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OPERATIONS AND MAINTENANCE STUDY

PROJECT NO. 263-0177

VOLUME I

EXECUTIVE SUMMARY, FINDINGS AND RECOMMENDATIONS

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VOLUME I

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SECTION I

EXECUTIVE SUMMARY

1.1 STUDY OBJECTIVES:

The U.S. Agency for International Development (USAID) has made a significant commitment to the development of telecommunications in Egypt, and over the past fifteen years has contributed to four major projects, Telecom.I, II, III and IV. As a result of this commitment, USAID commisioned this study with an overall objective of evaluating ARENTO's current operations and maintenance practices and procedures for AID-financed equipment and materials provided under these four projects and recommend. improvements.

Also, the study evaluates the response of the equipment contractors to their contractual obligations covering work programs, maintenance and training requirements. In addition, those areas of telephone practice which are closely associated with the operations and maintenance of the AID-financed equipment have been reviewed and recommendations included.

1.2 FORMAT OF REPORT:

This fiinal Report is contained in two volumes: Volume I (this volume) contains Section 1, the Executive Summary; Section 2, an Overview of project team Findings; and Section 3, a summary of Recommendations.

Volume II contains the supporting material by Tasks, A through E, in the form of Appendices.

- APPENDIX 1: TASK A - Work Plan and General Comments
- APPENDIX 2: TASK B - Review of Records and Documentation
- APPENDIX 3: TASK C - Contractor-O&M Work, Program and Training
- APPENDIX 4: TASK D - Site Visits, Investigate O&M Practices
- APPENDIX 5: TASK E - Recommended Operational Improvements

1.3 SUMMARY OF FINDINGS:

Section 2 of this volume covers the findings of the Project Team. The following subjects, included in the Delivery Order Scope of Work, are addressed in some detail:

- Contractor responsibilities - O&M:
- Contractor responsibilities - Training:
- Spare parts:

- ARENTO current O&M practices:
- Training and capabilities of the O&M staff:
- General condition of installed facilities:
- Introduction of new technology and procedures to improve O&M practices:
- Present ARENTO O&M organization:

In general, it was found that the contractors had fulfilled their responsibilities in providing O&M procedures, training and spare parts. ARENTO's current practices, while satisfactory in most areas, could be improved. For example, outside plant and fiber optic practices provided by the contractor are no longer available in many locations. The capabilities of the O&M staff are generally adequate, however, training is week and additional training facilities and courses are recommended.

The general condition of the installed facilities is in line with the expected condition, based on the age of the equipment. There are a few exceptions and these are covered in Section 2 and in the applicable appendices in Volume II. Some new tecnology is being introduced, particularly in subscriber loop testing, and other improvements are being considered and are covered in the recommendations.

1.4 SUMMARY OF RECOMMENDATIONS:

The following recommendations are covered in detail in Section 3 of this volume and in the applicable appendices of Volume II. These recommendations are listed in the order of the suggested priority.

GENERAL RECOMMENDATIONS:

1.4.1 Network problems:

There is an urgent need for an USAID/ARENTO study to investigate, diagnose and solve serious network problems and it is recommended that this be done without delay. Some form of public education by ARENTO in the use and treatment of the telephone could well be part of the solution.(See Paragraph 3.2).

1.4.2 Network management system:

It is recommended that ARENTO should seriously consider the provision of network management facilities with a network management center to be installed in Cairo. (See Paragraph 3.3).

SPECIFIC O&M RECOMMENDATIONS

1.4.3 Transmission links between switching centers:

It is recommended that a team of experts be assembled to check the affected transmission routes and to make their report together with recommendations for appropriate corrective measures as necessary. (See Paragraph 3.4).

1.4.4 Centralized operations and maintenance centers (COM centers):

It is recommended that a study be made of the present operation and functions of the 1A COM Centers, in detail, and that a plan be prepared to utilize these centers more effectively and efficiently. This plan should consider the use of the facilities as described in Section 3.5, the integration of other exchanges into the Cairo center and the linking together of the 1A and No.5 centers.

Thought should also be given to the use of the subscriber line data base now being built up in the fault clearance centers. (See Paragraph 3.5)

1.4.5 Training:

Switching Equipment.

With the installation of many more lines of No.5 ESS equipment in the near future, it is recommended that a new, complete training unit be installed in Cairo for training on No.5 ESS operations, administration and maintenance (O&M). This unit should be staffed, initially, by US instructors. Their duties would be taken over eventually by ARENTO staff. This would obviate the need, and expense, of sending ARENTO personnel to the USA and would ensure that the maximum benefit was derived from any training funds made available. The location of this equipment should be carefully selected and the air conditioning requirements must be met and maintained at all times. This new training unit should not be fitted into "available space", as appears to be the norm, under any circumstances.

It is further recommended that all central office supervisors and other senior O&M staff be evaluated for their knowledge of the telephone network and the necessary interworking requirements. This should include call routing, signalling, interfacing with the transmission systems, and some instruction in quality of service measurements, etc. Refresher courses for those personnel in need should be designed to address these subjects. (See Paragraph 3.6).

Outside Plant.

It is recommended that a study be made of the Outside plant training facilities with a view to improving both the training curriculum and the OSP training facilities. (See Paragrap 3.6).

1.4.6 Exchange buildings and air conditioning:

It is recommended that a plan be developed to improve the environmental conditions of central office exchange buildings. (See Paragraph 3.7).

1.4.7 Repair centers, tools and equipment:

Considering the fact that the 1A ESS equipment will remain in service for a long time to come, it is recommended that a review be made of the functions of the 1A repair center at Bab-El-Louk with the intention of improving and/or renewing its present test and repair facilities. (See Paragraph 3.8).

1.4.8 O&M Organization:

It is recommended that a review of the O&M organization be made with the full cooperation of ARENTO. This could be completed within a short time frame. If the resulting recommendations were implemented by ARENTO, the present O&M organization could greatly improve its functional capabilities resulting in an extended useful life of the USAID funded equipment. (See Paragraph 3.9).

1.4.9 Quality of service performance objectives:

It is recommended that an active program be developed to enable ARENTO to monitor service performance and to measure that performance against a set of performance objectives to be developed and instituted. (See Paragraph 3.10).

1.4.10 Motivation

A complete review and evaluation of ARENTO's salary structure is recommended in order to insure employee conscientiousness, dedication and loyalty. (See Paragraph 3.11).

SECTION II

OVERVIEW OF FINDINGS

2.1 GENERAL:

This section will highlight the findings of the Project Team during the nine week study period. Section III will summarize the recommendations of the study team. The Appendices will treat each of these subjects by Tasks in accordance with the Scope of Work in the Delivery order. It is suggested that these apppendices should be reviewed before embarking on any of the recommendations summarized herein.

2.2 SCOPE OF WORK:

The scope of work for this study relates to the switching equipment, outside plant, power and supporting systems provided under the USAID/ARENTO Telecom Projects I, II, III and IV, and covers a study of ARENTO's Operations and Maintenance (O&M) practices, with specific reference to the maintenance and operation of the fo;;owing equipments:

. Switching Centers, Network surveillance and control systems and their environmental conditions,

- Power Systems associated with the switching centers
- Outside Plant installations at six exchanges
- Fiber Optic and Transmission Systems

In order to fully judge the efficiency of operations and maintenance in any individual switching center exchange, it is necessary to look at the external factors which affect the performance of an individual switching center and the network as a whole. The quality of service delivered to the subscriber is the basis for judging the efficiency of planning and the effectiveness of the operations and maintenance effort, not only in any particular switching center but in the overall telecommunications network.

The documentary information which has been provided by AID, ARENTO and AT&T International on the switching systems, together with on-site observations and discussions, has yielded sufficient background information on the status of the O&M maintenance, the Contractor's participation in the O&M and training programs to allow this portion of the study to be addressed.

The Outside Plant (OSP) portion of this study examined that part of the network from the Main Distribution Frame (MDF) to and including the distribution cable terminal (DCT). This appraisal was conducted for the purpose of characterizing ARENTO's current Operations and Maintenance (O&M) program and recommending operational improvements.

The power portion of the O&M study was conducted by gathering all available and pertinent documentation that reflects the history of 1A ESS and No.5 ESS installations, the installation contractor's on-site maintenance support, and the subsequent ARENTO O&M efforts after final acceptance. In addition, numerous interviews were conducted with ARENTO O&M power personnel. Finally, site visits were conducted. Each site visit was conducted in the presence of ARENTO O&M personnel and was evaluated in terms of a power inspection checklist. This allowed each site to be consistently reviewed in terms of the same criteria for plant condition, environment, safety, supplies, operating procedures, maintenance quality and records.

The study evaluation also included ARENTO's O&M program relative to the transmission equipment associated with the fiber optic network. The installation contractor's responsibilities regarding O&M and training were examined and evaluated as well. Fiber optic junction cables and associated equipment were installed in both Cairo and Alexandria.

