6 Procurement & Material Control

Although distribution of the materials purchased under the Mongolia ESP was not part of MK's scope of work, MK has always maintained a general sense of awareness as to the end use of the equipment and spare parts purchased by the project. Mongolia lacks the automated systems that would have allowed an outside entity to monitor such warehousing and distribution with ease and it was clear that the MOEGM did not have the time or inclination to give MK open access to the Mongolian warehouses.

Erchimimpex is the MOEGM entity for power plant procurement, warehousing thousands of items for use in the power plants and other designated areas. Their manual system was outdated, labor intensive and lacked the ability to generate data required to properly forecast, report and assist procurement and accounting. New philosophies that would extend the life of existing parts, and techniques that would help to control inventory creep, shortages, and overages through proper maintenance of existing parts and supplies, needed to be implemented. As an example, they have the ability to rebuild pumps and motors but lack the wrapping and protective material necessary to properly store and protect them against the elements which shorten the shelf life. New cost saving management techniques could be realized with proper warehouse and computer training and instruction toward problem identification and solution.

MK took the approach that having the right part in the warehouse (or a number of warehouses) and knowing where to locate it when needed, process the core for rebuild, and/or reorder for inventory from the previous source, knowing what price was previously paid, should all be well within Mongolian capabilities.

These capabilities and many others are vital to the stability of the Energy Sector. The component support of the Energy Sector has been left to manual archaic methods which were ultimately handicapping Mongolia's ability to become self-sufficient.

In an effort to resolve this problem and move Mongolian warehousing to a more manageable position for the Mongolians and a more observable position for future USAID activity and other world lenders and donors, MK made the proposal to USAID to upgrade Erchimimpex's materials management methods (including cataloging, forecasting, expediting, warehouse operations, management reports and interpretation, training on hardware and software) to a modern computer based system. This proposal was approved by USAID and implemented by MK. Erchimimpex actively participated in the ninety day training program from 19 May 1995 through 14 August 1995. MK approached the task by dividing it into two responsibility areas – physical warehousing and computer tracking.

An expatriate warehousing specialist worked with the warehouse managers and the commodity engineers to set up a clean, organized warehouse. They were instructed in more efficient methods of receiving, issuing, locating and stocking inventory. Safety meetings were conducted with responsible personnel instructed as to the frequency and content of these meetings for their future use. It was emphasized that the inventory in the warehouse must be cared for to ensure use in the future. Parts which were shelved or stacked on the floor were still susceptible to coal dust and normal dust blowing through the buildings. Parts which were allowed to sit unprotected on the floor could be better protected by being palletized since funding for center aisle shelving was not possible at the time. Additionally, the warehouse managers were provided with rust preventive wrapping paper and instructed in the use of grease and oil as preservatives to be used with the paper. Old dirty parts could be cleaned with oil and sandpaper and then wrapped and marked for future use.

Shelves and floor areas were marked with an easy to understand numbering system. Every item in the three warehouses and the three yard areas was given a specific location identifier which ultimately was input on the computer. Schematic diagrams showing location numbers were made of each warehouse and the yard areas for reference from the office.

MK researched the market for a viable warehousing computer program which was capable of operating in dual languages. None of the Mongolians at Erchimimpex had enough English language training to be able to fully run an English language program, however their second language is Russian and English/Russian software was available. There is no Mongolian language warehouse software available. Erchimimpex was provided with computer

hardware, software and peripherals and a warehouse inventory program by the name of IDEAS marketed by Cogent Information Systems.

Ideas/Warehouse (IDEAS/WH), developed by Price Waterhouse and acquired by Cogent Information Systems, was designed to enable users to closely monitor the physical movement of inventory. This software is basically modular with components for Inventory Accounting, Procurement and General Ledger. Using only the Warehouse module has given Erchimimpex a direction to grow and further automate their systems.

An expatriate computer specialist trained Erchimimpex personnel in the use of the computer, the various software packages, the peripherals and the IDEAS program. Training centered on one or two people with the intent of those people training others. In addition to learning which keys to strike, they were instructed as to the many ways the programs could provide them with useful information based on manipulation of data through reporting. Much time was spent discussing minimum/maximum stocking levels and how this small part of the large software package could help keep the power plants operating. Part of the objective of training was to illustrate how it was possible to know what was in the warehouse and where it was—without ever physically going to the warehouse. This was the tie-in of the shelving location and the warehouse schematic. Conversely, it was possible to walk right out to the warehouse and go directly to the inventory being sought.

The physical inventory was taken by the methods normally used by Erchimimpex, but was input on a spreadsheet and on the IDEAS software. Once all input was complete, a Cogent representative was brought onsite to help balance the inventory, customize the programs and provide a desktop reference for the Erchimimpex version of the IDEAS software. MK provided computer procedures translated into Mongolian covering basic computer topics, hardware care, UPS and printer maintenance, computer backup, terminology and safety. Erchimimpex was also provided with required supplies for one year's operation.

As with any training program, the success or failure lies with those trained. It is MK's belief that the Erchimimpex training program has planted the seeds of many ideas which will shape the future thinking of their management.

4.7 US Training

4.7.1 Formal Mine Training - USA

In response to requests from the MOEGM to provide Mongolian mining engineers with the opportunity to work with modern mining technologies and to understand how efficiently Western mines operate, a formal mine training course was implemented.

MK operates coal mines in the US similar to the mines in Mongolia and was selected to conduct the training exercises. Operating mines in Montana and Texas were chosen as the best sites to visit with ten Mongolian mine engineers and two interpreter/translators selected to participate. Mrs. Burenjargal of the Mongolian Mining Research Institute was a participant with special interests in strip-mine reclamation. She was assigned the task of developing a reclamation plan for the Baga Nuur mine to be implemented under a World Bank project.

USAID budgeted $140,000 to cover travel and other related costs. The trainees departed Mongolia on 14 September 1995 and arrived back in Mongolia on 9 October 1995. The two escorts reported that the trip was very productive and related that training and exposure to the mines was of great importance to the participants. Sufficient information and knowledge was obtained to develop mine reclamation plans. Improved techniques for each aspect of mining operations and hands-on experience should help each trainee impact future Mongolian mine development, especially successes in improved productivity which is the immediate priority concern and adequate supplies of fuel for the heating seasons. Future programs to provide this type of formal training is strongly recommended and should be placed high on future priority lists.

A separate report documenting this training was submitted to USAID in October 1995.

4.7.2 Power Plant Training - USA

Three training assignments were planned for Mongolian power plant engineers and managers. The first was to provide training to engineers in the execution of small projects. Two projects were identified: a study and design to improve the reliability of the electrical grounding system at Power Plant #3, and a study and design to improve the reliability of the fire detection and annunciation system at both Power Plants #3 and #4.

A team of Mongolian engineers was selected from the plants and MK's project engineers, two for the grounding project and three for the fire system project. A Burns and Roe engineer was brought to Mongolia to work with the selected Mongolian engineers on the study of the systems and the gathering of technical data that would be required to evaluate the systems and decide what could be accomplished within the budget and schedule constraints of the project. This team then traveled to Burns and Roe's office in New Jersey, where the Mongolian engineers worked closely with Burns and Roe's professional staff to write a report on their findings, make the decisions on what could be accomplished, select appropriate material items, and prepare the material specifications and requisitions to procure the materials.

In addition to this task the Mongolian engineers visited power plants and equipment supplier facilities in the New Jersey area. This program was successful as the team was intimately involved with the steps followed in a project such as identification, analysis, budget and scheduling constraints, design material selection and specification, requisition preparation and documentation. The five week period, two weeks in Mongolia and three weeks in the US, resulted in the report on the status of the systems and a design with material requisitions that would improve the reliability of the systems. Unfortunately, funding and schedule restraints of the Energy Sector project precluded actually procuring the material and performing the installation.

Two groups of eight, mid- to upper-level managers and engineers were selected, one group with emphasis on plant operations and the other on plant maintenance, to attend three week training sessions in the US. A description of the training and the benefits to be realized and a selection criteria was developed . This was coordinated with the MOEGM and each plant was requested to nominate twice as many candidates as were required, with MOEGM and MK making the final selection. The training was to include seminar-type sessions on organization, finance, budgeting, planning, procedures, manpower and administration for both power plant operations and maintenance management. These sessions were to be conducted by US utility personnel.

The attendees were then to spend time in power plants with personnel of similar areas of responsibilities and see the organizations in operation. Visits to utility equipment vendors and manufacturers were also planned to expose the participants to state of the art utility equipment available in the US. Unfortunately, funding was not available for this training in 1995 due to the amount of required equipment and spare parts purchased for the power plants. It is strongly recommended that this program be taken up should funding become available in the future.

A separate report documenting this training was submitted to USAID upon completion.

SECTION 5.0 PROCUREMENT AND TRANSPORTATION

5.1 Procurement Objectives

The objective of MK's procurement effort under the ESP was 1) to provide high quality equipment, materials and spare parts at the best possible price to the mining and power plant requisitioners and end-users and 2) transport these commodities to the project by using the most economical and expeditious means available—while staying within the procurement regulations established under the Federal Acquisition Regulations (FAR) and USAID's Agency for International Development Acquisition Regulations (AIDAR). MK recognizes the responsibility to USAID and the Country of Mongolia in providing continuity to a sustained coal mining and power/heat generation program.

In many cases, the emergency nature of the ESP required purchasing personnel to utilize source and origin waivers and sole-source procurement but for the most part, the standard FAR/AIDAR guidelines were strictly followed. All procurement was fully transparent and documented. Files were diligently audited internally by MK personnel to ensure contract compliance.

5.2 USAID Approval Procedures

Over the years, MK has worked with USAID on many projects throughout the world and is very familiar with the Handbook series published to supplement the Federal Acquisition Regulations. In most cases, procurement packages followed the normal procedural requirements of the handbooks. Early in the project, it was understood that any offshore procurement action of less than $5,000 would be approved at the project level. Any action between $5,000 and $24,999 would require the signature of the USAID Representative in Mongolia and for all actions over $25,000, a full Recommendation for Award (RFA) summary would be sent to both USAID/Mongolia and the CTO in Bangkok, Thailand. Recommendation for Award/Advance Notification of Award approval was usually received within a period of 10 days.

Once the purchase order was completed and issued to the supplier, a copy was distributed to the approving USAID office and in all cases, copies were sent to the MK office in Ulaanbaatar.

5.3 Summary of Procurement

The transition period between Component I and Component III was critical to reaching the goals established by USAID for this project. On or about 23 April 1993, the responsibility of the equipment and spare parts for the ESP Project was transferred from UE&C to MK. A

complete listing of the remaining deliverables under the UE&C contract was given to MK. This listing disclosed status and physical location of the deliverables by line item, part number, description and UE&C purchase order number. After total accountability of all items was disclosed, MK, on behalf of UE&C received and inspected these parts on arrival in Ulaanbaatar and forwarded the inspection reports to UE&C for payment by them to their suppliers.

This transition between contractors went remarkably smooth and all of the commodities were delivered to the project by the fall of 1993.

5.4 Value Engineering Studies

The Value Engineering studies of 1993, 1994 and 1995 resulted in prioritized commodity lists approved by USAID and Mongolian engineers and were forwarded to MK's Boise home office (BHO), for entry into the procurement system. The initial study in 1993 showed that many of the motors, valves and parts for both the mines and the power plants were available only from the original equipment manufacturer (OEM) and therefore resulted in a CIS buying effort. Details of that endeavor are outlined later in this report.

5.5 Commodity Procurement Plan

To execute an efficient purchasing effort for the initial buy out and the follow-up materials to the end of the project, a Commodity Procurement Plan was written, distributed and approved by USAID in the fall of 1993. This plan outlined MK's procurement strategy for the 30 month project based on company practices and compliance with FAR/USAID regulations. Project-specific procedures were developed for hands-on operations for all those involved in the day-to-day operations of the project. These were also provided to USAID during the preliminary CPSR meeting held 10 January through 14 January 1994 in Boise, Idaho. MK responded to the USAID Contracting Officer's preliminary CPSR report with an approved Corrective Action Plan, which was implemented and included in MK's project Commodity Procurement Plan.

5.6 Procurement Of Materials

5.6.1 Free-On-Board (FOB) Shipping Terms

Based on many years of International procurement and transportation experience, MK immediately proposed to USAID that commodities be procured on a Free-On-Board (FOB) or Free Alongside Ship (FAS) basis whereby US suppliers were required to deliver equipment to a point at a US port. FOB/FAS terms are defined by the International Chamber of Commerce (ICC) in INCOTERMS 1990 for standardizing international trade practices. The advantages to the ESP for using FOB/FAS shipping were many:

o The capability of reducing ESP ocean freight charges through receiving commodities at only two port locations and thereafter negotiating a project rate with a US shipping line. This is possible by consolidating large volumes of cargo.

o Having greater efficiency for receiving items coming from numerous US supply sources throughout the US and funneling items into one primary and one auxiliary US port for inspection, quantity verification, preparation of documentation, export packing and cargo consolidation. Reference Section 5.8.

o The capability of the agent or MK to reject commodities before departing the US. When commodities have been received and inspected and have been determined to be damaged, incorrect in description or generally in unacceptable condition, the forwarding agent or MK can reject goods before they are shipped.

o The capability of reducing export packaging costs and documentation preparation costs by performing this work at only two locations and in large volumes. Additionally, there are better controls in packing and consolidating to prevent reopening and repackaging upon arrival in Ulaanbaatar.

o Greater efficiency at the Port of Vostochny when commodities arrive well organized. This reduced confusion and additional port charges. The alternative was material departing ***many*** US ports on ***different*** US flag steamship lines all serving the Port of Vostochny.

o Under FOB/FAS terms there is greater efficiency by using a single forwarding agent in the US experienced with Mongolian documentation and customs requirements. The agent worked together with a counterpart in Mongolia to receive and off-load freight at the counterpart's receiving yard.

o Under FOB/FAS terms, the supplier's bid price for commodities is less costly because the supplier receives payment sooner than other alternatives, has less risk with only shipping to a US port, and may have less costs by not having to perform packaging and exportation services. Without physical inspection by MK personnel, acceptability of supplier-performed packaging cannot be guaranteed.

o The project has better control of scheduling material in and can establish priority cargo.

o Somewhat more liability and risk to the ESP in taking custody of commodities sooner; inside the US as opposed to having the supplier control the exportation and shipment under CIP terms.