The general level of cooperation received from ARENTO O&M staff, was good. Unfortunately, there was no ARENTO team, as called for in the delivery order. An ARENTO team would have enhanced the conduct of the study and would have increased ARENTO's knowledge of the study, its findings and its recommendations.

2.3 LOCATIONS REVIEWED WHERE EQUIPMENT WAS PROVIDED UNDER TELECOM I - IV PROJECTS:

Switching Equipmennt:

The following offices were provided under the AID-financed projects TELECOM I, II, III and IV:

TELECOM I, II and III. - All AT&T 1A ESS Electronic Export Model

Office	In-Service	Capacity (lines)	Location
Zamalek	1984	25,600	Cairo
Heliopolis I	1984	40,960	Cairo
Heliopolis II	1986	40,960	Cairo

Maadi	1983	30,720	Cairo
New Maadi	1984	20,480	Cairo
Abbassia	1987	40,960	Cairo
Bab-El-Louk	1985	30,720	Cairo
Auto I	1985	40,960	Alexandria
Gleem	1985	22,528	Alexandria
Ibrahamia	1985	25,600	Alexandria

TELECOM IV - All AT&T No.5 ESS Digital Equipment

Heliopolis II	May 1992	20,000	Cairo
El Kalaa	July 1991	38,000 Note 1	Cairo
Marioteyah	Aug.1991	40,000 Note 2	Cairo

Note 1. El Kalaa has 30,000 lines local and 2 remote switching units of 4,000 lines each. One is located at Maadi (in the 1A ESS office) and the other at Mokatan.

Note 2. Marioteyah has 2 remote switching units of 4,000 lines each. One is located at Haraam and the other at Giza.

In addition, there are two COM Centers for 1A ESS offices, one in Cairo and one in Alexandria, and a COM Center for the No.5 ESS offices in El Kalaa, Cairo.

Due to the lack of complete documentation, it has not been firmly established that Abbassia and Heliopolis II were part of the USAID funding package. For the purposes of this study, however, it has been assumed that all offices shown above are USAID-financed.

Outside Plant:

Exchanges under study are Zamalek, Bab-El-Louk and Heliopolis in Cairo; and Auto, Ibrahimia and Gleem in Alexandria. All associated networks were installed during the implementation of the Telecom II & III programs. The OSP network installations in Bab-El-Khalk and Pyramids West Exchanges, authorized by Telecom IV, are still under construction and have not been accepted or are being maintained by ARENTO. Consequently, these two OSP network areas fall outside the scope of work and will be excluded from this portion of the overall undertaking.

Power Systems:

The power plants reviewed were associated with the #1AESS and #5ESS switch

installations covered under Switching Equipment above.

Fiber Optic Cable and Transmission Equipment:

In Cairo there are 17 exchanges with equipment installations and connecting fiber cable and in Alexandria there are 6 exchanges with similar installations. See attached diagrams for network layout and equipment locations.

2.4 CONTRACTOR RESPONSIBILITIES - O&M:

Switching Equipment.

In the Telecom I, II and III projects, the switching contractor provided one year of maintenance at each office after the final testing and the cutover. In addition, there is an AT&T contracted person who is still available to support the ARENTO 1A ESS O&M staff when required. This person has maintained this position since all these offices were cut into service.

The contractual agreement for Telecom IV calls for one year maintenance from the Contractor. Both El Kalaa and Marioteyah have been in service for almost two years and although the one-year maintenance period has long since expired, it is understood that neither of these two offices have been finally accepted by ARENTO. Both offices are monitored by AT&T personnel on a full time basis from the COM Center in the El Kalaa building. The Heliopolis III office is still under the AT&T one-year warranty and maintenance period.

The type of O&M program developed by the switching contractor is based on the standard routines and practices as specified for the particular switching equipment under discussion, i.e. No.1A ESS and No.5 ESS. This type of O&M program is, in all respects, the same as that used in the United States where millions of lines of these two types of switching offices are in-service.

This program is completely adequate when performed in accordance with the routines and schedules established by the manufacturer. From observations, conversations and the maintenance records made available, the contractor's O&M program is being observed and complied with in each office.

Power Equipment.

From all available data, it appears that AT&T-hired contractors remained on site at each switch/power installation for a contracted period of one year after provisional acceptance. AT&T provided contract options for these personnel to remain for extra years beyond the one year maintenance period, but these options were not picked up by

ARENTO. Instead, ARENTO insisted that AT&T provide maintenance support until all outstanding items were corrected. At that time, ARENTO finally accepted the installations and AT&T was released from its obligations.

During the one year maintenance period, AT&T provided all power maintenance work, which would include checking battery electrolyte levels, cell temperature readings, maintaining power plant cleanliness, checking low voltage alarm circuits, etc. (see the following text for full power O&M responsibilities actually performed, as well as those suggested to be added to routines).

ARENTO personnel from the power O&M group would periodically visit switch sites to take an accounting of the condition of the plant they were to accept, to learn power particulars from the AT&T contractor, but never to take an active role in the upkeep of the plant until after final acceptance. In cases where a switch has gone beyond the one year maintenance period and is not yet finally accepted by ARENTO, this could pose a problem, since it is unclear who is taking active responsibility to maintain power systems at those locations. At present, with all No.5 ESS locations, AT&T is employing a company called J.T. Smith, which does not provide a continuous on site presence. They are available for call-out, but it is unclear as to who would respond at those sites which have exceeded the year maintenance period but have not been finally accepted. At the time of switch/power hand-off from AT&T to ARENTO O&M responsibility, AT&T provided a suggested list of routine maintenance activities associated with power plants. In addition, each 1A ESS site was equipped with a full set of Bell System Practices which detail the operation and maintenance of batteries, inverters and rectifiers.

Outside Plant.

For exchanges Zamalek, Bab-El-Louk, Heliopolis, Gleem, Auto & Ibrahamia, Ford Aerospace maintained all OSP systems for the period between Provisional and Final acceptance or at least 12 during the "Guarantee Period". Following the Guarantee Period, ARENTO contracted with NSPO to provide extended maintenance in all six exchanges for various periods between one and two and one half years. During the Guarantee Period, each exchange area was maintained as a fully operational system from the line side of the MDF to the DCT's, inclusive, for local plant and from the MDF to MDF for junction plant. Local loops and junction circuits were maintained within acceptable limits of a performance level established at the time of provisional acceptance.

A program to effect the outside plant maintenance was established by the contractor. This program consisted of three types of maintenance as defined below:

a) Preventive maintenance conducted on a regularly scheduled basis to detect and clear sources of potential trouble before they affect service.

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b) Routine maintenance to identify and improve circuits with performance levels outside acceptable limits.

c) Extraordinary maintenance required to locate and repair cable or equipment damaged by ARENTO, third parties or force majeure.

Where available, the contractor used test data provided by #1ESS switches. Generally, all maintenance work was handled on a priority basis with the restoration of service the first priority. One maintenance objective during the Guarantee Period was established at less than a 2% trouble report rate. This report rate was calculated on the number of subscriber trouble reports per month for each 100 working lines. A second objective was the clearing time following a service outage. This was set at clearing half of all troubles within 2 working days of report and the remaining half within 6 working days.

The overall operation and maintenance program implemented by the installation contractor, during the Guarantee Period, is viewed to have been adequate and comparable with programs of the same level of technology and expectations.

Fiber Optic and Transmission Equipment.

Information obtained via interviews with ARENTO personnel indicate that the contractor operated and maintained the fiber optic network satisfactorily during the one year "Guarantee Period". ARENTO contracted with the Belsam Co. for an additional one to two years of maintenance.

To satisfy contractual obligations, Ford Aerospace developed and furnished ARENTO, an O&M manual entitled "Operation and Maintenance Handbook, Fiber Optic Inside/ Outside Plant Facilities for Cairo and Alexandria".

2.5 CONTRACTOR RESPONSIBILITIES - TRAINING:

Switching Equipment.

Contractual obligations called for the training of personnel in sufficient numbers to allow ARENTO to meet the complete operations and maintenance requirements at each of the new offices covered by Telecom I,II and III projects. From site visits and discussions with the O&M staff, it would appear that all 1A office O&M supervisors received extensive training in the United States, generally lasting a period of about 9 months. This training covered not only the functions and operation of the 1A switch but also provided general instruction in the field of telecommunications.

In addition, a 1A ESS training unit was set up at the ARENTO training school for instruction in Egypt. No firm figures are available as to the actual numbers of personnel

that have attended this particular school or the numbers that have received on-the-job (OTJ) training but during the site visits, it became clear that each 1A switching office is staffed by a supervisor with USA training (9 months) and 3 or 4 technicians who have received OTJ training.

The training requirements as specified by ARENTO for Telecom IV call for the contractor to provide the numbers, types and qualifications of instructors, and the number of man-months required to produce an output sufficient to properly staff all maintenance and operations jobs. ARENTO requested in their Request For Proposal (RFP), that all personnel needed to initially staff the maintenance and operations functions for all offered equipment undergo their training abroad.