- More direct, hands-on involvement for MK and the international freight forwarding agent in controlling commodity shipments, expediting, insurance claims, etc.

Under certain circumstances, MK purchased commodities on an FOB factory or ex works basis when it was more advantageous to the project. In those cases, transportation arrangements were made by the MK BHO staff to pick up the material at the supplier's facility and move it to the appropriate Port of Embarkation for export to Mongolia.

MK felt that FOB/FAS Port of Seattle/Tacoma (or Houston) was the most efficient and cost-effective method of keeping large volumes of exported material under control. It offered cost savings to the project, gave the project direct control over the entire procurement and transportation process and offered much greater material accountability.

5.6.2 Requisition Process

As a result of the prioritized commodity lists generated from the Value Engineering studies, approved requisitions were sent from Mongolia to Boise office at the conclusion of the yearly meetings. Boise based personnel entered these requisitions into the system and the purchasing process began. Some of the requisitions were complete with exact specifications and were ready for bid, however most needed more detail before vendors could offer competitive bids. Once this process was completed, Request for Proposal (RFP) packages were sent to long-time MK suppliers, project-suggested suppliers or suppliers obtained from a multitude of advertised or trade sources.

Since the requisitioned commodities had either "emergency" or "equipment-down" status, the bid process was expedited according to the priority of the item. The Boise office acted as a go-between for the technical experts at the mines and the power plants and the supplier/manufacturers in the US to ensure what was needed onsite was actually ordered and delivered.

5.6.3 Bid Evaluations/Recommendations for Award

After the bids were received in Boise, financial, commercial and technical evaluations were performed for each bid to ensure compliance with all requirements of the RFP. If there was any question regarding technical compliance, the bids were forwarded to the engineering staff or end-users in Mongolia for their review and approval. Once the evaluations were completed, an RFA/Advance Notification of Award was sent to MK personnel in Mongolia along with a copy of the purchase order. The

RFA and purchase order's were reviewed, approved and then passed on from the Boise office to the USAID CTO in Bangkok, Thailand for approval.

5.6.4 USAID Approvals

USAID/Mongolia was kept in the loop of approvals in that commodity procurement packages would be passed to them after the bid process was completed and a final purchase order was prepared. If the package was over the $25,000 threshold, an additional approval was necessary from the Regional Contracting Officer (RCO) in Washington DC (soon after transferred to Bangkok, Thailand). USAID could monitor the progress of a particular package or of the commodities en route to the project.

5.6.5 Domestic Expediting to Port of Seattle/Tacoma

After USAID approval was received for the purchase order packages, the successful bidder was verbally awarded the contract in an effort to speed up the delivery process. The hard copy purchase order was faxed and then mailed to the supplier. At this point, MK transportation, on receipt of the purchase order copy, would contact the supplier and track the materials to the US port destination. If there were any delays in the manufacture or delivery of components that would affect final delivery, this information was passed back to the end-user and acted upon immediately. Pressure would be put on the supplier to keep to the original delivery schedule, but if this was not possible the project was alerted and could schedule accordingly.

5.6.6 Receipt, Consolidation and Containerization at Port

A freight forwarder was selected by MK in the early stages of the project to provide assistance at the port of export. It was imperative at this point to have an agent representing the project to manage the receipt of materials from the suppliers. Project equipment and materials were consolidated and containerized at Sea-Pac Services at the Port of Seattle/Tacoma, Washington. The operation and impact of Sea-Pac is outlined in more detail in Section 5.8.

5.6.7 Reporting and Record Keeping

MK's Boise office was the source for completing the required US government forms necessary under this contract. Information was updated regularly and reported on the required schedule. Statistics on small business, minority business and woman-owned business are gathered from this same office.

5.7 Non-US Procurement

5.7.1 Justification for Non-US Procurement

As noted above, the procurement requirements of the USAID Energy Sector Project were primarily met by US suppliers. In many cases however, equipment and spare parts were not available from the US and other sources were sought. Under strict adherence to FAR/AIDAR procurement regulations, exceptions to standard US procurement were allowed, according to USAID Handbook 1B, Chapter 5, Section 5B4a and as referenced in USAID Handbook 14, 752.7004.

In all instances, a minimum of four out of the seven criteria, identified in the above reference, justified the non-US procurement and provided the foundation for USAID approval.

SEVEN CRITERIA (at least one is required for a waiver)

1. There is an emergency requirement that can only be met in time by a source outside the authorized geographic code.

2. The commodity is not available from the US.

3. The lowest delivered price from the US is reasonably estimated to be at least 50% or more higher than the delivered price from the CIS.

4. N/A

5. Persuasive political considerations.

6. Procurement in the cooperating country (where it is not already eligible) would best promote the objectives of the foreign assistance program.

7. Such other circumstances as are determined to be critical to the success of project objectives.

5.7.2 Background

As discussed earlier, Mongolia depended on the Soviet Union and Eastern Bloc allies to construct, staff, manage, operate and repair the country's power and heating infrastructure which consisted of coal mines, railroads, power plants and heating distribution systems. Mongolia suffered a crippling social and economic blow when the former Soviet Union abruptly withdrew technical, managerial, financial and commodity

support from the Energy Sector. When Russian assistance abruptly ceased, Mongolia was unprepared to assume management responsibilities for the energy components. This crisis left Ulaanbaatar homes, offices and industries in a precarious position as Mongolian winters typically reach temperatures of -35° C.

The USAID project under UE&C was successful in meeting its first year's objective. The initial 1992 funding obligation was used for emergency repairs and maintenance which, if not performed, would have resulted in disastrous physical and economic consequences during the 1992/1993 heating season.

MK helped to avert another crisis situation in the 1993/1994 heating season with technical support and source/origin waivers that totaled $2,462,415. This exceeded the approved waiver amount of $2,209,757, but the items purchased were approved and vital to the successful completion of the project's second year of operation.

The 1994/1995 heating season was not classified as "emergency" by USAID and only a small waiver of $133,000 was approved with the bulk of the procurement being completed from the US.

The final CIS procurement for the 1995/1996 heating season was $553,390. These critical spare parts will prove to be invaluable during the 1995/1996 heating season. Although the waiver was approved for $645,057, projected delivery time and budget constraints, made it necessary to cancel the remaining CIS procurement effort. The consequences of these cancellations have yet to be determined.

5.7.3 CIS Procurement

The intent of the procurement effort was to buy from the US whenever possible. Great pains were taken to provide drawings and specifications (both electrical and mechanical, complete with onsite engineering evaluations, appraisals and suggestions) as standard attachments to the requisitions sent to Boise

Ongoing communications and monitoring of the procurement progress by our onsite project engineers was encouraged by BHO procurement personnel to eliminate misunderstandings and potential losses due to incorrect parts or equipment being shipped and received in Mongolia.

As a result of this painstaking process, items were identified as ***unavailable from the US or unreasonable from a procurement and engineering viewpoint***. When this occurred, the waiver process was initiated, and if approved, CIS procurement activity begun.

Being unavailable from the US is understandable but being unreasonable from a procurement or engineering viewpoint requires explanation. Many of the spare parts MK was required to purchase were part of a system specifically engineered and designed to fit in concert with the rest of a system. Reverse engineering is expensive and time consuming. It is often impractical to custom build one spare part or piece of equipment. US manufacturing ranks among the best in the world, and given enough time and money, capable of building almost anything. However, time is often limited, and so is the budget.

The criteria for waiver approval takes these factors into account.

Some of these spare parts would have required copyright permission, which would have been virtually impossible to obtain. Much of the equipment supplied through CIS procurement, requires direct replacement equipment from the original manufacturer to minimize installation problems. System modifications would be required if standard US equipment were to be purchased.

Based on the size of some of the motors required, replacing them with current US design was not a practical solution. Current Western designs are so much different in size that extensive foundation modifications would have been required. This was not economically feasible since a motor being purchased may be used at several different locations. Too often, the manufacturing lead time for a US motor of this size proved to be longer than could be reasonably accepted by the project schedule. The very nature of this project was most often an emergency and MK was required to respond as quickly as possible. A one year delivery schedule was not acceptable in an emergency situation.

5.7.4 Special Problems with CIS Procurement

MK has pioneered new procurement procedures with respect to educating vendors in the CIS and Mongolian procurement personnel, to achieve and maintain acceptable US government standards in compliance with the FAR procurement regulations.

In the first year, the education process was extensive. Bidding was unheard of and never used by the Mongolians. The Mongolians felt that it wasted too much time and created unnecessary work. The last round of procurement went extremely well and they were able to see the benefits of a good procurement process.

The most common problems that MK encountered in CIS procurement, and their respective solutions are detailed below:

- Communications

Communication problems are not limited to differences in language. MK had good interpreters and translators, fluent in both Russian and English. The bigger problem was that telephone and fax communications were often unreliable between Mongolia and Russia and other parts of the CIS.

DHL and other express carriers offer sporadic or unreliable service, or service is not available at all. Couriers were commonplace as the only reliable source of document transfer. Telephone communications to Moscow sometimes worked well.

MK attempted to deal with these problems by establishing a good vendor rapport. Meeting with them personally whenever possible and getting good telephone and fax numbers helped a great deal, as well as a contact person in Moscow when available. MK tried to select well established and financially sound vendors. The Foreign Trade Mission, located in Ulaanbaatar, was capable of acting as a liaison with just about any Russian vendor MK wished to contact. MK also tried to communicate in writing, both in English and Russian whenever possible, since a vendor may or may not have access to someone capable of accurately translating documents. MK's translators are very familiar with the intent, as well as the content, of the communication. In this way, MK was reasonably sure of the accuracy of the communication

- Banking and Terms of Payment

Most CIS vendors wanted as much money up front as they could get. They would commonly ask from 60% to 100% advance payment in the form of a wire transfer to their bank. The vendor needed the advance money to pay the initial manufacturing cost and along with most vendors and people in Russia, hard currency is in short supply. It is not unusual for the banks to lose track of wired funds. Because hard currency is in short supply, banks are sometimes tempted to delay the wire process.

Letter of credit agreements were used to safeguard MK's and USAID's funds in processing payments with CIS vendors. The letters of credit provided a degree of protection for both parties and were preferred over a large advance payment. MK used banking partners at Key Bank in Boise and INKOM Bank in Moscow, Russia to assist in successfully implementing the L/C's with the CIS vendors. All of the vendors were paid after the L/C requirements were met. The wire transfer payments were completed in a timely manner and all funds were confirmed received by the vendors.

Additional steps taken to secure that all MK and USAID advance funds were accounted for included the following project procedures:

1. Know as much about the vendor as possible.

2. Pay as little down as possible. Structure terms that require a small amount of money to initiate the contract, more when the vendor is ready to ship and the bulk of the funds paid upon receipt and inspection.

3. Carefully weigh the bid proposals and select a vendor large enough, who is internationally established, and one that can be relied on to handle any problems that may arise based on his relationship with his bank and years of experience. Further, if the vendor is properly funded and experienced, he is more likely to give more reasonable terms.

4. A larger vendor may also be established with a New York City bank whereby transfer problems can be handled expeditiously. Monitor transfers closely and don't hesitate to initiate a wire transfer trace immediately if there is any doubt as to the successful completion of the transfer.

5. Don't transfer funds over weekends or holidays if possible.

6. The best protection against monetary loss on non-delivered merchandise is a solid vendor.

- Competition

The standard bidding process is a foreign concept to many of the smaller and some of the larger vendors. Bidding under USAID regulations is also very difficult for CIS vendors and requires a great deal of explanation and communication. Because of the problems previously stated, along with a possible lack of experience or history with potential vendors, it is difficult to get an acceptable bid response in the form of a bid package within a reasonable time frame.

MK's focus was the acquisition of good products at fair prices, within acceptable delivery time frames. MK did not have the option of traveling to the CIS to call on all of the bidders to determine their solvency and reliability. For this reason MK attempted to counter these obstacles by applying the following policy:

1. Translate all pertinent documents into Russian and explain the bid procedures with as much care and patience as is required.

2. Know the vendors as well as possible.

3. Plan for and provide an adequate bid response time.

4. Document all telephone communication and fax responses.

5. Follow up with the bidders to be sure the bid package was received and will be responded to.

6. Fully adhere to commercial evaluation criteria when dealing with new, unknown bidders.

7. Continually search for alternative sources and check prices currently being paid against those quoted by new suppliers.

8. MK shared their concerns with potential vendors. They know the problems that exist in the CIS and will understand your reluctance to pay large advance payments.

o Delivery

Timely delivery depends upon several factors. Rail cars are not always available and/or they have to be ordered in advance. Often they go to the highest bidder. Most of the time vendors must wait until a train is going in a particular direction with the available cars. Travel in the CIS is not only difficult but can be dangerous.

MK was sympathetic to the vendor's problems of maintaining projected delivery schedules, however it was very important for MK to depend on the delivery projections. MK discussed this problem with each vendor and came to these conclusions:

1. The vendor must be strong enough and one in whom there is reasonable confidence that whatever situation may occur will be handled.

2. The misconception that they are no longer responsible for freight once it is turned over to the railroad is a typical attitude among vendors. The contract must hold them responsible to delivery to your location of receipt and inspection. The supplier can find missing freight much easier than the buyer.

3. Balance of payment upon receipt and inspection helps to hold the interest of the vendor, especially if there was a small advance payment with a large payment due upon receipt of the goods.

4. Communicate and expedite.

5. MK used the MOEGM and their contacts to help expedite delivery or find lost freight when necessary.

6. Tie the receipt of all required delivery documentation to the final payment. When the paperwork is completed the final payment will be made.

7. For critical items, initiate a penalty clause for a late delivery. MK did this on the last item purchased for the 1994/1995 heating season. The item was late and approximately $3500 in penalty fees were withheld from final payment.

Great strides were made from the beginning of the project in the area of CIS procurement. MK's years of procurement experience and successful implementation of good procurement practices and principles, were instrumental in avoiding losses common to the region. Paying for goods and then not receiving them simply did not happen because of the way the contracts were structured. MK's procurement and accounting staff took great pains to be sure the contract provisions were understood and followed by the CIS vendors. MK's project accountant closely monitored all wire transfers into the CIS and was quick to take corrective action if a problem arose.

The first buying trip to Moscow was a success and laid down fundamental contractual procedures that prevented losses due to misunderstanding. No shortcuts were taken in establishing the important communications link between MK and the potential suppliers. From the bidding process through award, to receiving and inspection, the proven procurement philosophies of MK resulted in a successful CIS procurement program.

5.8 Transportation

From the outset of the project, it was clear that transportation of commodities to Mongolia would be a key to successful completion of the ESP. With the short summer season limiting the availability of scheduled downtime for power plant repair, it was critical that materials be expedited, shipped, received and distributed without delay.

5.8.1 Transportation Survey

An extensive transportation survey was performed by MK and a plan effected to avoid the probability of inordinate delays. The four primary factors considered prior to selecting the most efficient and effective routing were: USAID regulations, container management, total transit time and overall cost.

In addition to these primary factors, it was important to provide the project with inland transportation options to minimize the effects of potential problems created by Mongolia's geographic location and the social, economic and political instabilities of the region.

The USAID requirement for use of a US flag carrier for ocean shipment immediately limited the options. The options included Sealand and American President Line's (APL) TEU (twenty equivalent units) and FEU (forty equivalent units) container service to CIS and People's Republic of China (PRC) ports of call, charter or part charter of non-container services from various smaller tug and barge operations, and Waterman's lash barge open top service.

The equipment/container issue simplified the decision process as Sealand was the only company that would quote a through-rate to the destination. They also were offering two vessel sailings per month. APL, the only other viable line with container service, would not allow their containers beyond the port of debarkation. Sealand would allow their containers to be sent to Mongolia without charging for the return and/or requiring complete container purchase up front. Sealand's involvement with the Trans-Siberian rail and port authorities also provided a vested interest and the ability to obtain information required for tracking and expediting. Additionally, Sealand's involvement and experience would provide needed expertise on local regulations and procedures for the movement of hazardous cargo and special handling requirements for oversized equipment.

With approval from the USAID Transportation Department, and based on the above criteria, the decision was made to focus efforts on the Sealand options. The remaining determining factors were cost and overall transit time. Reviewing the CIS and PRC inland freight options, it was determined that while the difference in cost was minimal, the overall transit time would be affected by backlog at the Chinese-Mongolian border. This backlog was being caused by a combination of several factors including import and export customs clearances and the need for transloading caused by the variation in rail gauge between China and Mongolia. Therefore, based on the above determining factors, the inland transportation route was defined as the Trans-Siberian Rail route.

The remaining issue was the port of debarkation. Vladivostok was initially considered to be the obvious choice as it is the largest CIS port on the eastern seaboard. Further investigation revealed that, because of it's size and familiarity with the western world, the volume of cargo was causing congestion and delays. A lesser known but more efficient port at Vostochny was then selected.

5.8.2 Freight Forwarder Function and Responsibility

The nature and complexity of this project dictated the use of a competent freight forwarder. The basis for selection was that of experience. The success of the project hinged on the ability of the freight forwarder to control the shipments of hazardous, oversized and fragile cargo through a myriad of trans-shipments including ocean, rail and truck. It was essential that the forwarder have experience and established contacts in a region in the transition of adjusting their method of operation to accommodate the western world. The fact that both the CIS and the PRC had recently opened their doors to free trade and the accompanying complexities, magnified the need for connected, experienced resources. Based on solid performance on previous projects and criteria demonstrating an established presence and working knowledge of the region's particular characteristics, Trans-Oceanic Shipping Company was commissioned to handle the freight forwarding duties of this project.

In addition to the coordination and tracking of both air and ocean cargo, Trans-Oceanic was also responsible for many critical items prior to the sailings. Services included:

1. Coordination of materials receiving and reconciliation of project purchase order with packing list.

2. Determination of quantity, type and size of containers.

3. Coordination of hazardous cargo consisting of confirmation of Harmonized Schedule B numbers and verification of adequate packing as required.

4. Generation and distribution of shipping documents including the Commercial Invoice, Bill of Lading, Certificate of Origin and Shippers Export Declaration

5. Actual scheduling and booking with the steamship line.

6. Charges from steamship line, packer and any other goods or services consolidated and forwarded on a master invoice with applicable backup.

Trans-Oceanic performed as contracted and provided excellent service in dynamic and adverse conditions. The basic ocean routing was changed from the Trans-Siberian route to a completely new route through China without impacting the flow of material. The select air freight shipments were routine for Trans-Oceanic and the largest non-military air shipment of explosives ever attempted (more than 200,000 lbs) was successfully completed.

5.8.3 US Port Selection

The initial port selection criteria included the capabilities for the handling of explosives. Since the procurement of explosives was started immediately after contract signing, it was discovered that no ship line would allow movement of such a sensitive commodity. The criteria them became primarily geographic with emphasis on regularly scheduled Sealand service. The Port of Seattle/Tacoma, Washington allowed for convenient and inexpensive trips to both the packer/warehouse and the port in the event circumstances warranted the onsite attention of MK.

5.8.4 Consolidation/Packer

Once the route, ship line, port and freight forwarder had been established, the final decision was to secure a warehouse for consolidation and containerization. The primary responsibility was to physically receive the materials, advise the freight forwarder and purchasing agent of the material receipt including weight and cube and to organize and pack the containers optimizing the space and weight limitations. The primary responsibilities were also to observe and record obvious damage and advise of the condition of the export packing and marking.

Even though the suppliers were responsible for proper export packing and agreed to follow specific guidelines for quality, it was still important for a physical inspection by a qualified export packer. The packer would need to be proficient in not only recognizing deficiencies but being able to repack according to Mil Spec standards. Additionally, the consolidator/packer would be required to have the capabilities to handle and pack hazardous cargo according to restricted articles/hazmat standards. The final qualification would be heavy lift/special handling capabilities.

The above criteria was included in a survey of the port areas. Sea-Pac Services provided the most comprehensive and qualified response and was subsequently selected to perform this service. Their performance was steady and strong and they handled everything from 20 M^3 dragline buckets to delicate scientific instrumentation. Damage of material received in Mongolia was minimal and timely reporting allowed all project personnel to stay informed.

5.8.5 Ocean Shipping

Due to backlog of freight at the Chinese-Mongolian border, it was determined that the routing from Tacoma to Yokohama, Japan, transhipment via feeder service to Pusan, Korea and then into Vostchony would be the most expedient strategy. The inland routing consisted of off loading the containers cross dock to the railhead, movement to the Mongolian border, interlining with a Mongolian Rail, and finally, movement to the end destination of Ulaanbaatar. Actual door-to-door service averaged approximately 52 days.

Mid-project, Sealand dissolved it's affiliation with the CIS Trans-Siberian Rail entity. Based on the fact that MK was utilizing shipper-owned containers, this dissolution dictated utilization of a route which would allow Sealand to return the containers to the port of debarkation. Using the original study, it was determined that the best option would be to change the routing from Yokohama to Xing Xang, China, rail to the Mongolian-Chinese border, transfer the containers from the Chinese gauge rail trucks to the Mongolian gauge rail trucks and interline for final rail shipment to Ulaanbaatar. This process was established and tracked and was found to actually improve the average total transit time to 50 days.

5.8.6 Air Freight

Air freight was directed from the onset of the project to be held to a minimum. The availability of regularly scheduled, US flag passenger and small cargo service into Beijing, China and the use of either MIAT or China Air for the final leg satisfied all USAID regulations. This option was used on a limited basis and required prior USAID authorization.

The actual freight costs on the project exceeded MK's original estimated budget of $800,000 by approximately $750,000. The overrun variance was due to required air freight cost, which totaled $534,800 and inland purchase order freight costs which amounted to $235,150. The air and inland freight costs were approved by the USAID representatives in Mongolia and were vital to the successful completion of the equipment needs of the project.

The emphasis of the project start up, as far as commodity procurement was concerned, was expedient acquisition and movement of badly needed explosives. The power plants needed coal and without the explosives it was feared that the mines would not be able fulfill the demand. The explosives were purchased in the US but transportation became a key issue as the only way to move the explosives via ocean-going vessel would be to charter an entire ship at an exorbitant cost.

MK underwent a thorough process of obtaining facts, authorizations and waivers and defining capabilities and limitations finally determined the only viable method of providing the project with the explosives was to charter the largest commercial transport airplane available in the world. The charter was arranged and the explosives, along with other critical equipment was flown to Mongolia from Bangor, Maine in 3 days. This was a monumental effort, but one that assured success for the 1993/1994 heating season.

5.8.7 Receipt Of Materials and Turnover in Mongolia

Paramount to purchasing and transporting the materials was ensuring they were received in Mongolia, duly recorded and officially turned over to the MOEGM for the final intended use.

At the US consolidation point, Sea-Pac Services, each box or unit was marked with the applicable purchase order number. The prefix to the purchase order number, being either an M or a P, determined whether the intended final use was at the mine or one of the power plants. Whenever possible, an entire container would be loaded for either the mine or the power plant to avoid a mixture of alternate destination material. Materials were received by container in Ulaanbaatar and depending upon the markings were sent to either the Erchimimpex (power plants) or Nuurs (mines) warehouses for receiving and distribution.

A primary concern of MK was the accurate receiving and inspection of material. Internal forms of *Receiving and Inspection Reports* and *Over, Short and Damage Reports* were used to record the shipments. It was imperative that the receiving at both Nuurs and Erchimimpex be attended and supervised by an MK representative. Upon receipt of the commodities, MK officially transferred title to the MOEGM and released MK and USAID from further responsibility .

The systems set up in both the US and Mongolia proved very successful. Based on the volume and cost of material shipped, the instances of lost, stolen or damage product were negligible. In the event of these occurrences, a paper trail led to probable cause and recovery.

SECTION 6.0 MINING

6.1 General

The original project scope of work and primary objectives for the mines was to:

1. Review and summarize conditions in the Mining Sector and develop a work plan to assist the major mines.

2. Identify and compile a listing of critical equipment, material and parts required to maintain the existing Russian manufactured mining equipment, plants and other support facilities.

3. Provide technical assistance for mine planning and mining operations with special emphasis placed on modern maintenance practices.

4. Provide Western concepts for operational and maintenance management training.

5. Initiate procurement activities for acquisition of those items identified and approved by the MOEGM and USAID.

Several studies and reports on the Energy Sector mines have been prepared by various entities, submitted to interested agencies and are generally available for review. Subject studies and reports fully describe 1992 vintage conditions and production capabilities of the major mines; in 1992 those being Baga Nuur, Sharyn Gol and Aduunchuluun. The studies did not cover the Nailiakh underground mine or mention the Shivee Ovoo mine which was being developed but not yet producing coal. Ulaanbaatar power generating stations were dependent on output primarily from the Baga Nuur and Sharyn Gol mines.

The deficits in coal production commencing in 1992 are related to many causes. It can be assumed that the exit of Russian personnel involved with the Mining Sector program had its impact, however, loss of economic support was the primary factor in declining production. Most of the five-year planning inventory of on-hand equipment, spare parts and supplies in 1987 had been consumed by 1992. The Energy Sector Project was implemented to help overcome these difficulties, both economic and to improve mining technologies. The USAID cash transfer project implemented in early 1992 resulted in a substantial portion of the funds being allocated to the Mining Sector.

Following in Table 6-1 and 6-2 are statistics for Coal Reserve and Production of Active Coal Mines in Mongolia and the Coal Specifications of Active Coal Mines in Mongolia.