From information received from ARENTO, 8 people have taken a 3-month No.5 ESS training course in the USA. For the 3 switching centers involved, this would appear to be sufficient. These trained supervisors are now providing on-the-job (OTJ) training in these offices, however, this OTJ training does not appear to be planned by ARENTO management and has no official schedule. It appears to be the sole responsibility of the exchange supervisor.

It is understood that the training given to the original 1A ESS trainees lasted a period of 9 months and included not only O&M instruction on the 1A ESS but a course in telecommunications in general. The No.5 ESS students receive 3 months instruction in only the necessary O&M for the No.5 ESS equipment. There is no immediate explanation for this variance between courses, however, it does make the selection of suitable trainees for No.5 ESS training all the more important, because obviously, they must already have reached a suitable level of education and have the necessary experience and background in telecommunications before taking the No.5 course.

Outside Plant.

The training developed by the contractor incorporated formal classroom instruction in Egypt (ARENTO TTRI) and in the United States as well as on-the-job training on the use of U.S. technologies and methods. The course was designed in a modular format with class sizes in the 8-12 range. The students were required to have education, experience and language profiles consistent with the level of course material taught. The contract allocated training for 201 students ranging in type from electrical engineers to craftsman.

ARENTO made all student selections and required that 80% of the trainees meet 80% of the performance criteria for each course taken before a "Certificate of Completion" for the training program was issued.

ARENTO personnel were trained as instructors in civil works, splicing and installation, and testing and maintenance. In addition, they were provided with instructional

materials, training aids and documentation concerning the system components, their functioning, fault locating techniques and repair and maintenance procedures. This material also contained performance objectives and evaluation criteria for each course. The following courses were provided:

- OSP Planning Methods Course - This training was conducted in U.S.
- Outside Plant Engineering Course - This classroom training was offered in the U.S. to Engineers and Technicians, selected by ARENTO.
- T- Carrier Span Line Design Course
- Protection Civil Works Construction Course
- Cable Placement Course
- T- Carrier Installation and Repair Course
- Cable Balancing Course
- Cable Fault Location Course
- OSP Acceptance Methods Course
- Station Installation and Repair Course
- Subscriber Loop Acceptance Testing Course

Fiber Optic and Transmission Equipment.

Meetings with ARENTO engineers that were familiar with the fiber optic network installation and contractor maintenance revealed a limited amount of training by Ford Aerospace. Most of the significant instruction on system O&M was said to have come from the Belsam Co. during a period of extended maintenance.

2.6 SPARE PARTS:

Switching Equipment.

The contract with the manufacturer for the 1A equipment called for the establishment of a Repair Center. This center is installed in the Bab-El-Louk exchange building, near the Spare Parts Storage Center. It is equipped with automated processor controlled test gear and conventional test equipment. The original specification was for capacity sufficient to allow for the repair of modules, PCBs and equipment associated with a 200,000 line switching system, in one work period.

This center was visited and ARENTO informed that they receive about 70 units and boards for repair each month. The type of boards repaired are all single layer. Multi-layer boards are sent to the USA for repair.

The spare parts storage center for all the 1A switching offices is also located in the Bab El Louk building. This center maintains a minimum 3 years supply of spare parts for the 10 1A ESS switching centers in Egypt. In addition, some spares are kept in each office

for immediate use, should an emergency situation arise.

The storage center is well organized and orderly in appearance, however, records are not computerized but kept in card files.

One particular fault which occurs frequently is a problem with the front panel power switch on trunk units and multi-frequency signalling units. This simple pushbutton-type on and off switch fails to stay in the "on" position and has to be wedged in with a paper clip or something similar. This is a long standing problem which has not been solved.

The repair center personnel complained of a lack of certain repair facilities which, if available, would improve their overall repair capability.

At the present time there is no centralized storage of spare parts for the No.5 ESS switching centers. This is due principally to the fact that these three offices, for all intents and purposes, are still under the maintenance supervision of AT&T. One of these offices is still under warranty. At each office, a complete set of spares are kept within the equipment room, and these are sufficient for one year operation.

After the final acceptance of each of these three switching centers, sufficient spares will be made available to meet 3-year requirements.

The supply of spare parts for the 1A ESS equipment maintained in the Bab-El-Louk storage center can be considered as "ample".

The design, and the built-in reliability, of the No.5 ESS equipment is such that the quantity and types of spare parts has been reduced to a minimum. The No.5 ESS has fewer circuit pack codes than earlier SPC-type equipment, which means easier maintenance and simpler administration of spares. The cutover expectancy of circuit pack replacements per 1000 lines per month was originally around 2. This reduced to 1 per month after the first year of service (mature expectancy). In recent years, these figures have been reduced still further.

The quantities and types of spare parts specified by the AT&T for the No.5 ESS offices can be considered as "ample".

Power Equipment.

As to spare parts provided by AT&T, contractual obligations required the installation contractor to provide ample spares to support the one year maintenance period. Beyond that, there were options to buy spares for an extended three years at set prices. ARENTO stated that they had found flexibility in working with AT&T in order to adjust what items and amount of items were provided under the one year allotment of spares, based on ARENTO's past experience as to the life cycle for selected components

and sub-components operating in the Egyptian telephone system. Thus, over the years, provider and client have mutually established an ample set of spares for power systems. ARENTO has established its own spares warehousing facilities and distribution network for power supplies.

Outside Plant.

The contractor furnished, at the time of final acceptance, spare parts and consumables of the same standards of design and performance as those used for the initial installation. Spares were supplied in all material categories except manholes and handholes and were of ample quantities to support normal maintenance for an extended period.

ARENTO provided warehouse facilities in both Cairo and Alexandria that were used initially during construction and subsequently during the maintenance period. Adequacy can only be assumed at this point in time.

Spare parts for the six exchange areas under study, as well as the rest of the telecommunication network are stored at two locations in Cairo and one location in Alexandria. However, each exchange visited maintains a limited number of spares locally which is replenished via a requisition to the warehouse manager. The general consensus is that spare parts are not adequate in number or variety. New spares that are purchased are not of equal type or quality.

Alexandria, due to it's seaside location produces a corrosive climate that must be monitored constantly. SAI cable cross-connecting blocks in the Gleem Exchange are experiencing major breakdowns, the cause of which has not been confirmed. Corrosion is suspected but manufacture defect is not ruled out. Serious shortages now exist in this type material. In both areas spare parts designated for maintenance are used for impromptu cable and terminal extensions resulting in further depletion of the inventory.

Fiber Optic and Transmission Equipment.

It is reasonable to assume that the contractor provided levels of spare parts consistent with the contract and viewed to be adequate. Spare parts were stored at ARENTO provided warehouse facilities in both Alexandria and Cairo during construction. Currently, most spares are located at the equipment repair laboratory in Cairo.

Although defective equipment is repaired when possible at the repair facility in Cairo, serious shortages exist in spare parts. The situation in Alexandria is reported to have deteriorated to a point where cannibalizing existing equipment is the only avenue open for maintaining service. Waveguides associated with microwave transmission in this area, are under constant attack from corrosion and spares have been exhausted.

2.7 ARENTO CURRENT O&M PRACTICES:

Switching Equipment.

All the 1A ESS and No.5 ESS switching centers were visited during the third and fourth weeks of this study. The following abbreviated notes provide a general commentary on those visits.

Equipment Rooms

The 1A ESS equipment rooms are generally dusty and tend to be untidy. Only in Alexandria was there an exception to this general observation. It should be noted that the amount of dust in the air is noticeably less in Alexandria than in Cairo. Air conditioning units are all working and in some locations their numbers have been increased in recent months, such as in New Maadi. It is noticeable that equipment room doors are left open at times, generally because the O&M personnel have lost, or never had, a magnetic card to operate the security locks on the doors. An open door plays havoc with the air pressurization of the equipment room and throws an additional load on the air conditioning units. The design of the 1A ESS equipment does make use of electro-mechanical relays on certain frames which are vulnerable to dust. Tape units also, although they are enclosed, can eventually be affected by dust in the air. In New Maadi, plastic sheeting is in place over certain equipment frames to keep down the amount of dust getting to the equipment.

At two 1A ESS offices, problems with rodents getting into the equipment rooms were reported !

The three No.5 ESS switching centers are all comparatively new and placed in service within the last two years. The equipment rooms are clean and orderly. This particular type of equipment presents an exceptionally neat and orderly layout of equipment, being totally enclosed with all cabling concealed as much as possible. However, appearance is not the main reason for the No.5 ESS switch design. The doors keep dust and dirt away from the equipment and O&M personnel cannot brush against the electronics as they walk past. The doors are therefore cost-effective.

Security devices on all doors are being used and the air conditioning of the whole equipment area is good.

One problem encountered at Marioteyah concerns the raised floor upon which the No.5 ESS equipment is installed. This floor, which was manufactured in Egypt under license from an Italian company, is already showing signs of surface irregularities.