TABLE 6-1

ACTIVE COAL MINES IN MONGOLIA

COAL RESERVE AND PRODUCTION

	Underground Mines		Open Pit Mines														
	Nalaih	Saihan Ovoo	Baga Nuur	Sharyn Gol	Aduun Chuluun	Tal Bulag	Chandgan Tai	Tevshiin Govi	Tavan Tolgoi	Bayan Teeg	Mogoin Gol	Zeegt	Hoshoot	Hartarva Tai	Nuurst Hotgor	Shivee Ovoo	Ulaan Ovoo
Start Up Date	1922	1965	1978	1965	1969	1976	1966	1985	1966	1962	1971	1977	1973	1976	1965	1992	1992
Mine Capacity (Thousand Tonnes/Year)	300.0	25.0	6000.0	1400.0	600.0	100.0	150.0	50.0	150.0	150.0	100.0	100.0	100.0	150.0	150.0	500.0	
Mine Depth (Meters)	300.0			300.0	300.0	80.0	130.0	300.0	500.0			100.0	150.0	100.0	150.0	160.0	
Operation Depth (Meters)	200.0			200.0	50.0	35.0	24.0	13.0	32.0			24.0	40.0	19.0	38.0	19.0	
Geological Reserve (Million Tonnes)	78.7	2.3	687.0	127.2	29.3	415.0	213.0	920.0	5000.0	3.5	15.0	6.8	9.2	25.7	12.5	1000.0	40.0
Mining Reserve & '94 (Million Tonnes)	53.3	2.1	270.8	30.2	7.2	12.7	121.0	13.1	1595.9	26.4	2.6	2.2	9.6	5.9	5.6	282.6	24.0
Production Projection for 1995 (Thousand Tonnes)	40.0	10.0	3500.0	1000.0	384.0	55.0	50.0	50.0	35.0	80.0	40.0	25.0	35.0	60.0	55.0	560.0	

TABLE 6-2

ACTIVE COAL MINES IN MONGOLIA

COAL SPECIFICATIONS

	Underground Mines		Open Pit Mines														
	Nalaih	Saihan Ovoo	Baga Nuur	Sharyn Gol	Aduun Chuluun	Tal Bulag	Chandgan Tai	Tevshiin Govi	Tavan Tolgoi	Bayan Teeg	Mogoin Gol	Zeegt	Hoshoot	Hartarva Tai	Nuurst Hotgor	Shivee Ovoo	Ulaan Ovoo
Coal Age and Type	Brown B3	Brown CC	Brown B2	BrownB3	Brown B1	Brown B2	Brown B2	BrownB2	Coking Permian	Bitu-minous	Bitu-minous	Bitu-minous	Creta-ceous	Bitu-minous	Car-bon-iferous	Creta-ceous Brown	Bitu-minous
Average Thickness of Coal Seam (Meters)	1 - 10	1 - 3.4	17.2	5 - 33	17.7	7.5 - 34	30 - 40	5.5 - 64	18 - 25	12 - 16	3.4 - 23	14	7.3 - 28	40 - 45	14 - 18	9 - 8	54
Inclination Angle of Coal Seam	8 - 15	0 - 3	8 - 27	8 - 15	5 - 8	8 - 15	5 - 40	18 - 24	8 - 10	25 - 30	8 - 10	40 - 55	14 - 18	6 - 8	10 - 15, 20 - 30, 60 - 65		
BTU (Kcal/Kg)	6300-6600 / 3500-3700	8820 / 4900	5940-6120 / 3300-3400	7200 / 4000	4266-4410 / 2370-2450	4428 / 2460	5400 / 3000	5400 / 3000	9216-10440 / 5120-5800	8424 / 4680	9540 / 5300	7200 / 4000	9000 / 5000	6300 / 3500	6840 / 3800	5985 / 3325	8640-10080/ 4800-5600
Total Humidity (%)	20.0 - 22.0	4.4	20.7	15.0	49.0	30.0	39.5	40.0	15.7	7.6	8.3	14.0	2.8	12.1	4.2	32.0	13.4
Ash Content (%)	14.9	21.6	22.6	19.9	8.5	27.5	7.3	25.0	16.5	15.6	13.5	10.5	14.6	19.4	30.0	11.0-18.0	10.0
Sulfur Content (%)	0.6	0.6	0.5	0.7	1.4	1.4	0.6	0.7	0.7	1.0	0.9	0.4	1.1	0.3	0.5	1.0	0.3
Volatile Value	41.1	11.8	44.5	44.5	49.0	40.0	44.1	50.0	30.7	35.4	30.0	33.3	46.2	32.0	28.1	40.2-47.0	35.0

6.2 Coal Mines Supported

6.2.1 Nailiakh Underground Mine

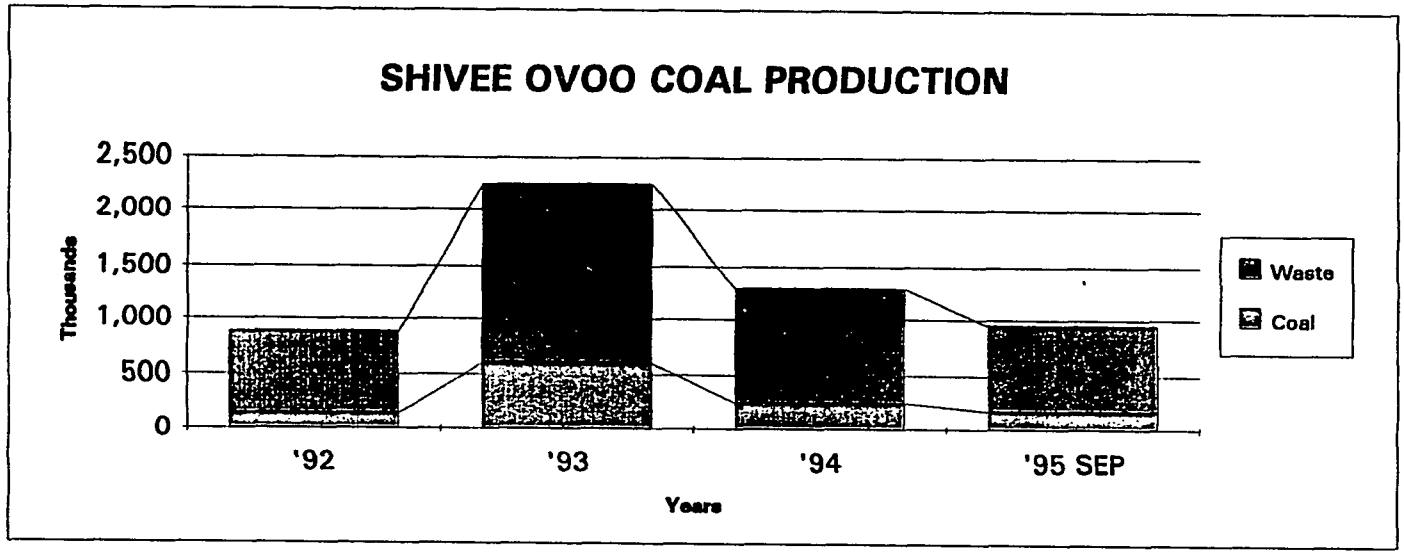
The Nailiakh underground mine located about 30 km east of Ulaanbaatar commenced production in 1922 furnishing some fuel to the power plants until 1992 when underground production stopped due to explosions, fires and flooding. Most of this mines output was to provide fuel to local consumers, the Nailiakh Glass Factory and local area small heating plants. USAID purchased dewatering pumps and associated piping which were received and installed in the summer of 1993. Attempts to re-open this mine were unsuccessful. Another explosion occurred with fatalities, thus ending this mines underground production. A private company is currently producing small amounts of low grade surface coal for local consumers only; none to the power plants. Closure of this mine has resulted in serious economic difficulty for the city of Nailiakh and the local area; unavailability of high quality fuel, closure of the glass factory and the loss of over 1200 mining related jobs.

6.2.2 Shivee Ovoo Coal Mine

A large lignite deposit, estimated geologic reserves of some one billion metric tonnes is located 275 km south of Ulaanbaatar alongside of the main rail line. Original conceptual design work by M-K Engineers which was presented to the MOEGM management staff certainly impacted the decision to proceed with development of the mine. The infrastructure necessary to support the mines development existed only 7 Km from the deposit, an abandoned Russian military base which included a utility system, fresh water supply and energized high voltage substations/power lines. The USAID Cash Transfer Project furnished funds to purchase mining equipment, develop a dewatering system, construct a three-line rail siding for coal loadout and construct an overhead electrical distribution system.

A USAID funded permanent construction equipment shop is nearing completion with only some minor interior work remaining. This mine commenced coal shipments in late 1992 and supports consumers in the local area with regular rail shipments to Power Plant #4 in Ulaanbaatar. The moisture content of the deposit is high and has been cited as the culprit in problems at the power plants. In the summer of 1995, the reported water level was approximately 2 meters below the deposit and if the dewatering system continues to operate, the moisture problem will improve somewhat, but will not completely resolve the difficulty. This will require the modifications and installation of drying equipment at Power Plant #4 to eliminate the additional consumption of mazut to offset the moisture content. Mine data and yearly statistics are tabulated in Table 6-3.

TABLE 6-3



	'92	'93	'94	'95 SEP
Coal	145	603	250	174
Waste	728	1,639	1,043	769
Ratio	1.3:1	2.7:1	4.1:1	

6.2.3 Sharyn Gol Coal Mine

Sharyn Gol is an open pit mine, employing a system of draglines, trucks and rail lines for overburden removal. The coal seams are mined using electric powered excavators and end dump trucks. Coal for rail shipment is hauled to an out-of-pit coal pulverizer, crushed, screened and loaded into the rail cars via belt conveyor. Fuels for the local area consumers are loaded onto whatever type vehicle can negotiate the pit ramps, usually a farm tractor and wagon. In the interest of safety, it was suggested the coal be transported out of the pit by mine haul trucks to a safe area and one small loader devoted to outside sales.

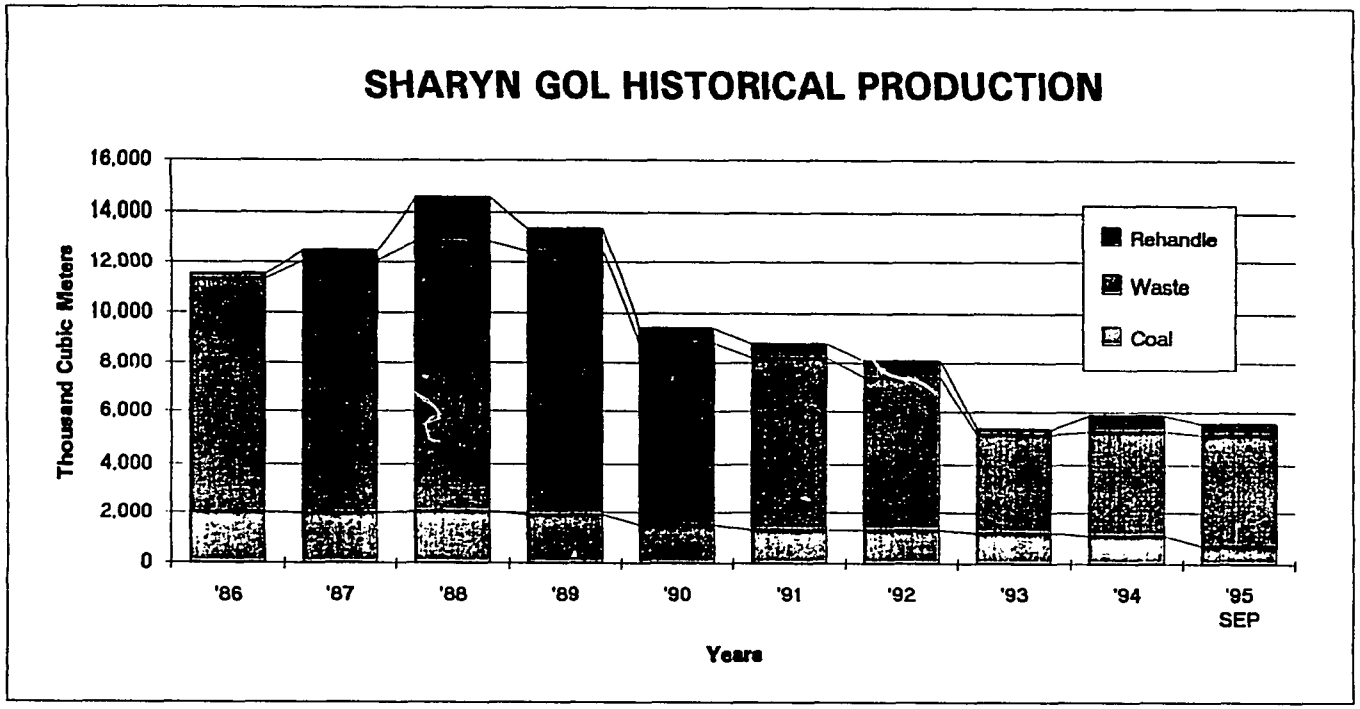
Sharyn Gol mine operates a heating plant which furnishes heat and hot water to the mine facilities and local community. A problem developed with the boiler ash removal conveyors late during the 1992/1993 heating season shutting the heating plant down. Parts to effect repairs were not in country. An emergency waiver was approved by USAID to procure US$115,000 of parts from the CIS to restore operation. It was a miserable situation but somehow, the residents survived the remainder of the winter. It took two summers (1994 and 1995) to excavate and replace broken piping. One new steam boiler was also installed by a Russian contracting company to improve plant efficiency. Electrical power is received from the central energy grid high voltage power system. Sharyn Gol produces a high quality B-3 type coal, low in moisture content, the main customers are the Darkhan Power Generating Station, Erdenet Power Generating Station, the Erdenet copper mine and Power Plant #3 located in Ulaanbaatar.

The USAID Cash Transfer Project resulted in some funds being allocated to Sharyn Gol. MOEGM records indicate that one new diesel locomotive, six new Belaz-548, 45 MT haul trucks, two bull-dozers and approximately 26 km of railroad track were purchased to help overcome the huge deficit in overburden removal.

Reliable production statistics are available back through 1986. The mine commenced production sometime in 1965 reportedly reaching a peak in 1988 producing 2.I MMT declining to 1.1 MMT in 1994. Coal Production for 1995 through September was 700,085 MT. Due to the coal seams declination (about 9°) the stripping ratio has constantly increased and is about 6.35:1 BCM/Tonne at the present level of mining. Statistics indicate overburden removal peaking in 1988 at 10.8 MM^3 declining to 4.0 MM^3 in 1993.