Building problems in general

All telecommunications buildings visited were dirty, untidy and unkept. Doors are generally left open all day, and in some cases, the windows also. Due to the location of the commercial offices, and offices for the technical staff within these buildings, there is a steady stream of people passing in and out all day. Under these conditions, dust, dirt and maintaining a clean and conditioned equipment room is a serious problems.

O&M staffing

The general impression received at each location is that the O&M staff are qualified and capable of maintaining the equipment in accordance with manufacturer's standards. Office supervisors have all received training in the USA and their support staff have all received OTJ training. In the case of the No.5 ESS centers, the supervisors are now providing staff with OTJ training.

The O&M staffing of a 1A ESS office calls for a supervisor and three or four support Personnel during regular working hours. When these offices are unmanned, the 1A ESS COM Center at Ramsis, which monitors the operation of all the 1A ESS offices on a 24-hour basis, takes over the supervision of all these centers. The No.5 ESS offices which are also unmanned after normal working hours, are monitored and supervised from the COM Center, installed in the El Kalaa building, by AT&T personnel with ARENTO people in attendance.

There is a tendency to overstaff both the 1A ESS and the No.5 ESS offices. One important purpose of the COM Center is to reduce the personnel requirements at the switching centers it monitors. Nevertheless, ARENTO maintains a full O&M staff at each office during normal working hours.

Although the last 1A ESS office was placed in service in Egypt in 1987, AT&T still provides a 1A ESS O&M Consultant. He is located in the Ramsis COM Center and apart from the routine task of providing OTJ training and generally monitoring the ARENTO maintenance of these 10 offices, he is also available for emergency situations, should they arise.

Other Observations

At each of the 1A ESS offices, the supervisor was asked if there was any suggestion, comment or recommendation they wished to make which would help to improve the operation and maintenance of the equipment. In every case the response was about the same - everything is fine. However, everything is not fine if one analyzes the performance data given out by the machine. There are problems which originate outside of the office and if these problems are allowed to continue, there will come a time when the performance of the switching equipment will be affected.

The disturbing fact is that although the 1A ESS O&M staff appear to be aware of these problems, and the office performance sheets are available for analysis by the pertinent ARENTO staff, as far as can be discovered, no action has been taken to solve these problems.

Power Equipment.

It is obvious that the power and generator rooms have been properly maintained and that the plants are performing as expected and appear to be able to reach their full life expectancy without wholesale changeout of major numbers of power components. Each power plant visited is operating in accordance with specifications. Cairo's overall climate and operating environment are harsher to deal with than that of Alexandria. Consequently, Alexandria offices appeared to be more sanitary and less prone to pollution problems.

While Cairo buildings as a whole were more contaminated from dust and dirt, all ARENTO-maintained power rooms, where separated from the switching equipment, were generally clean and in good repair. In both city areas, power O&M personnel take great pains to ensure that only pure, distilled water is used in battery cells. Although AT&T installed water distilling plants as a part of the turn-key operations at each site, most units were not in operation, because of problems in consistent water pressure or availability at those sites. Cairo personnel would carry water from a centralized distilled plant to each power room. Alexandria has distilled water provided from a medical supply firm.

Battery Plants

In general, all 1A ESS and No.5ESS battery strings had the following positive characteristics of proper installation and O&M:

- electrolyte levels were between high and low marks
- proper cable support clamps were used
- cells were numbered for reference and record keeping
- no corrosion on connectors, nuts, bolts or washers
- no cell cracks
- only a handful of electrolyte spills on cells
- clean vent caps and cell surfaces
- cell temperatures within recommended operating ranges
- all connections were tight
- racks were properly grounded
- no bootleg cabling added after installation
- standard racks were in good condition
- no excessive gassing of hydrogen
- almost all battery plants had 8-hour capacities which is well in excess of actual plant loads although Marioteyah and El Kalaa were close to actual load.

- room ventilation was adequate and operational
- room temperature was controlled and within recommended range
- working access to cells was adequate
- cabling distances to switch were within spec
- no leaking pipes overhead
- floor loading was within weight tolerances
- HVAC and louvered panels provided venting of gas to outside
- eyewash stations were available and accessible
- fire extinguishers were readily available

Both Cairo and Alexandria power O&M personnel kept a number of standard battery plant fixtures and records in a centralized location. This was due to the fact that both power organizations were centralized groups that traveled to individual switch sites to perform routine maintenance. No one assigned to an individual switch site was authorized to perform any work on power systems.

While individual sites may have limited supplies of fuses, grease, etc.; as a whole, the power O&M personnel carried their tools, supplies and engineering data with them to the sites being maintained. Each 1A site had a complete set of Bell Practices, which provide proper guidance in the upkeep of power plants. These same practices could not be found in the No.5 ESS offices, although ARENTO had not yet assumed O&M responsibilities at those sites.

A review of both Cairo and Alexandria routine maintenance programs showed that an acceptable level of basic O&M work was being conducted with respect to monitoring electrolyte density/specific gravity, electrolyte levels, cell temperatures, connector integrity, corrosion, pilot cell voltages, and string voltages; as well as to cleaning battery cells, connectors and their associated components (vent caps, racks, cables, etc.). All activities conducted were appropriately documented, with copies of the same going to the switch supervisors and Engineer Hegazy (for Cairo, only).

The following operational anomalies were observed with respect to certain battery strings:

- scaling of lead plates and accompanied sediment deposits were observed at the following sites. In general, +24 volt strings seemed most susceptible to these conditions:

  *Bab-El-Louk +24v (8 year old site)
  *Maadi, limited throughout (10 year old site)
  *Heliopolis II, +24v & -48v D pitted (7 year old site)
  *Abbassia, minor on +24v/1 or 2 -48v cells (6 years old)
  *Zamalek, nearly none (9 years old)
  *Ibrahamia, pervasive throughout all end cells (8 years)

∘ plate expansion on end cells at the following sites reflects signs of aging:

*Maadi -48v E string, only
*Zamalek, minor throughout
*Auto, minor throughout (9 years old)
*Gleem, minor throughout (8 years old)
*Ibrahamia, minor throughout

∘ environmental cleanliness affects the likelihood that contaminants will be introduced into cell electrolyte (reducing the useful life) and dry out connectors (increasing the likelihood of corrosion and voltage depletions), and was observed at:

*Marioteyah- a new No.5 ESS. (thick dust)
*El Kalaa- a new No.5 ESS. (light dust)
*Heliopolis III- same condition as El Kalaa

∘ windows in the battery room should be painted over, so that direct sunlight will not fall on cells and affect their temperatures. The No.5 ESS sites at Mariotiyia, El Kalaa and Heliopolis III had clear pane windows that should be darkened.

∘ floor drains were not readily adjacent to the battery strings or available to allow for flushing of spilled acid from electrolyte (either from overfilling or cell cracks), except for the newly installed No.5 ESS's. This could cause toxic problems or personal injury as the 1A's age, especially at sites such Bab-El-Louk or Zamalek where people spaces and other equipment are located below the battery plant's floor.

∘ safety equipment was generally missing at all locations. Each site had eyewash stations and fire extinguishers. While power O&M personnel stated that they brought the needed safety gear with them, when working on batteries, AT&T had provided gloves, goggles, sodium bicarbonate solution to neutralize acid, aprons, and first aid kits for each site. In cases of emergency leakage of older cells, when power O&M personnel are not readily on site and switch site personnel may attempt to contain a hazardous condition, these items should be readily available. In addition, there was an absence of any "No Smoking" signs at all sites, despite the fact that some battery strings were adjacent to switch site people areas. Hydrogen gas is released from batteries and present a readily flammable work environment.

∘ room temperature for batteries should be between 70 and 80 degrees F. Ibrahamia was cooler than that range, and random cell readings showed temperatures as low as 64. Unusually low temperatures can cause reduced battery capacity. The HVAC system at Gleem was not operational at the time of

the site visit, with room temperature at around 80 and random cell readings as high as 78. This is believed to have been a temporary anomaly, although battery life can be reduced when temperatures consistently stay above 80 degrees F.

∘ O&M personnel should have complete and easy access to all cells for purposes of routine or emergency maintenance. AT&T had clearly laid out battery strings to meet that requirement. However, loose gear, boxes, equipment, furniture, etc were obstructing access at Maadi, Abbassia and Ibrahamia.

∘ visual inspections of most all Cairo 1A ESS sites reflected a general shortage of cell thermometers, hydrometers, and routine maintenance tools (such as non-metallic & paint brushes, insulated torque wrenches, clean rags or sheets), although ARENTO indicated all required materials were centrally stored.

∘ maintenance records failed to indicate whether regular plant routines were being performed in the following areas:

*check voltage on each cell (quarterly)
*detailed visual inspection on each cell (annually)
*check all bolt connections and torque per IEEE 450. After torquing, check resistances of each cell-to-cell and cell-to-terminal connection and record findings (annually)
*check integrity of racks (annually)

Rectifier Plants

All AC to DC power plants had sufficient rectifiers to charge all batteries plus leave one spare for full-float charge operation. The rectifiers operated in parallel and shared the load power requirement. All +24v and -48v rectifiers were operating within spec.

Interviews with power O&M personnel and reviews of power routines indicate that ARENTO is proficient in checking output voltages, adjusting individual rectifiers outputs to better load balance the entire rectifier plant by use of the thumb screws, checking no/full load switching, checking power distribution board readings for plant load and DC output voltages, checking fuse protection circuits, calibrating meters with voltmeters, and checking both the high voltage and low voltage alarm circuits. As with the battery records, routine maintenance performed was adequately documented and shared with both the switch supervisor at each site and the O&M manager in Cairo.

The following operational anomalies were observed at specific sites visited during the O&M review:

- Maadi's +24v rectifier bay 2A/lineup 0003 was running very hot and showed over 200 amps being provided from this one rectifier. This amounted to over

one-half of the total plant load, which was an excessive burden. The rectifier was also humming excessively, and if left uncorrected, could introduce excessive noise to the switch equipment itself. There was no noise monitoring equipment available to test for this condition, while at the site, nor was there any heat monitoring test gear. This rectifier must receive some maintenance attention, or ARENTO may face costly equipment replacement in the not too distant future.

- Heliopolis II's +24v rectifiers were also humming excessively, although there was not the same overheating problem that was detected at Maadi.

- Heliopolis III's G2 -48v rectifier was also running very hot, and its digital amp meter was not operational. This power plant is still under the No.5 ESS warranty period, and the on-site AT&T O&M person indicated that he would have the trouble called-out to the O&M power contractor.

- access to the inside of rectifier panels revealed the need for more cleaning around power contact areas. The majority of rectifiers were locked and not accessible for internal maintenance assessment.

- Cairo and Alexandria power engineers indicated that they take individual cell voltage readings on regular schedules and by means of discharging whole batteries taken off of rectified AC power. Given the high number of commercial 380v AC power interruptions (both planned and unplanned), rectifiers and their adjoining battery strings are already undergoing a high number of discharge and equalizing charge (recharge) cycles. The frequency of these day-to-day demands on both rectifiers and batteries can lead to shorter life expectancy of these power system components. Alexandria power O&M indicated that in addition to the discharging/recharging cycles that occur in response to commercial outages, they are discharging, equalizing and taking cell voltage readings on a monthly basis. It is surmised that this monthly process is imposing too much of a demand on rectifiers and batteries, given the age of the plants and the nature of unstable commercial power. The combined effect is to hasten the deterioration of existing power systems. It was noted that the Ibrahamia batteries had a much higher level of scaling and sediment deposits, than other sites visited.

In contrast, Cairo power indicated that the discharge/recharge cycle is conducted every six months. This may be too infrequent, given the age of some of the power plants, where O&M personnel should be paying closer attention to individual cells that are showing signs of deterioration. A recommended solution for both cities is to adjust to quarterly schedules for individual cell voltage discharge readings. In addition, AT&T is providing stationary battery chargers with the installation of the No.5 ESS power plants. ARENTO now has an additional tool that can be used in isolating individual "trouble cells" from the whole string, without having to excessively discharge/recharge whole strings for cell voltage

readings or equalization requirements.

Converters

In general, the 1A ESS 130v DC to DC converters were in good operational order. Only minor loads of 130v power are required for switch testing capabilities. All converters observed are self-contained units requiring little maintenance or upkeep. Power O&M records indicate that personnel are monitoring required output voltages, as well as high and low voltage alarm circuits, as is recommended. Meters appear to be calibrated, and the converters do not appear to show any signs of aging, leakage or malfunction. As with any other piece of power equipment operating in the Egyptian environment, diligence to cleaning, air ventilation, etc. cannot be minimized, in order to maximize life expectancy, which appears to be good at present.

Inverters

All sites visited employed Lorain 5 KVA inverters. New No.5 ESS sites have state-of-the-art small, self-contained units which are maintenance-free and solid state units that would be replaced in whole, upon failure. 1A ESS sites utilize the older, bay frame-work vintages with more operational components requiring O&M attention. Most sites have one inverter, although COM Center and 3B remote monitoring sites will have a second unit installed (as was the case at Auto and El Kalaa). In general, inverters were run on-line, given the nature of commercial power interruptions and operating norms established for telecom applications. Inverters were providing from 220 to 227 volts for standard #1E applications and from 120 to 123 volts for COM Center and 3B usage. Typical plant loads supplied were 3 to 5 amps. All units observed had bypass circuits and static switches for system transfers. Meters appeared to be calibrated, and power O&M records indicated proper maintenance awareness of checking output voltages and testing the transfer system.

The following operational anomalies were observed:

- inverters at New Maadi and Maadi were down, due to the need to replace capacitors. This is a common condition with these systems as they exceed 5 years in age. Although power O&M indicated that they are able to procure capacitors locally, in Egypt, it was not known why these inverters would be out of operation for overnight, until power personnel could return with the required parts. This is especially a concern given the volatile nature of commercial AC interruptions in and around Cairo. AT&T noted problems in Maadi since 3/93.

- in connection with the first anomaly (above), Cairo O&M provided a list of required spare parts that are in the process of being procured. One-fourth of all required spares were associated with the inverters. Four different types of capacitors made up the bulk of this list, along with four different types of relays;

all of which the power engineer indicated were available in Cairo. Various thyristors and diodes completed the list. A concern is raised that critical power supplies to overall switch O&M efforts (without an uninterruptible power supply, switch maintenance can go down in times of commercial power outages) appear to be jeopardized by the inability to supply timely spare part replenishment to the sites.

- inverters are showing natural signs of aging and evidence that a great deal of corrective maintenance is being expended on these units. Yet, interior cabinet areas showed a great deal of dust accumulation, indicating that greater attention is needed to preventative maintenance.

Diesel Generators

The Abbassia generator room was exceptionally clean, with no oil spillage, loose gear or dust accumulation. Zamalek was also in good order, given its age of nine years. Alexandria diesels had logged the most time in the operation of the engines, with Auto Diesel #1 at around 600 hours of usage. This is a further indicator of commercial AC problems, and the need for close monitoring of battery cell voltages in a limited discharge/recharge cycle. Each 1A switch-room had a generator control panel to indicate when the emergency generators were running and the office was off commercial AC.

Maintenance records for the diesels were excellent, indicating that close attention is paid to emergency AC power at both Cairo and Alexandria. Routines indicated an awareness for the need to check oil and water levels, check the starter battery voltage, check the generator frequency and voltage, check the diesel fuel supplies, check the transfer switch, load the alternator, clean the louver ventilation filters, and to clean the engine, control panels and emergency protection circuits.

In general, all generator rooms had ample supplies of oil, oil filters (which appeared newly installed, in all cases), rags, drain pans, etc. Requested spare parts for control panels, diesel battery chargers, and the engines made up the majority of items being procured in Cairo, at present; i.e., another indicator of the importance ARENTO places on its emergency generator plant. Diesel fuel reserves were consistently kept at the ARENTO-recommended level of 3/4 full, except at Heliopolis III, a site not yet accepted from AT&T.

No.5 ESS generator rooms revealed state-of-the-art control panels and digital technology, associated with the typical configuration of three 200 KV Caterpillar diesels. Man-machine interface panels clearly display all diagnostics that can be read from one position, by pushing icon buttons. It is a fool-proof, simple to understand system, which has also been equipped with its own air conditioning system, in order to prevent excessive heating. Digital meters scroll through a variety of system readings to give the

observer a quick overall readout of the condition of the generators without having to do anything on one's own.

- although the diesels get a lot of use (cutting on a few times a week on average and running from 15 minutes to an hour at a time; 3-4 hours total a month), there does not appear to be a regular annual routine to run the engines under supervision for a minimum of one hour, so that leaks, bad seals, oil pressure problems, etc. can be detected under preventive maintenance conditions.

- most 1A ESS generator rooms had oil spills on the floor. It was unclear as to whether this was caused through the process of changing oil, but records indicated no leakage conditions.

- overall upkeep was not neat or clean, making it difficult for people to get around and do their work. Most all vent filters looked as if they needed cleaning, which is critical to proper ventilation and the avoidance of overheating. Although all generators appear to be performing adequately, it is questioned whether diesels housed in outside trailers do not have excessive operating temperatures, especially when performing under the summer sun.