Historical mine data, consumer information and yearly statistics are tabulated in Table 6-4.

TABLE 6-4



	'86	'87	'88	'89	'90	'91	'92	'93	'94	'95 SEP
Coal	2,026	1,985	2,053	1,900	1,475	1,297	1,291	1,183	1,074	700
Waste	9,258	10,084	10,813	10,567	7,348	6,910	6,100	3,951	4,194	4,444
Rehandle	208	411	1,621	920	568	574	688	202	619	420
Ratio	4.57:1	5.08:1	5.27:1	5.58:1	4.98:1	5.33:1	4.72:1	3.34:1	3.90:1	6.35:1

6.2.4 Baga Nuur Coal Mine

This is an open pit mine producing lignite fuel with Power Plant #4 being the main customer. Production commenced in 1978 reaching a peak in 1988 producing 4.1 MMT, declining to 2.8 MMT in 1994. The overburden removal process is the same as at Sharyn Gol mine: dragline, rail and haul truck. Overburden removal peaked in 1992 with 9.7 MM^3 removed declining to 9.6 MM^3 in 1994. Baga Nuur also operates a heating plant furnishing heat and hot water to the mine facilities and local community.

Electrical power is received from the central energy grid high voltage power system. Coal is mined by excavator, loaded onto haul trucks, hauled to a crushing/load out facility similar to Sharyn Gol. Coal is also mined at a satellite pit located several kilometers west of the main mine. Run of the mine coal is loaded directly into railcars as there are no crushing facilities.

There are approximately 1400 employees working at this mine. Historical mine data, consumer information and yearly statistics are tabulated in Table 6-5.

6.3 ESP Facilities Supported

Other facilities of the Energy Sector were supported with Mining Sector funds. Commodities furnished were special tools, mechanics tool sets, consumable maintenance/service supplies and other items requested such as motor rewind wire for the central repair shop. Other facilities supported were:

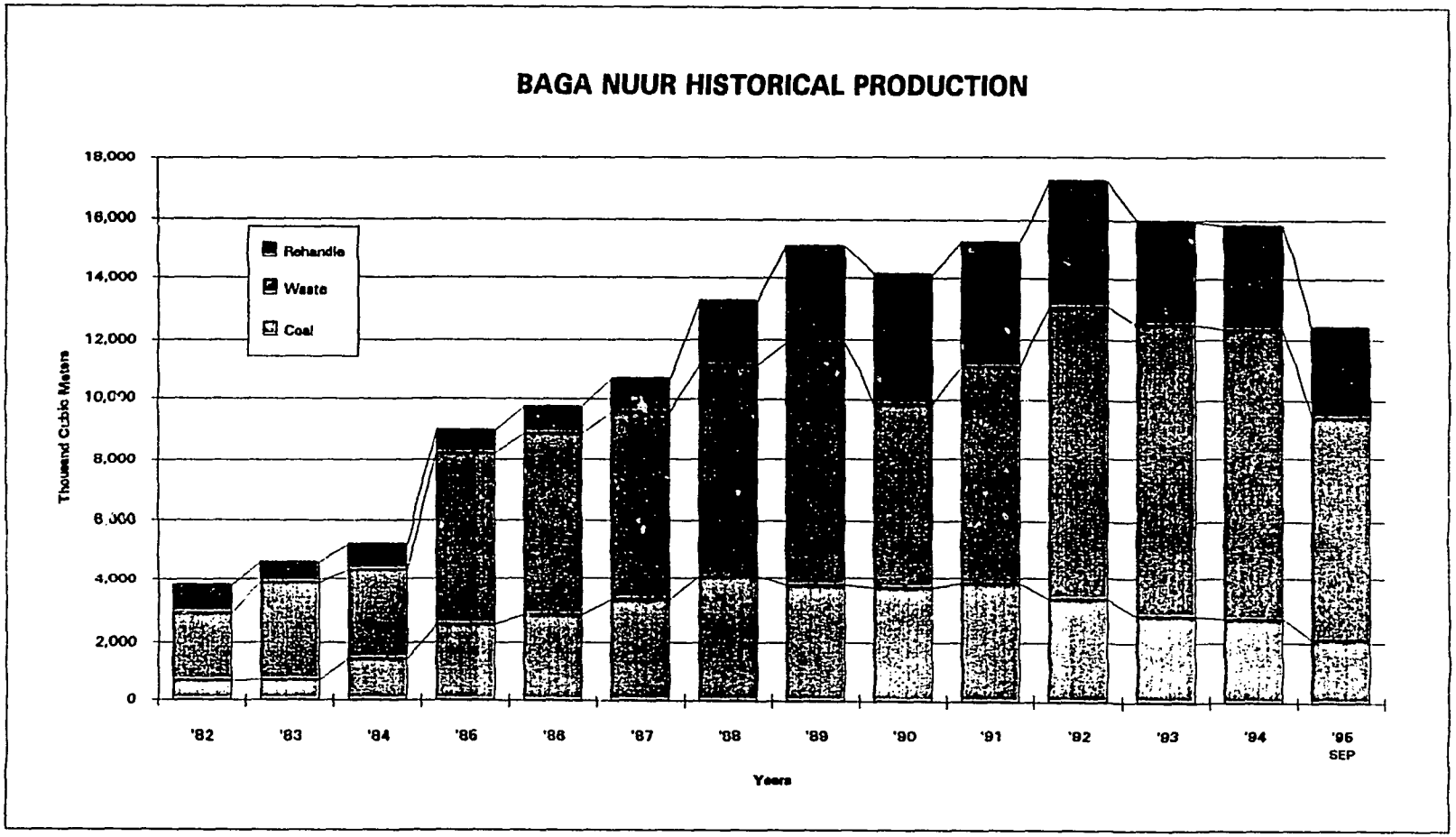
Aduunchuluun Coal Mine
Tavan Tolgoi Coal Mine
Dalanzadgad Power Generating Plant
The Nuurs Company
Central Equipment Repair Shop

The central equipment repair shop was assisted by the Mining Sector team until mid-1994. Primary responsibility for coordinating support requests/procurement activity was transferred to the power plant engineering team and supported with power plant sector funds. The mining team continued with technical assistance as requested.

6.4 Economic Support - Procurement 1992/1993/1994/1995

Technical inspections, status of equipment condition, what could economically be restored to operation were determined and material/parts lists were established and reviewed which resulted in a priority listing approved by the MOEGM and USAID. Some of the items purchased are listed herein to identify their importance.

TABLE 6-5



	'82	'83	'84	'85	'86	'87	'88	'89	'90	'91	'92	'93	'94	'95 SEP
Coal	700	718	1,459	2,573	2,882	3,339	4,054	3,786	3,701	3,832	3,399	2,848	2,791	2,109
Waste	2,197	3,155	2,886	5,654	6,026	6,259	7,063	8,113	6,156	7,229	9,735	9,680	9,568	7,338
Rehandle	880	768	900	781	838	1,053	2,180	3,208	4,264	4,183	4,093	3,418	3,462	3,005
Ratio	4.4:1	5.5:1	2.7:1	2.6:1	2.5:1	2.3:1	2.4:1	3.1:1	3.0:1	3.2:1	4.4:1	5.0:1	4.7:1	4.9:1

- Dragline Buckets, 10/70, 15/90 and 20/90 M^3 for Baga Nuur Mine and 6/45 M^3 excavator bucket for Sharyn Gol Mine.
- High Voltage trailing cable for the excavators/draglines, and drills.
- Many sizes of wire rope, plastic impregnated for mining equipment.
- Blasting accessories/new blasting initiation systems.
- Locomotive parts and batteries.
- Truck batteries, tires, tubes, and other components.
- Periodic maintenance items such as air/oil/hydraulic filters.
- All types of mine support tools, portable welding machines, light plants and air compressors and high voltage splicing materials.
- New Flexco conveyor belt splicing kits and accessories.
- Conveyor belting sizes l,000mm to l,600mm.
- Special wire rope slings/shackles for heavy lift safety.
- Protective safety equipment for maintenance/repair work.
- Haul truck engines.
- Computers and software for a computer based equipment management system.

These are samples of the types of equipment, components and consumables provided to the mines.

6.5 Accomplishments

The ESP has been successful in correcting the downward trend in coal mining activities by providing critical supplies, spare parts, tools, equipment and technical assistance during the past three years, thus avoiding a winter crisis caused by a shortage of fuel. The major power generating plants received just enough fuel, just in time, to remain on-line during the heating seasons.

In October 1995, on-hand fuel supplies were low. The power plant stockpiles were well below desired levels at this time of year but were above the stock level at this time in 1994. Uncovered coal supplies at the mines have improved especially at the Baga Nuur mine. Sharyn Gol mine will not produce sufficient fuel to meet the demands of its many customers. Shortages will have to be covered by the other mines.

MK achieved some success in impacting the attitude structure of Mongolian mining personnel regarding safety, work habits, housekeeping, maintenance, efficiency and planning. There was success in introducing Western concepts in the areas of mine planning and production processes. Other improvements were observed, such as completion of work assignments, safety and care of equipment, equipment availability, haul road maintenance and condition and most other mine activities.

6.6 Conclusions

Much remains to be accomplished before the Mining Sector can become stable and self-sufficient. They will require continuous material/technical assistance until such time as the financial condition of the country achieves stability and can absorb the costs incurred by the Central Energy System.

SECTION 7.0 POWER PLANTS

7.1 General

The primary objective of the project for the power plants was to provide aid in the form of spare parts, replacement equipment, and tools to assist the plants in maintenance to extend their life and improve the deteriorated condition until projects could be identified and funded by the world's funding institutions for the rehabilitation of the plants. Early in the project a Value Engineering was undertaken to identify those areas that would provide the most benefit to the Energy Sector with the funds appropriated for the project. This effort defined Power Plant #3 as the plant requiring the most assistance that, if assisted, would provide the greatest benefit in keeping the production of electrical and thermal energy at the required levels over the immediate future.

Power Plant #2 was to receive minimal assistance as it is the smallest and oldest plant in the system and as such, while important, any increase in energy production would be minimal. Power Plant #4 would also receive minimal attention as it is the newest and most modern of the plants in the system. The power plant at Choibalsan in the eastern province of Dornod was not identified for assistance until a field trip by the USAID Project Manager and MK engineers in June 1994.

Secondary objectives were identified to provide technical assistance to all plants as the opportunities presented themselves in such areas as plant operations, maintenance, safety, organization, administration, and procedures.

Equipment at the power plants is often kept in operation despite warning signs that a breakdown is imminent. When the breakdown subsequently occurs, the damage is more extensive, the repairs costlier and forced outages are longer in duration. All power plants lack funding to purchase material, equipment and spare parts to perform routine maintenance even though they have regular maintenance plans. It is also difficult to adhere to the maintenance plan because of the continual interruptions for emergency repairs. Poor maintenance was also compounded by lack of proper maintenance tools and inadequate lighting.

The Energy Sector and the MOEGM, were providing very little to power plant management in the way of training for employee supervision, motivation and communication. The still evident effects of Socialism allow for no positive feedback to employees during performance of specific work assignments or after completion and no mid-performance monitoring. Employees seldom know the benefits of their work and thus have no idea of their place of importance in the work chain. If there was feedback, it was most often negative. Little attention has been paid to improving tradesmen's skills, when more emphasis should be placed on employee training in both the classroom and the field environment.

Difficulties were encountered with unreliable delivery and poor quality coal. This problem was compounded by low quantity of both the coal and mazut stock during past heating seasons.

The high voltage transmission and distribution system (outside of MK's scope of work) is in very poor condition. During 1995 it has caused power blackouts of the entire grid which lasted at times up to 12 hours before power was restored. Serious consideration should be given to overhauling the entire system.

MK Mongolian engineers worked very closely with their counterparts at the plants. After being trained by their MK supervisor, Mongolian engineers passed on their knowledge to power plant personnel.

Early in 1995, USAID increased MK's scope of work which was divided to 28 tasks. Each task was assigned to a Mongolian engineer with direction provided by two MK expat engineers. Each task had project planning sheets outlining such pertinent items as the project description, project objectives, schedule, etc.

All power plant procurement documentation was successfully prepared by the Mongolian engineering staff with assistance from the MK expat supervisors. The level of knowledge and understanding the Mongolian engineering staff gained in a short period of time was commendable. They can continue to be valuable assets to the power plants by training other power plant personnel in both US contract practices and technical specification interpretation.

MK was instrumental in providing information to various high ranking USAID representatives and other US Government officials who visited Power Plant #3 concerning the Mongolian Energy Sector's urgent need for assistance. The handouts prepared for these occasions were the result of close collaboration between Power Plant #3 officials and the MK engineering staff. Such documentation contributed to better understanding of the CES's needs and resulted in additional financial assistance for the 1995/1996 heating season.

7.2 Condition and Situation at the Power Plants

7.2.1 General

All the plants were found to have some common conditions and situations. The organizational structure at all the power plants is basically the same, large multiple function matrix-type organizations. Practically all working levels of the organizations have multiple supervisors for the differing functions for which they are responsible. All the plants are over-staffed compared to similarly sized and configured plants in the US.

Preventive maintenance programs were basically non-existent due to the lack of spare parts and maintenance materials. The general operation philosophy was to run equipment until it failed because the parts were not available to make repairs and/or the need to produce energy took precedence over maintenance requirements.