- there are no records to indicate that the following readings are being made, in order to stay within specifications:

  * oil pressure
  * low oil pressure
  * water temperature
  * high water temperature
  * ambient temperature
  * governor droop
  * voltage droop
  * frequency droop
  * no load RPM
  * overspeed stop condition

- despite being the newest sites and having the most up-to-date generator rooms, the No.5 ESS generators were not as well maintained. There was a thick coat of dust. This can adversely affect the operation and life of generator diesels and/or require more frequent maintenance to be performed (oil changes, vent cleaning, etc.). The problem appears to be that Marioteyia and El Kalaa have exceeded their one year maintenance period, with neither ARENTO or AT&T taking direct responsibility for oversight and maintenance, at present; i.e., no one is actively watching out for these systems in the interim. This is an important problem, given the high number of commercial AC outages and the need for reliable emergency AC power. By contrast, the Heliopolis III No.5 ESS is under

the maintenance period. The AT&T maintenance man noted that the emergency generators were kicking on too frequently, since they were set to a low voltage alarm of 360 volts which is considered to be too sensitive to area brown-outs. It was also noted that diesel fuel reserves at Heliopolis III were too low, at 1/4-1/3 capacity. While AT&T readily admits responsibility for these two anomalies, they still have not been corrected by the power subcontractor to AT&T, as of the writing of this report.

- water heater jackets (for hot standby operation) were generally not engaged at most sites. While this is probably not a problem during warmer seasons of the year, this may be an issue during winter months.

The power O&M engineers at both Cairo and Alexandria are considered to be very proficient in their knowledge of DC and AC power systems. In Cairo, there are two power O&M engineers and four technicians for USAID-financed equipment. There is another power group in Cairo to handle other power plants other than AT&T switches, plus a group that handles power installation jobs. In Alexandria, the O&M power section is comprised of about 4 engineers and 15 technicians. They handle the power equipment O&M for all Alexandria exchange systems.

In order to provide back-up to the Cairo power O&M group, ARENTO is sending an engineer to the U.S. this summer for No.5 ESS DC and AC training.

Outside Plant.

ARENTO's overall O&M effort relating to the Outside Plant Facilities installed on Telecom II and III is determined to be satisfactory. This evaluation is based on knowledge of the installed network in terms of quality, visual inspections, interviews with ARENTO personnel and a history of cable faults for the last 12 months. The network is judged to be experiencing normal ageing relative to it's expected lifespan which is presumed to be a function of inherent quality as well as maintenance effort.

Performance objectives for clearing cable troubles are within acceptable limits as compared to Western standards. The addition and expected effective management of the Fault Clearance Centers will undoubtedly raise ARENTO's Operation and Maintenance Program to a higher plateau.

2.8 TRAINING AND CAPABILITIES OF THE O&M STAFF:

Switching Equipment.

It is concluded that the ARENTO O&M supervisors have had adequate training and from discussions with them, appear to be quite capable of operating and maintaining

the equipment.

1A ESS Switching Centers

At the present time, each 1A office has an O&M supervisor of engineer ranking with a support staff of 3 or 4. Generally, the supervisor has had 9 months training in the USA at a AT&T school. Most of his staff have received training at the ARENTO training school and all are receiving on-the-job training under his supervision. The senior member of the support staff is, in most cases, also ranked as an engineer. Several of the senior personnel on the support staff will go to the USA in June of this year for No.5 ESS training. In no case was there a 1A office O&M supervisor who had not received AT&T USA training, in fact, several had already been to the USA a second time for advanced 1A training relating to the more difficult problems associated with software rather than to hardware.

All supervisors interviewed appear to have a good knowledge of the equipment in their charge. The more senior members of the support staff also appeared to be quite competent. There is no scheduled on-the-job training. Technicians gain a knowledge of the equipment simply by association and from day-to-day O&M activities. This is not the best way to learn because they tend to do the same things over and over again without gaining a real knowledge of why they are doing them.

No.5 ESS Digital Switching Centers

At present there are only three No.5 ESS offices in service and of these, only two are now outside of the 1 year maintenance warranty period. There are, at present, 8 people trained for O&M on the No.5 offices, plus 2 more trained for No.5 power O&M. 18 more ARENTO personnel will travel to the USA in June of this year for No.5 training.

It should be pointed out that the No.5 ESS switching center requires fewer maintenance personnel than the older model 1A ESS. The modern digital No.5 equipment has been designed such that all switch maintenance functions can be performed from either a local or remote terminal. There is no preventative maintenance as such; only corrective maintenance.

The fact that the No.5 ESS offices have been in service only a short time makes it difficult to form an opinion as to the adequacy of the present staff available for No.5 O&M. These three offices are monitored from the COM center set up in El Kalaa by AT&T staff with ARENTO personnel receiving on-the-job training.

The selection of ARENTO staff for the No.5 US training course is based on evaluation tests performed by AT&T. The people are proposed by ARENTO, and it is understood that they have the last word on the final selection.

The present ARENTO No.5 O&M staff have all received 3 months training in the US and all are qualified by AT&T training school standards. These offices have only one shift of O&M personnel during the day. They are unattended from 5pm to 7am. During this period, the COM center monitors these three offices.

Training in General

There is an ARENTO training school in Cairo where young students are given up to 3 years instruction in various aspects of telecommunications. The courses include general subjects such as mathematics, electronics, digital technology and diagrams. The students then go on to basic telecommunications and finally are selected for the final year training in either outside plant, switching or transmission. They graduate as switch technician, outside plant technician, etc. The intake is about 90 students per year with around 20 per year graduating in each discipline.

Recently, changes have been made because it became apparent that the educational level of the 16/17-year old students was not high enough to allow them to successfully master the switching course. This course for the younger students has now been dropped and will be replaced by new courses in electrical power and air conditioning. Switching courses will be given but the starting educational levels for students have been re-classified. The school also offers short refresher courses in switching and it is understood that at this time, 75% of all students are taking this type of course.

There are other regional training centers, distributed such that training is available to most ARENTO staff without the need for travel and accommodation. In addition, the National Technical Institute (NTI) runs academic courses in telecommunications.

Some of the information received at the school is interesting.

. Of the original 8 instructors taught in the USA to teach the 1A ESS at the training school, most have now left for other work overseas.

. Some students trained at the school as outside plant technicians are now employed as security guards.

. The training school was not consulted in any way about the educational levels and technical background requirements for those people chosen to receive No.5 training in the USA, nor were they consulted in the important matter of the length of the training.

There is a Model 1A ESS office installed at the school. At the time of the visit, the air conditioning was not working and the temperature inside the equipment room was close to the upper operating limits. It is understood that this situation has existed for some time. These 1A training facilities are not used that much any more.

There are no No.5 ESS training facilities at the school at present.

Summary

It would appear that a large percentage of the O&M staff rely very much on OTJ training, however, there does not appear to be any documented OTJ training material or training course schedules. Much of this important training activity is left to the discretion of the O&M supervisor. Personnel undergoing OTJ training should be working to well prepared and documented courses of instruction, even though the instruction takes place within a working exchange. The exchange O&M supervisor should ensure that the course is completed in accordance with the schedule. The person receiving the training should be tested at the school for level of proficiency and for pay scale grading.

All training must have some incentive and this can only be applied by instituting a system of proficiency grading tied to a revised system of pay scales.

Power Equipment.

AT&T provided both formal course training back in the U.S. for ARENTO power engineers and on-the-job instruction at installation sites, as required. With the 1A ESS contracts, AT&T provided a D.C. power course only. Between Cairo and Alexandria O&M, it appears that only a handful of engineers received this training, and they were left on their own as to obtaining diesel generator training. ARENTO operates its power groups with two categories of personnel;i.e., graduate power engineers and technicians. ARENTO found the D.C. power course to be more suited to technicians than engineers. Because these courses are taught in English, only, ARENTO would pre-certify who was most suitable to attend. based in large part on the individual's ability to understand English. This does not necessarily ensure that the personnel most needing formal training would receive it. Perhaps an engineer with a good grasp of D.C. fundamentals would be most proficient in English and would thus be selected to attend stateside course training.

Conversely, a technician who knows little English would not be sent, but could have benefitted the most from the coursework had he or she been able to understand the language. With the No.5 ESS program, training has been supplemented to include diesel training, as well as D.C.coursework. The issue of language proficiency remains and will continue to remain, since the universal language used in telecommunications literature, instructions, manuals, specifications, etc. is English.

Power engineers were considered to have a good command of English, which is a prime requisite in being able to gain from AT&T-sponsored training and to work from manufacturer O&M manuals or Bell Practices. Technicians generally come from secondary level trade schools and do not have good English skills. Consequently,

engineers train technicians through on-the-job (OJT) sessions. There are not enough power personnel in Cairo to assign a full-time O&M technician with the installer during new power system turn-ups. However, Cairo does have power people work with AT&T during the one year maintenance period, as time permits. Technicians are primarily trained on-site. They begin with the basics of cleaning, then work up to being able to take voltage readings, add water to electrolyte and doing system disconnects. Next they advance to doing interactive routine maintenance, such as placing an equalizing charge on a battery string. Finally, they would progress up to reading drawings and to trouble shooting problems.

Engineers read manuals, explain to others their content, concentrate on drawings, and move up in terms of overall responsibility when they are observed to be ready for independent actions. ARENTO also runs a training process, where the O&M manager invites in personnel from each maintenance staff every two weeks and reviews maintenance problems of the last two weeks, so that these O&M members can get practical experience in understanding the thought process involved in troubleshooting and corrective actions required.

Since power O&M is centralized, COM Center troubles are called out to power. They then dispatch to individual sites. No power work is done by local switch site personnel, and they do not have the tools or supplies to attend to power conditions. Cairo power O&M states that they have enough centralized spares, tools and power accessories to carry to the sites and do their work. It should be noted, however, that there are shortages such as with the inserter capacitors. Alexandria power appears to be adequately staffed to carry out their jobs, given the limited number of sites there. Cairo does appear to be shorthanded, with a total of six power personnel for 10 existing sites and more No.5 ESS's to come. Cairo power indicated that they are not introducing new technology or procedures to help with their O&M efforts.

Outside Plant.

There are three basic methods by which ARENTO personnel receive training. First, through schools conducted by installation contractors as a condition of a contract with ARENTO. This type of schooling generally includes instruction in the United States as well as in Egypt and covers subject matter and methods consistent with current U.S. technology. Second, in a technical vocational school operated by the government in collaboration with ARENTO. Students in this school participate in a three year program that teaches the technical aspects of the Telecommunication business. These students are prep school graduates, 15 to 16 years of age and attend this school in lieu of receiving secondary level public education. A student that successfully completes this program is given a Technician Certificate and is obligated to work for ARENTO for five years. This institution graduates between 20 and 26 students per year from the Outside Plant Network course. The curriculum also includes courses in

Switching/Power and Transmission systems.

The training center also offers refresher courses that is reported to occupy 75% of the training effort. However, schooling of any kind related to the American OSP systems under study has deteriorated over time as course materials and equipment were exhausted and emphasis shifted to new systems and providers.

The third avenue for gaining knowledge is by on-the-job (OJT) training. This method is generally relegated to the lower level employee such as helpers and diggers.

Fiber Optic and Transmission Equipment.

Virtually all training for operating and maintaining the fiber optic system in this study is conducted on the job. New technicians receive instruction in ARENTO's technical school but the level of knowledge regarding this equipment could not be quantified.

2.9 GENERAL CONDITION OF INSTALLED FACILITIES:

Switching Equipment.

1A ESS Switching Equipment

The general condition of each of the ten 1A ESS switching centers, taking into account the chronic dust and dirt problem, is about that which would be expected after an average of 8 years in service. They function well and outside of some calamitous event such as fire or explosion, there is no reason why they should not go on providing a good quality of service for many more years to come.

The equipment is generally solid state, is very rugged and built to stand the test of time with a normal life expectancy of more than 30 years.

ARENTO may rest assured that the 1A ESS offices will continue to function according to specifications for as long as they are required to do so, assuming a planned development to an all-digital network within the next 20 years.

No.5 ESS Switching Equipment

The three No.5 ESS switching centers are, for all intents and purposes, new. All have been placed in service within the last two years and as such, the question of their present condition and ability to provide an acceptable quality of service are not relevant at this time. The No.5 ESS equipment has a design life of at least 40 years with a reliability objective over that period of only 2 hours downtime. It represents the latest digital switching technology commercially available today. When operated and correctly

maintained within a well designed, modern network, it will provide a quality of service second to none.

COM Centers

The 1A ESS Com Centers are in good order and well maintained. This is of course, very important, when one considers the fact that these centers, particularly the COM Center in Cairo, monitors the operation of all the 1A offices in the network. They are able to provide the necessary O&M support which is vital to the operation of the 1A ESS network as a whole, and should be able to continue meeting this requirement for many years to come.

What is not clear however, is if the COM Center facilities could be used more efficiently than they are at present. The questions that arise are those which relate to operating staff management, traffic measurement and the administration and maintenance of subscriber lines. The original "Invitation To Bid" requested the following facilities for the COM Centers:

a. Operation and maintenance through man-machine interfaces
b. Alarm treatment and supervision
c. Traffic measurement
d. Maintenance and administration of subscriber lines
e. Changes in day-to-day subscriber data
f. Changes in exchange data base

At this time, it has not been possible to determine precisely if the facilities requested under c, d, and e, are being used, and if they are, how they are used. From information made available, it would appear that ARENTO is not making full use of the facilities that these systems offer.

Outside Plant

The OSP facilities installed during the implementation of Telecom II and III and currently operated and maintained by ARENTO consists of six networks that approach 300,000 primary cables pairs, approximately 350,000 secondary cables pairs, in access of 700 SAI cabinets and about 17,000 DCT's. This total network carries a working line load that averages 72%. Individual exchange areas vary in cable fills between 50 and 90 percent. These facts are mentioned in order to establish the size and utilization of network facilities. Overall maintenance effort generally expands as network utilization increases.

Visits to all six exchange areas and interviews with respective ARENTO managers were held concerning operating procedures and maintenance programs. Tours of office and workspaces followed including inspections of records and documentation in the data

group area as well as observations of test room activity. Availability of office space in exchange building complexes is more than adequate and the co-habitation of all groups related to providing and maintaining service appears wise at this stage of Egypt's technological evolution. Office furnishing, however, are generally in disrepair except for upper management levels.

Workspace has almost no air-conditioning which results in open doors and windows for ventilation. With Egypt's dusty atmosphere, especially in Cairo. this creates a working environment filled with dust that permeates the smallest crevice making the whole workspace grimy. Field visits were also carried out in all six exchange areas for the purpose of inspecting that portion of the OSP network subject to deterioration and damage due to inadequate maintenance or workman apathy.

All primary cables and associated tip splices installed by Ford Aerospace in the cable vaults remain neatly racked and arranged and are in good condition. Subsequently placed cables, although not covered by this study, are draped haphazardly along the racking, some lying on the floor and no plan for arrangement of tip splices is evident. This type of installation is typical of most local national contractors and there is no reason to believe the same situation does not exist in the manhole conduit network where recent cables have been placed.

Randomly selected SAI cabinets, IDCT's and EDCT's were examined in all areas both in Cairo and Alexandria. With few exceptions, the SAI cabinets reflected care and management of cable cross - connecting blocks, jumper wire and overall housekeeping. Most cabinets were padlocked with access limited to the technician responsible for all activity in his respective SAI's. Some hardware deterioration in the form of broken latches was witnessed in Heliopolis as well as missing locks.

All subscriber line carrier (SLC) installations visited, in this same area, had exposed tie cables between the SAI's and SLC's creating potential service and maintenance problems. Responsibilities for cable network maintenance and telephone installation come in contact at the IDCT's and EDCT's. Accordingly, the inspection of these two items of plant were made with a view towards the condition of the terminal block, terminal housing and cable installation only. All terminal components and u-guard installations were in good condition with only normal weathering of painted surfaces.

However, future problems could arise in Alexandria as salt air from the sea continues to attack all metal objects. Because the method of placing and terminating station wire in distribution terminals could effect cable network maintenance, a comment on this aspect of providing service is warranted. In nearly every case observed where station wire was placed in terminals following the initial wire runs, the wire was installed without regard to methods and practices taught at school and in the field during the OSP construction phase. Consequently, wire is not dressed down properly in terminals resulting in a jumbled mass and potential troubles.

Fiber Optic and Transmission Systems.

ARENTO's current program for operating and maintaining the PCM equipment related to the digital transmission network, financed by USAID, is by all indications adequate by western standards and above the norm for Egypt's environment and culture. The system has been operating successfully for a considerable number of years and is highly regarded as being the most reliable in country and easiest to maintain. Random inspection of the equipment rooms and workspaces were made and found to be relatively clean and sufficiently air-conditioned. Equipment showed little signs of ageing and no unusual maintenance activity. Trouble report history for this department was not available since no routine periodic fault report is generated. Only those instances when the infrequent and substantial outage occurs is a report made and forwarded through the lines of organization.

2.10 INTRODUCTION OF NEW TECHNOLOGY AND PROCEDURES TO IMPROVE O&M PRACTICES:

Switching Equipment.

With respect to the AT&T-supplied switching equipment, the procedures and practices for the operation and maintenance of this equipment have been very carefully planned and fully specified. The No.5 ESS machine represents the latest technology in the digital switching field. The Bell System recognizes the primary importance of O&M and the No.5 has been designed with O&M efficiencies a top priority.

In the case of the 1A ESS machines, these too have powerful O&M programs and facilities which have been carefully human engineered to provide a high level of O&M

efficiency throughout the life of the equipment. The O&M design has been made as user-friendly as possible.

Outside Plant.

ARENTO are now installing a network of Fault Clearance Centers which will eventually serve the whole Egyptian telephone network. At present, there are two centers in Cairo and one in Alexandria. These centers are located at Mohandaseen and Kubba in Cairo and at Ibrahamia in Alexandria. Each serve a variety of exchange types, depending on the particular area. The Mohandaseen Center, which went into service August 1992, serves 164,000 lines including ARF Crossbar, EWSA (analog), EWSD (digital), 1A ESS and NEAX 61E. A similar mix of switching equipment types are served by the other two centers. It should be emphasized that the type of switching equipment is not important here for these centers are only concerned with the subscriber's line. A metallic pair between the center and the exchange to which the subscriber's line under

test is located is required to perform the necessary line tests. One test line is allocated per each 5,000 subscriber lines.