7.2.2 Power Plant #2

Power Plant #2 was constructed in two phases beginning in 1959. The first phase, built by the Chinese, consists of three - 35 t/hr boilers and two - 12mW turbine generators. The second phase was completed in 1971 and has two - 75 t/hr boilers and one - 12mW turbine generator. While this plant is the oldest and smallest in the CES, it plays an important role as it is the necessary energy source to start-up Power Plant #4 should it be totally lost from the system. This plant also supplies thermal energy to several industries.

Power Plant #2 is the cleanest and best managed plant in Ulaanbaatar. The primary reason for this is the plant shutdown from May 15th to September 1st each year, which allows a more than adequate maintenance period and, due to the small size, the cost to maintain it is relatively inexpensive.

7.2.3 Power Plant #3

This plant was constructed in two phases beginning in the 1960's. The first phase called the low pressure plant consists of six - 75 t/hr boilers and four - 12.5mW turbine generators. This phase was designed to produce 50mW electrical energy and 207 G-cal/hour of thermal energy to industrial steam users and the district heating system. The second phase, called the high pressure plant, was constructed in the 1970's and consists of seven - 220 t/hr boilers and four - 34mW turbine generators. This phase was designed to produce 100mW of electrical energy as the generators were never fitted with hydrogen cooling to increase the output to 136mW and 350 G-cal/hr of thermal energy.

This plant was found in a deplorable state. The entire plant was extremely dirty with all floors, walkways and equipment covered with layers of coal and dust fly ash. Water, steam and coal leaks were found in all areas of the plant. The ash sluice trenches were plugged and the ash flooded onto the basement floor where, mixed with the coal dust and fly ash, it reached depths of six to twelve inches. The plant was very dark with the majority of the light fixtures either broken or in need of light bulbs. A large percentage of the plant instrumentation and control devices were not in working order and control systems designed to work in automatic mode were manually adjusted.

A major coal dust explosion occurred in late 1993, a district heating system generator exploded in early 1994, and the turbine motor on turbine generator number 8 also suffered major damage in early 1994. All of these incidents caused the majority of the plant to shutdown with capacity lowered until repairs could be made.

Approximately 1400 persons work at the plant including 150 engineers and managers. In a plant of this size and configuration in the US there would be approximately 300 employees of which four or five would be engineers.

7.2.4 Power Plant #4

This is the largest and newest power plant in the CES. Construction was completed and the last units placed in service in the mid-1980's. The plant consists of eight boilers and six turbine generators designed to produce 540mW of electricity and 3,057 G-cal/hour of district heating water. This comprises approximately 70% of the CES electric energy and 60% of Ulaanbaatar's thermal energy requirements.

Even though this is the newest and most modern plant, it is deteriorating rapidly due to the lack of funds for routine and major maintenance efforts. The problems were compounded by numerous coal dust explosions and fires in 1993 and 1994 that took large sections of the plant out of service while coal conveyor sections or pulverized coal dust systems were rebuilt. The Government of Japan (GOJ) began a program in 1993 to provide some aid to this plant to reduce the rate of deterioration and to improve reliability. Approximately 1800 persons work at this plant including 200 engineers and managers.

7.2.5 Choibalsan Power Plant

The Choibalsan plant is a small, 36mW, isolated plant located in the Dornod province, approximately 750 km east of Ulaanbaatar. It serves the town of Choibalsan and surrounding villages (soums) with an overall population of 65,000. The plant consists of three each 35 t/hr and 75 t/hr boilers and two - 6mW and 12mW turbine generators. The plant uses coal supplied from the nearby Aduunchuluun coal mine.

When this plant was first visited in June 1994, it was found in an extreme state of disrepair and operating with very low reliability. The lack of plant lighting and the excessively dirty state of the entire plant made it an extremely unsafe place to visit, much less work in. The lack of funding over the previous four years had led to the majority of the equipment being in an inoperable state. The plant reported that during the winter of 1993-1994, it had experienced total shut down twice and the system came dangerously close to freezing up. Emergency repairs were made and at least one boiler and turbine generator were able to start, thereby avoiding disaster.

This plant does not come under the CES as it is not electrically connected to CES. The plant reports directly to the MOEGM and, unlike the other power plants in Mongolia, is responsible for all the local diesel generating and coal fired heating plants located in the many soums in Dornod. The high cost of diesel fuel puts an enormous financial drain on the Choibalsan plant. If this problem could be solved, the Choibalsan plant could be one of the most profitable in the country and would most likely be able to be maintained and operated without financial assistance. One factor that makes this a possibility is the relatively low cost of coal from the Aduunchuluun mine.

7.3 Assistance Provided to the Plants

7.3.1 General

The primary source of assistance provided to the plants was the purchase of needed equipment, spare parts, and tools with which to perform maintenance and improve the operation of the plants. Other forms of assistance included training in several areas, technical assistance, safety tours, and inspection and fact finding visits to plants.

One important area of training and technical assistance which not only had a positive effect on the management of the project, but will also stay after the project ends, was the introduction of a project management system in April 1994 to identify and define the project tasks, plan the work sequence, obtain necessary approvals, and monitor the progress during the implementation of the task. Five Mongolian engineers were hired during 1994 to work with the expatriate engineering managers in the execution of the project. These engineers all had power plant engineering, operation, and/or maintenance experience and varying degrees of English proficiency.

This staff was supplemented during 1995 with four Power Plant #3 duty engineers assigned to work with the group on a two month rotational basis. These engineers were all trained in the importance and use of a project management system and in the preparation of technical specification packages for the procurement of equipment, spare parts, and tools. They were also the interpreters for all meetings held with the management of the plants, CES, and technical meetings at the MOEGM. Some of these engineers will continue to work for the plants or CES and some will probably continue to work in the private sector in support of the Energy Sector. In either case the country of Mongolia will benefit from the exposure and training received while working on the project.

7.3.2 Power Plant #2

The requirements for assistance at Power Plant #2 were minor in comparison to Power Plants #3 and #4. Spare parts and materials were procured for both the 1994/1995 heating season and the 1995 summer maintenance season. Biweekly meetings were held with the plants senior management to discuss their needs, problems, and coordination of technical details for the items purchased on their behalf.

7.3.3 Power Plant #3

The majority of funding was provided for Power Plant #3 and was the location of the project office. In the first year of the project, the majority of time was spent evaluating the needs of the plant and ordering critical spare parts and tools.

Beginning in April 1994, the expatriate engineering managers undertook a program to increase the awareness of plant management to the need to make the plant a safer place to work. The primary method employed was to conduct daily morning tours of the plant by two MK expat engineers with two Mongolian engineers. During tours notes were made on the lighting, cleanliness, status of maintenance work, and operational parameters. The observations were reported to the duty engineer on a daily basis. Through these tours MK was able to provide instant feedback to both the engineers in training and the Mongolian power plant operators as to what our concerns were with relation to the operation of the plant. A weekly meeting was held with the plant director to review the observations made during the tours, discuss the current operation of the plant, review status of maintenance work, and discuss items of general interest. Similar regular meetings were held with the power plant chief engineers to address matters more technical in nature and centered on maintenance and operational problems and their solutions. At those meetings priorities for USAID-financed purchases of equipment, material and tools were discussed and agreed upon. All meeting minutes were translated into Mongolian and distributed.

Health and Safety seemed to get the least amount of attention from power plant supervisors. A management safety committee was formed at MK's suggestion and a monthly safety tour was conducted jointly by plant management and the ESP team. Each month a different area of the plant was targeted for this safety tour. Photographs were taken, a report of the deficiencies published, and follow-up inspections organized. In spite of initial success our efforts There is a long way to go to comply to the safety standards of Western power plants.

These efforts resulted in improved cleanliness and lighting conditions in the plant. This aided the plant in securing a loan from the Asian Development Bank (ADB) for the rehabilitation of the high pressure boiler plant. After the first inspection, the ADB had

indicated that if the plant did not show improvements in these areas, it would be difficult for them to approve the loan.

Technical assistance was provided to the plant by both the MK power engineering team and consulting engineers brought in from Burns and Roe Engineering for specific tasks which were outside the expertise of the resident engineering staff. The resident staff provided technical assistance for a wide variety of tasks: ball mill foundation reconstruction, deareator fabrication, project management techniques for managing subcontractors working for the plant, organizational structure, modifications to foundations and piping systems to accept new equipment procured from the USA, etc.

TDY engineers were provided to work with the plant engineers on the grounding system study and design, task #19, the study and design for the fire protection annunciation system, task #20, and the structural review of the building roofing system after the partial collapse of the high pressure boiler roof.

As detailed in Section 4.4, training played an important role in the assistance to the plant. Training was provided for managers on use of vibration analysis equipment, non-destructive testing equipment, maintenance of supplied equipment, welding, contracting and procurement procedures, and project management.

By far the greatest amount of assistance, as far as funds expended was concerned, went for the procurement of equipment, spare parts, and tools. This also created an environment for training as there was insufficient funding to accomplish all that was identified. Lists were created, revised, and prioritized many times and involved personnel from the plant, the MOEGM, and the MK power engineering team. Criteria was established for the preparation of lists and discussions were held to ascertain the validity of the need and the priority of each item.

7.3.4 Power Plant #4

Assistance to Power Plant #4 was similar to that for Power Plant #3, but on a smaller scale. The fact that the GOJ was providing some assistance and the results of the value engineering task kept the involvement of ESP personnel to a minimum. The main contribution to the plant was in spare parts procurement and training.

Biweekly meetings were held with the plant's chief engineer and the meeting topics centered around the delivery status of parts ordered, general operating conditions, and the status of maintenance programs. Plant personnel participated in all the training programs offered.

7.3.5 Choibalsan Power Plant

During a three week visit to the plant in January 1995, the requirements of this plant were reviewed with all departments of the plant and a prioritized list prepared. During this visit a review of the plants expected loads over the next few years was made and a maintenance plan developed to adequately prepare the needed number of boilers required to meet the loads. For the 1995 summer maintenance season, the USAID project procured in excess of $500,000 in spare parts and tools for the plant.

Plant management used the MK developed plan to prepare their material lists and to seek additional funding from the MOEGM to accomplish the work. The limited time remaining on the ESP project precluded the procurement of major materials required for the planned program.

Technical assistance was also provided to the plant during the visit on a review of the organizational structure and suggestions as to how the organization could be restructured to become more efficient. Plant personnel participated in the NDE equipment training and the welding training programs.

Table 7.1 provides a cost summary of the equipment and material purchased for each of the power plants under the USAID program. The costs tabulated in this table do not include freight or other costs associated with the procurements.

TABLE 7-1

USAID - MONGOLIAN ENERGY SECTOR PROJECT POWER PLANT PROCUREMENT SUMMARY

	1993	1994	1995	TOTAL
POWER PLANT #2			118,000	118,000
POWER PLANT #3	1,500,000	2,255,000	688,000	4,443,000
POWER PLANT #4		890,000	310,500	1,200,500
CHOIBALSAN		10,000	510,000	520,000
ENERGY REPAIR COMPANY		11,500	21,000	32,500
TOTAL	1,500,000	3,166,500	1,647,500	6,314,000

7.4 Results and Accomplishments

The assistance provided to the power plants has resulted in the meeting of the goals of the project. The plants have operated at a level to meet the minimum energy needs of the city of Ulaanbaatar while funding was obtained by the GOM to provide much needed rehabilitation and upgrading of the plants. During the project, the number of major outages diminished to the point that there were no major outages or accidents in the plants that severely effected the production of energy during the 1994/1995 heating season.

While the delays being experienced on the ADB project at Power Plant #3 and the GOJ project at Power Plant #4 will have an impact during the 1995/1996 heating season, the funds expended for the summer 1995 maintenance season will definitely assist the plants in maintaining their energy output. This was accomplished by working closely with the management of the plants, primarily Power Plant #3, to identify critical equipment, spare parts, tools, providing technical assistance on an ongoing basis, keeping the donor organizations

apprised of the energy situation, providing training in key areas, and developing an excellent working relationship with all the agencies in the Energy Sector.

The introduction of American technology into the plants has provided increased awareness that there are better, more efficient, and higher quality equipment and tools available in the world. Mongolia has a unique opportunity to develop standards that incorporate advantages from the differing standards around the world. To the present, they have been solely following the old Soviet standards that the plants were built to and only replacing in kind without considering changes that would affect the operability and maintainability of the plants in a positive manner.

Observing and being exposed to Western contracting and procurement methods and procedures has provided valuable insight and training for the Energy Sector personnel. The effects of this will be realized as greater levels of funding are provided by the international funding organizations and the Energy Sector manages their projects to the demanding standards of these organizations.

The awareness of the importance of safety and cleanliness to plant personnel has been raised due to the creation of the management safety committee and the daily tours at Power Plant #3. Prior to the start of these programs, there was only *one* employee with any responsibility for safety in the work place. There is now a safety and inspection department staffed by six people. They have started to conduct their own tours and are performing investigations into accidents and developing procedures to maintain a safer environment for the work force. While cleanliness at the plant is far from that found in American plants, the number of personnel assigned to plant clean up has been significantly increased and the main operating areas are kept in an acceptable state of cleanliness.

Communication to Erchimimpex and power plant materials managers was greatly improved by the introduction of dual language letters authorizing release and pick up of materials. This significantly increased the speed by which equipment was delivered to and put in use by the designated power plant.

The MK Mongolian engineering staff gained valuable knowledge and expertise in doing business using US contract standards and regulations. They have been sufficiently trained to order spare parts from US manufacturers and to communicate with them in English.

Mongolian power plant managers and MOEGM officials worked closely with MK and volunteered information even when it was not so pleasing. MK was welcomed as valuable members of their management team as they realized that MK and USAID were there to help them.

USAID assistance played a major role in supporting the Mongolian Energy Sector for three heating seasons, but the years of neglect continue to show at all power plants and continued assistance is required to not only provide more spare parts, but to continue training power plant personnel how to perform proper plant maintenance.

The present power plant organization relies too much on the leadership and decisions of one or two senior managers for all major as well as minor decisions. This management mentality must change and more decision making authority must be delegated further down. There is a lack of job descriptions to identify roles and responsibilities for each employee. All of this contributes to cumbersome management organization with the responsibilities of one individual overlapping with responsibilities of others.

SECTION 8.0 PROJECT RESULTS AND ACCOMPLISHMENTS

The primary objective of the project, "To provide essential emergency support to the Mongolian Energy Sector for the three heating seasons, 1993/1994, 1994/1995 and 1995/1996.", has been met.

While there is still much to be done to bring the Energy Sector to the level of Western utilities and coal mines, the power plants located in Ulaanbaatar performed at or above the minimum requirements of energy production during the term of the contract. Coal production has been erratic, but with valuable assistance from the USAID program, they have been able to deliver enough coal to the power plants to avoid shut down.

The number of accidents and failures leading to curtailment of the production of energy has decreased over the term of the ESP contract to the point where during the 1994/1995 heating season, there were no incidences that severely affected energy production.

Fires and explosions in the power plants were a major problem in recent years. MK personnel, under the USAID program, have worked with the power plants to reduce hazards and improve early detection. In the 1993/1994 heating season there were seven major fires and explosions in the Ulaanbaatar power plants with one fatality. In the 1994/1995 heating season there were none. This remarkable improvement is largely the result of USAID involvement.

The major coal mines continue to struggle, but US assistance has improved the availability of excavators and haul trucks so that the decline in overburden and coal production has been halted. USAID assistance has been invaluable in averting any major shortfall in supplies for the past two years. Coal supplies to the power plants have often been delivered just in time during the winter, but even a short term shutdown has been avoided.

A listing of specific tasks completed at the power plants is included in the Appendix to this report to illustrated in more detail the various specific efforts that were completed to achieve the successful results.

Many accomplishments of the USAID ESP program over the past three years are apparent in current operations and others will become apparent only through improved operations in coming years. Some of the major accomplishments and results are summarized here:

1. A major failure or shut down of the energy system has been avoided through three critical heating seasons.

2. Critical repair parts and supplies have been identified through Value Engineering studies and efficiently procured for maximum use of the available USAID funds.

3. All purchased commodities over the three heating seasons have been delivered in a timely manner without any lost or unaccounted for material.

4. Valuable training and technical assistance has been provided to all areas of the Energy Sector so that they are now in a much better position to develop a self sufficient system.

5. The project was completed on time and within the approved contract budget.

6. MOEGM procurement and inventory control procedures have been improved through formal and informal training and by USAID purchased equipment.

7. Work place safety and safety awareness has been improved through constant training and assistance from MK technical personnel.

8. Supervision and supervisory competence has been improved through formal and informal training programs conducted by project personnel.

9. Equipment maintenance has been improved through formal training programs, workshop tool procurement and intensive attention by MK technical personnel.

10. Records and reporting have been improved in some Energy Sector organizations by the purchase of US made computers and software and training in the use of new software.

11. English language competence has been improved for many power plant engineers and managers through the English language instruction offered under the USAID program.

SECTION 9.0 RECOMMENDATIONS FOR FURTHER USAID AND OTHER DONOR ASSISTANCE PROGRAMS

9.1 General Comments

There are many fundamental problems in the Energy Sector, most are a direct result of past decades of mismanagement. The Energy Sector will not become self-sufficient until some structural and political problems are resolved regardless of the continued assistance of foreign donors and aid organizations.

The Mongolian Energy Sector is managed by a very cumbersome bureaucracy built up over many years of socialist government management. Electricity and heating were heavily subsidized under socialism with little attention paid to cost, efficiency or pricing. The present government is trying to correct this, but the cost of energy is a very political issue and results have been slow. Prices charged to consumers for energy are still very low by world standards while energy production costs are relatively high.

Residential consumers now pay about $0.04/kWh for electricity and some industrial consumers pay less than $0.03/kWh. This is barely enough to pay actual production cost without anything for supporting the bureaucracy or for renewal of plant and facilities. A consequence of this imbalance is that the power plants and coal mines do not receive enough of the revenue to support daily operations and the condition of plant facilities are in a constant downward spiral. The situation is further compounded by many consumers who cannot or will not pay for their energy usage.

The Energy Sector will continue to decline and be dependent on foreign donors as long as this subsidization of energy costs is forced upon the distribution system, power plants and coal mines.

9.2 Recommendations for Further Action

The following specific programs are suggested for consideration of further USAID and other donor efforts in support of the Mongolian Energy Sector:

9.2.1 Present Program

The present support program should be continued with increased emphasis on training, tools and management assistance, but with somewhat reduced emphasis on procurement of spare parts and components. For the Energy sector to eventually become self sufficient, it will be necessary for the Mongolians to assume more of the responsibility with less dependance on foreign assistance.

This will require that they obtain the necessary training in modern technology and that they have the tools and maintenance equipment to do the work themselves. The USAID assistance effort should begin to shift toward that goal with reduced emphasis on short term, emergency patching to keep things running.

When the USAID Energy Sector Project was initiated, it wa[illegible]inated that other donors and lenders would become involved with substantial [illegible]rm [illegible]rojects which would eliminate the need for the USAID support. Unfortunately, [illegible] donors have been slow to react and major renovation projects will not get underway until late 1995 and 1996. Their impact will not be apparent before 1997. The present USAID program should be extended by at least one more year. The present support program includes:

- Procurement of instrumentation, equipment, parts and workshop tools
- Maintenance training
- Supervisor and safety training
- Training in modern management methods
- Computer training and procurement of computers
- English Language training

9.2.2 Extension of Present Program

The present program has concentrated on Power Plant #3 and Sharyn Gol mine with minor assistance to Power Plant #4, Baga Nuur mine and Shivee Ovoo mine. The program at Power Plant #3 has advanced to the point where involvement can be reduced and the program can begin to be extended to Power Plant #2, Power Plant #4 and Choibalsan. Choibalsan and Power Plant #2 have been neglected by all donor programs and are both badly in need of assistance. Mine assistance should continue to emphasize support for Sharyn Gol mine with some support for Tavan Tolgoi, Aduunchuluun and Shivee Ovoo.

9.2.3 Diesel Electric Plants

All of the small communities or soums have electricity provided by diesel generating stations and all are in a critical state of disrepair. All of the equipment in these plants was manufactured in either Russia or Eastern Europe and is thereby difficult for USAID to fund procurement of spare parts and components, but two critical items could be provided through the USAID program to assist these plants:

1. Procure two trailer mounted generating sets to be used in emergency situations as required to provide power when a station is completely down.

2. Procure workshop tools for use by the power stations so they have tools to make their own repairs.

9.2.4 Economic Evaluation of Diesel Power Stations

Given the state of repair at all of these stations, a sizeable investment will be required to either rebuild or replace them. Before that is done, a technical/economic study should be conducted regarding the rebuilding of each diesel generating station versus building electric line to tie them into the central grid.

Electricity generated by the present diesel powered stations costs $0.35 to $0.40 per kWh. Even with replacement by modern, more efficient units, the cost of diesel powered generators would be about $0.20 per kWh. The investment required to build electric lines to tie these areas to the central grid would be significant, but after completion the cost of electricity would be less than $0.08 per kWh. Eliminating all or most of the diesel generating stations would also reduce Mongolia's dependence on imported diesel fuel.

9.2.5 Renewable Energy

Much of Mongolia seems to be well suited for adoption of solar or wind electric generation. Southern Mongolia especially has a steady year round wind and with the declining cost of these generating stations it is appropriate to consider these sources. Renewable energy may be the least costly option for providing power to remote soums and individual housing units.

USAID could fund an evaluation and study of this option for consideration by other donors.

9.2.6 Inventory & Evaluation of Rail Overburden Equipment

Sharyn Gol and Baga Nuur coal mines each have a very large investment in rail overburden haulage systems. These systems are obsolete and inefficient, but it will be several years before they can be replaced and replacing them will result in greater dependence upon imported diesel fuel. In the interim, the mines must produce coal and the rail systems must be relied upon to move part of the overburden.

A complete inventory and technical inspection should be conducted of all rail equipment to determine replacements, rebuilds and repairs that are essential for this fleet to continue operating for the next few years.

9.2.7 Inventory Controls

Inventory control and supplies distribution is very lax and inefficient in all elements of the Energy Sector. A project should be implemented to assist the MOEGM in setting up a modern, computer based inventory control system. The project should begin with Nuurs Company and Erchimimpex then be implemented at each of the power plant and mine warehouse operations. MK, under the USAID program, acquired a computer based inventory control system, installed it and conducted a training course for usage at Erchimimpex. This was a start, but the same problem exists at all warehouses in the Energy Sector.

9.2.8 English Language Training

The Energy Sector will be increasingly involved in commercial and technical relations with the Western countries. It will be essential for engineers and managers to be able to communicate in English. Several major power plant and mine renovation projects will be started in the next several years and if the Mongolians are to be properly involved in implementing these projects they must be able to communicate in English.

An English language teaching project should be implemented for all elements of the Energy Sector. This would involve bringing several expatriate specialists to Mongolia to work with Mongolian professionals to conduct classes at each of the mines and power plants for an extended period (probably two years). Since the people who most need to learn English usually cannot be spared from their job to attend full time courses for the length of time required, the courses should be structured so that students can attend the classes and still work at their regular jobs.

9.2.9 Maintenance Training

Training classes in routine equipment maintenance should be conducted at each of the mines and power plants by competent expatriate maintenance specialists. These specialists should work with each of the mines and power plants for an extended period to assist them in developing an effective maintenance and preventive maintenance program.

Mongolian philosophy has been to run equipment until it breaks and then replace it. That cannot continue if the Energy Sector is to become self- sufficient.

9.2.10 Procure Work Shop Tools and Supplies

The Mongolian technicians and engineers are usually very good at making minimal repairs to repair broken equipment if they have the tools and materials with which to work. All of the workshops in the Energy Sector have a critical shortage of tools and supplies to perform minimal repairs and routine maintenance. Items required

include: hand tools, air compressors, welding machines, welding supplies, motor rewind wire, boiler tube, all types of shaped metal and various sizes of bearings.

MK, under the USAID program, has purchased some of this material, but much more is needed. This effort alone will require at least $1,000,000, but would pay dividends in improved maintenance and ability to make minor repairs.

9.2.11 Cross-training in the United States

A program should be implemented to take Mongolian engineers, supervisors and mangers to the US to work in a mine or power plant, doing the kind of work they normally do here.

For this effort to be successful, the Mongolians should work in the US several months in order to learn Western work habits and methods that can be applied to their situations.

This is certainly not an all inclusive list of things that need to be done for the Mongolia Energy Sector. It is intended to show examples of the kinds of things that should be considered and to initiate discussion of other essential requirements.

APPENDIX NO. A-1

STATUS OF ENERGY SECTOR

AUGUST 1995

EDITED NOVEMBER 1995

MORRISON KNUDSEN - BURNS AND ROE
USAID - MONGOLIA ENERGY SECTOR PROJECT

A. Summary

Every part of the Energy Sector in Mongolia is experiencing problems that severely impair the production, transmission, distribution, and use of energy. The severe lack of funding for procurement of coal and mazut, routine maintenance materials, spare parts, and tools, capital projects to improve operating output, reliability, efficiency, and environmental discharge improvements, and employee training in management, supervision, and trade skills creates a fire fighting-type operational mode that is always in the midst of a disaster. Less than adequate rate structure and collection, organizational structure, procedures, and accounting methods compound the problems.

Correction of the problems will require a multifaceted approach with the primary emphasis placed on keeping the Energy Sector operating at the best obtainable level. Training and capital projects to improve output, reliability, etc. need to be undertaken while this is being accomplished. Evaluation of and changes to the rate structure, organizational structure, procedures, and accounting methods should always be underway.

B. Status

B.1 General

All power plants and the energy transmission and distribution systems are lacking adequate funding to procure spare parts and materials to perform routine and scheduled maintenance functions. The skill level of the maintenance trades, welders, mechanics, electricians, instrument technicians, and general laborers is below that found in Western countries. Tradesmen are generally willing to learn and improve their skills and are capable of producing good work provided they are given the proper tools and materials with which to work.

The delays currently being experienced in beginning the major rehabilitation projects at Power Plants #3 and #4 will severely impact the ability of these plants to meet the required energy output over the next two to three winters. The original schedule for the ADB funded project at Power Plant #3 was to complete three of seven boilers by December 1995. The current schedule is to begin work on the first two boilers in March 1996. The contract is not expected to be signed until October 1995 and completion of all seven boilers would not be until December 1997 The rate of progress on the Japanese funding for major rehabilitation work at Power Plant #4 indicates that this work will probably not start until 1997 and not be complete until 1999-2000. At Choibalsan no major funding has been located other than funding for technical assistance provided by Tacis, the European Community aid agency for providing technical assistance to the CIS. Tacis has provided $1,000,000 to evaluate the condition of Choibalsan and Darkhan power plants and produce a scope of work for the rehabilitation of these plants. This work will then be used to attract funding from other international funding

organizations. It is not expected that funding for any rehabilitation work will be available for several years. The Darkhan plant is in better condition than other plants as Germany has provided funding for rehabilitation work in the past and it is understood that they will provide additional funding in the near future. Other than proposed ADB funding for some yet to be defined rehabilitation work on the Ulaanbaatar district heating system, there has been little progress in the evaluation and identification of needs of the district heating systems, electrical transmission and distribution systems, and rural electrification. All of these areas require attention as evidenced by the increasing number of forced outages on the energy distribution systems and the poor performance of the diesel generating plants and small heating plants in rural areas.

B.2 Power Plant #3

On the latest schedule of the ADB Rehabilitation Project, three HP Boilers will be complete by 31 December 1996 and an additional three by 31 December 1997. Only six boilers will be rehabilitated due to funding limitations. The rehabilitation work for the turbine generator plant, funded jointly by ADB, Danida, and NORDIC Development Fund, will be completed in mid-1997. These projects will greatly enhance the ability of the plant to run efficiently over the next seven to ten years. There are, however, other areas of the plant which require attention to compliment the existing projects. Neither of the existing projects are spending an adequate amount of funds on the control systems, electrical power systems, or plant auxiliary systems such as water treatment, fire protection, lighting, service air, welding systems, etc. Without upgrading these systems, the plant will surely continue to have frequent failures that interrupt the production of energy. An agency needs to review the work being completed by the existing projects and develop project packages that will provide plant personnel with the necessary systems to safely operate and maintain the plant.

B.3 Power Plant #4

This plant is the newest and largest of the plants producing electricity and steam for the CES. The plant was constructed in the 1980's with the first units placed in service in 1983 and the last in 1989. The plant has eight (8) 420 t/hr boilers producing 1,070 G-cal/hr of thermal energy. Of this 3,360 t/hr, 8,560 G-cal/hr, total capacity, 1,200 t/hr, 3,057 G-cal/hr of thermal energy is produced for the district heating system. There is a maximum electrical generation capacity of 540mW at this plant.

During 1993/1994 the Government of Japan (GOJ) provided limited aid to Power Plant #4 in the form of spare parts, materials, tools, instrumentation, and some training. During the 1993-1995 time period, USAID also provided support in the form of spare parts and training.

The biggest problem currently facing this plant is the lack of spare parts and materials with which to perform maintenance. This is, of course, due to the general lack of funding

available for the management of the plant. The maintenance plan for 1995 called for major overhauls and repairs to two boilers and two turbine generators. The plant was able to purchase enough material to overhaul and repair approximately 50% of one boiler and perform the overhaul of one turbine generator. Minor and routine summer maintenance of the balance of the plant has been spotty at best and dictated by the availability of materials and spare parts. Power Plant #4 management planned to purchase $4,400,000 worth of spare parts and materials from the CIS for the 1995 maintenance program. Of this amount $2,800,000 was actually funded and ordered as of August 1995. The majority of the materials and spare parts required are for boiler and ball mill repairs. Other systems and equipment in serious need of repair are the fire detection and protection system, the coal unloading facility, including the plant's locomotive, the plants switchyard equipment and control system, the plant instrumentation and control system, and building and roof repair including window replacement. It is extremely important that the plant be provided with adequate amounts of materials to make emergency repairs during the 1995/1996 heating season. The majority of this material is currently being procured under the USAID 1995/1996 heating season emergency procurement. Due to the lower than planned level of maintenance performed over the 1995 summer maintenance season the number of forced outages is expected to be greater this year than last.

The GOJ is in the process of providing a loan of approximately $40,000,000 to fund major modifications to the plant. The scope of work currently being discussed is primarily to change the boilers from indirect to direct firing with the ability to dry the coal to improve the combustion process. Whether other major modifications will be undertaken by this project is not known at this time. Actual construction work on this project is not expected to start until late 1997 or early 1998.

B.4 Choibalsan Power Plant

This plant is located in the capital city of Dornod province and is the sole producer of electric and thermal energy for the city and close surrounding villages. The electrical grid of this plant is not interconnected with any other generation source. The plant was built in the 1965-1975 time frame and consists of three, 35 t/hr boilers, three 75 t/hr boilers, two 6 mW turbine generators, and two 12 mW turbine generators. With the pullout of the Soviet military in 1990, the load requirements of the plant have diminished greatly. With 100% redundancy the plant could easily meet the load demands with two 35 t/hr and two 75 t/hr boilers and the two 12mW turbine generators.

MK/BRE and a Tacis representative spent time, on different occasions, in Choibalsan during the 1994/1995 winter season. Both experienced similar conditions with many electrical outages and hotel rooms with very little heat, 45°-50° F (5°-10° C) or hot water. During the visit, the district heating water temperature, at the point it leaves the plant, was never above 90°C and often as low as 70°C. The design plant discharge temperature for district heating

water is 120°C. At times, only one boiler and one turbine generator were in operation while emergency repairs were being performed on other equipment.

Since the departure of the Soviets, this plant has received little attention from anyone, including the MOEGM. USAID provided $550,000 in 1994/1995 primarily in the form of tools and instrumentation. Other than one large motor for induced draft fans, other identified spare equipment and materials could not be purchased due to time constraints. The GOM promised 256,000,000 Mongolian Tugriks to support the planned 1995 maintenance program, however, only one-fifth of this had actually been transferred to the plant's account as of August. With this 50,000,000 Mongolian Tugriks, the plant will purchase boiler tubing that Erchimimpex had previously ordered, but would not release without payment. This will allow minimal maintenance work on two of the 75 t/hr boilers prior to December 1995. The plant has contracted with a Russian contractor to provide approximately 12 welders and laborers to assist with the maintenance work.

Tacis has contracted with a Swedish engineering consultant to preform an evaluation of the plant and prepare a work plan detailing what rehabilitation and modifications are required to be made at the plant to extend it's useful life for a further 10-20 years. This report will then be available to international funding organizations to consider possible funding arrangements to implement the necessary work. As this process will take several years, funding is required to provide emergency materials and spare parts for repairs to the existing equipment to maintain an adequate level of energy output to meet the needs of the city. Due to the deteriorated condition of the entire plant, all boilers and turbines will have to be maintained at their current level to provide the necessary redundancy and operational freedom to meet the loads.

B.5 District Heating System

The district heating system is a series of interconnected loops in which water heated in heat exchangers in the power plants is pumped throughout the city and back to the power plants to be reheated and pumped again. All buildings in the city are connected to the district heating system and the heated water circulates through the building's radiator system to providing heat. In addition, each building or group of buildings has a heat exchanger in which domestic water is heated to provide domestic hot water. During the summer months when the heating load is shut off, water to heat the domestic hot water continues to be circulated. Often during the summer, outages are required in the district heating system to perform maintenance and make additions and modifications to the system and citizens are without domestic hot water.

The system is old and has been added to many times as the city has grown and new buildings have been built. The central control center is antiquated and is basically a manually operated system with no automatic controls. The system needs to be studied and

recommendations developed to simplify and improve the efficiency. The system does not have a means to measure and control the quantity of heat being distributed to the different sections of the city and individual buildings and apartments do not have controls to regulate the amount of heat taken.

The immediate problem to be addressed is the loss of energy due to leaks in the system and missing and poor insulation.

B.6 Electrical Transmission and Distribution System

The incidence of failures of the high voltage transmission system has increased over the last few years. During one major outage early in 1995, all the generation in Ulaanbaatar, Power Plant #2, Power Plant #3, Power Plant #4, and the Russian tie-lines separated from the system. The only generation that did not trip was the Power Plant #3 low pressure plant. The outage lasted a minimum of four hours and it was approximately 12 hours until the entire electrical distribution system was re-energized. Since that incident there were four similar incidences where Power Plant #4 and/or the Russian tie-lines have separated from the system. The effects of these outages were not as severe, as Power Plant #3 stayed on-line and the system was rapidly restored. The cause of these outages is due to the lack of spare parts for the high voltage switchgear and circuit breakers and lack of maintenance on the system. The same holds true for the low voltage distribution system as evidenced by the numerous outages in all areas of the city.

The central system control and dispatch center located in the CES building is in an extreme state of disrepair. The system provided by the USSR was extremely basic and only provided for indication of breaker position and indication of generation being supplied to the system. All the substations in the system are manned and the dispatcher must call a substation and ask the operators to perform whatever function is required. On a recent visit to the center, there was no indication evident. There are problems with the sending units at the different stations and with the communications system.

The first step to the solution of the problems for these systems is to provide technical assistance to the responsible operation and maintenance organization and identify the required spare parts needed to bring the system up to an acceptable level of reliability. Once this is underway, the system requires analysis to identify areas for modification and upgrading to improve the operability, reliability, and efficiency.

B.7 Organization, Training, and Procedures

These three important areas require much to improve the knowledge and efficiency of the Energy Sector. All the organizations are too large and intertwined to be efficient. Power plant organizations are approximately five times larger than comparable sized plants in the US.

The training at all levels is poor, primarily due to the lack of funding and proper training facilities. There are many procedures at all levels, however, there are many redundancies and being primarily manual systems, the procedures are cumbersome, the data produced is late, and quality of the data is questionable.

USAID, ADB, and World Bank have all provided funding and sponsored programs for assistance in these areas. USAID has ongoing English classes and has conducted video management training session using a series of tapes from the US Embassy. Efforts were also made to raise the level of safety awareness in the plants and to improve the level of communication and early identification of problem areas. Prior to the end of the project a welders training program was conducted and a training program for plant management was planned.

Changes to the organizational structure are extremely difficult to implement. The existing socialistic-type organizations have been many years in the making and there is great reluctance to change. The opportunity to see functioning organizations in action would assist this process. This can only be done by sending all levels of management to Western countries for training or exchange-type programs.

There are two major areas of weakness in the level of training in the Energy Sector. First, and the area requiring immediate attention, is the training of skilled labor. Trade schools are few and poorly equipped to train electricians, welders, mechanics, machinists, equipment operators, carpenters, cement masons, etc. It appears that students graduating secondary school basically only have two options: continue schooling at a college or university or get a job.

The option of learning a trade is practically non-existent. Skills are learned on the job by those who secure a job in the industrial or Energy Sector. The second area requiring immediate attention is that of supervisory training. In the Energy Sector, young engineers are placed in supervisory positions with little or no supervisory training. There is no means for talented tradesmen to move up the ladder into supervisory positions. This leads to a division between the formally educated and the labor force that results in friction and lack of quality and production. These problems can only be solved by education and training.

One means to overcome some of these problems would be to establish exchange programs with a US utility(ies) similar in size, located in cold climates, coal burning, and producing thermal energy. Establishing a modern, fully equipped trades training school in Ulaanbaatar and upgrading the CES training center would also be positive steps.

APPENDIX NO. A-2

USAID - MONGOLIAN ENERGY SECTOR PROJECT
PROJECT TASK LISTING - 1994

Task 01 Replacement of critical electrical motors and pump and motor assemblies, Power Plant #3 and Power Plant #4.

Task 02 Hazard Reduction Plan and Fire Prevention / Control Plan

Task 03 Power Plant #3 Clean-up; Purchase of Vacuum Cleaners, Expendable Tools, Plexiglass, etc.

Task 04 Calibration of UE&C Burner Controls, Flame Detection, and Coal Flow Detection Systems, Power Plant #3

Task 05 Proposal to Rebuild or Rehabilitate One Boiler, Power Plant #3

Task 06 Coal Unloading Station Coal Breaking & Rock Removal Equipment, Power Plant #3

Task 07 Provide Water Treatment Consultant to Power Plant #3

Task 08 Provide Support for Power Plant #3 Motor Rewind Shop

Task 09 Identify and Purchase general Maintenance Equipment and Tools to Support In-house Repair Projects at Power Plant #3.

Task 10 Operator and Management Training, Power Plant #3 and #4

Task 11 Evaluate and Recommend Required Renovations in Power Plant #3 such as District Heating Deareator #1, HP Boiler Repair, etc.

Task 12 Identify and Procure Necessary Expendable Supplies for the Central Maintenance and Repair Shop (CM&RS)

Task 13 Identify and Order Reference Books for Technical Libraries, All Energy Sector

Task 14 Upgrade Employee Health and Nutrition, Power Plant #3

Task 15 Procure Personal Computers and Develop Computer Competence in Support of Power Plant #3 Operation.

Task 16 Procure Critical Valves for 1994/1995 Heating Season, Power Plant #3 and #4

Task 17 Vibration Monitoring Equipment Balancing Training, Power Plant #3

Task 18 1994 NDE Examination of Three High Pressure Boilers, Power Plant #3

APPENDIX NO. A-3

USAID - MONGOLIAN ENERGY SECTOR PROJECT
PROJECT TASK LISTING - 1995

Task 19 Grounding System Rehabilitation, Power Plant #3

Task 20 Fire Protection System Rehabilitation, Power Plant #3 and Power Plant #4

Task 21 Training Programs, All Power Plants

Task 22 Provide Equipment and Tools for Power Plant #2

Task 23 Provide Equipment and Tools for Power Plant #3

Task 24 Provide Equipment and Tools for Power Plant #4

Task 25 Provide Equipment and Tools for Choibalsan Power Plant

Task 26 Provide Support for all Power Plants, Common Items

Task 27 Procure Tools and Expendable Supplies for Central Maintenance and Repair Shop

Task 28 1995 Non Destructive Examination of Five HP Boilers, Power Plant #3

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December 20, 1995

To: Distribution

Subject: Final Report for Mongolia Energy Sector Project, Contract AEP 0438 C 00 3023 00

In compliance with the terms of Contract AEP 0438 C 00 3023 00 for the Mongolian Energy Sector Project, please see attached copy of the "Final Report" for the period May 1993 to November 1995.

Distribution for the Final Report is shown below.

Sincerely,

K. P. Swanson

Karl P. Swanson

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