These centers, designed and built by Reliance Inc. of Texas, USA, provide state-of-the-art facilities for the processing of "188" repair service calls, from the reception of the repair service call to the dispatching of the fault repairman, the subsequent action taken and its satisfactory completion. The entire operation is computerized and represents the application of modern technology in this particular type of activity.

Each center will have a complete data base including all the necessary details of the subscriber's line and location for all the exchanges served from that center. The link between the dispatching consoles and the repair faultsman is perhaps the weakest part of the ARENTO system.

At Ibrahamia, a Motorola radio link is in service and at the other two centers, the faultsman is contacted via special telephone lines. This requires the faultsman to report back to the center the details of the fault and the action taken, completion time, etc. In all cases, the availability of ARENTO transport is limited and most faultsmen are required to operate on foot.

2.11 PRESENT ARENTO O&M ORGANIZATION:

Switching Equipment.

Very little detailed information with regard to the overall organization, departments, numbers of personnel, etc, has been made available. However, a general outline of the structure and organization based on information received from ARENTO O&M personnel at Manager and General Manager level has been drafted and is shown in Figure 1.1. The basic intention is to cover that part of the O&M organization which deals with the USAID-financed O&M switching equipment and support systems, however, other areas have been included where information is available. There is insufficient detail to allow for a thorough analysis of the present O&M organization, in fact, such an analysis should be part of an independent management study. The following commentary reflects the generally accepted management practices within the industry for a commercially oriented organization.

The line of command does not appear to be flexible. Assuming very little delegation of authority, management could become a bottleneck, planned or otherwise. There appears to be very little allowance for horizontal or lateral communications between managers. Without the full ARENTO organization it is difficult to judge the number of personnel at the manager level, however, from the information available, there appears to be more than required. A long chain of command with many links is usually an indication of inefficiency. It must also be remembered that as new services become

more readily available and sophisticated in nature, the grouping of resources becomes complex and more important to the efficiency of the organization. To continue the present arrangement of a manager for every different type and model of equipment in the company would eventually lead to a great deal of confusion, to say the least.

It is known that the present ARENTO organization totals somewhere in the region of 55,000 employees. A good indication of the efficiency of a telephone company can be obtained by calculating the number of personnel employed for every 1,000 lines of telephone equipment in service. This is a recognized measure of operating efficiency within the industry. An exceptionally good figure, as registered by some of the Bell companies in the USA, would be in the region of 5 personnel per 1,000 lines. Not all large international companies can match this kind of figure, however, a figure below 10 would be considered very satisfactory.

Assuming that ARENTO has, at present, about 2,500,000 lines, and assuming the total number of personnel to be 55,000, the ratio of personnel per 1,000 lines in service would be 22. This plainly indicates an inefficient organization with too many employees. This is generally the case where the company is under the control of Government and the need to create jobs is a primary consideration.

Outside Plant.

Generally, each exchange is divided into two areas of interlaced responsibility. An Exchange Manager accountable for the commercial office, subscriber telephone installations, the test room and in some cases general building upkeep. The other is a Maintenance Manager who is responsible for the overall condition and maintenance of the outside plant network. The exception to this arrangement is in Heliopolis where one manager has total exchange control. The exchange and maintenance managers report to a Zone or General Manager who in turn reports to a District Manager that answers to the Vice Chairman of Operations and Maintenance. See the attached organization chart for the exchanges in this study.

The OSP Maintenance Manager's department is comprised of a maintenance group and a data group each with duties and responsibilities that contribute to the overall performance and results of the network. Although some variations exists from one district to another, following is a composite functional breakdown of each type of group :

Maintenance groups consist of an engineer that supervises up to six teams of men, each of which includes a technician, a joiner and helpers. Supporting all teams, as required, are men that do all excavation work associated with repairing and installing buried cable. These groups are responsible for preserving the integrity of the outside plant cable network from the Main Distribution Frame (MDF) to and including the exchange distribution cable terminal (EDCT). Included in this task are fault location, fault

clearance, fault tracking, cable and hardware damage repair, preventive and routine maintenance testing and scheduled recurrent housekeeping inspections of manholes (MH), Serving Area Interfaces (SAI) and EDCT's. Although not an O&M function, the maintenance groups are charged with engineering and installing small cable extensions and EDCT additions in their respective exchange areas. A junction cable that terminates in a maintenance manager's exchange is also his responsibility.

Data groups are primarily responsible for preparing and maintaining records, maps and drawings of the OSP network. Generally, each exchange has an engineer that supervises personnel that perform the following tasks :

a) Post all telephone, cross-connect and defective pair activity to the Exchange Cable Count Records (ECCR).
b) make new ECCR's for newly installed cables.
c) Post EDCT additions to ECCR's.
d) Prepare construction drawings for cable and terminal additions.
e) Post all changes and additions to the outside plant as-built drawings.
f) Prepare lists of vacant and defective cable pairs for the maintenance group and commercial office.

The departments are provided workspace, usually in the exchange building complex which appears to be adequate. This observation however, must be viewed in accordance with what is considered the norm for Egypt's environment and culture.

ARENTO's current program for operating and maintaining the outside plant network in the six exchange areas, involved in this study, is virtually that which was established by the contractor during the guarantee period. This was deduced from visits to the exchange areas and through conversations with managers and group supervisors. The program includes procedures for routine and preventive maintenance as well as emergency repairs. All maintenance managers have enacted schedules for routinely testing all vacant and defective primary cable pairs from the main distribution frame (MDF) and the same test for the secondary cable pairs from the SAI's. The cycle frequency of these test vary from once to 6 times per year depending on the size of the exchange network and manpower which is not necessarily proportional.

Never-the-less, a respectable effort is being made to preserve the quality and integrity of the network. As primary and secondary cables are tested all pertinent information is given to the data group for record updating. Also, SAI's and EDCT's are inspected and cleaned on a routine basis. Preventive maintenance, if necessary, is usually done at this time generally in the form of jumper replacement and sprung contact repair. Manholes are opened, emptied of water if required and given a cursory inspection as well. Cable vaults, because they are dry and experience almost no activity are rarely visited. These inspections are repeated every 2 months to annually depending also on the size of the network.

It is the Maintenance Manager's objective to clear the same day, all cases of cable trouble received before 10am. For trouble reports received after 2 pm, the goal is to clear them all the following day. These respectable targets will necessarily be mitigated by digging permit delays, lack of sufficient transportation, spare parts and absence of powered equipment. Monthly reports listing total faults, faults cleared and faults remaining are sent to the Vice Chairman - O&M.

The Maintenance Department and the Exchange Manager's department interact and join forces to achieve a common goal on two occasions. Otherwise they generally operate autonomously. For those exchange areas not under the control of a Fault Clearance Center (FCC), a trouble reported by dialing #188 is received in the test room of the respective exchange. A trouble ticket is prepared with all pertinent information and is forwarded to a test position where an initial test is made to determine the nature and location of the trouble relative to switching, cable or wire. The Maintenance Department becomes involved only when the fault is determined to be in the cable network. Should this be the case, a maintenance group is dispatched to perform their own routine of tests, fault locating, and repair procedures.

Upon completion of repair work, the test room makes a final test to confirm that the service has been restored. Any changes to the original circuit is sent to the test room for station record card updating and to the data group for cable record updating. Defective cable pairs are also recorded and tracked by the maintenance group for repair when the amount at one location justifies opening a primary cable splice or excavation of a buried cable. The procedure for handling trouble reports in those exchange areas controlled by an FCC is considerably different and more efficient. In these cases, the FCC's receive all trouble reports for their respective areas, make the appropriate initial tests, dispatch a repairman to clear the fault, make final tests, update the data base if necessary and generate meaningful reports.

The Maintenance Department gets involved only when the fault is determined to be in primary or secondary cables. Currently, most faults are occurring on the subscriber side of the distribution terminal. To date, two of the six exchanges (Zamalek and Ibrahimia) in this study fall within an FCC area. Another instance of cross-department activity occurs when a request for service is made at a Commercial Office. The Maintenance Department's role in this process is first by providing the commercial office with a current list of vacant cable facilities by updating this list as cables are routinely tested. Then, if there are no available pairs at the required location, to either clear defective pairs if possible or request permission to engineer and install a small cable and or terminal addition.

Should a major expenditure be necessary, the projects department must approve, fund and schedule this expenditure. Finally, if all facilities an equipment are available and the new service contract is consummated, a maintenance group, in some cases, will make the cross-connect at the SAI and a final test. The facility information is

forwarded to the test room for station record card preparation and filing and to the data group for cable record updating. The primary responsibility as well as most of the work operations related to service order processing falls within the Exchange Manager's control and is addressed in this section because of department interfacing only.

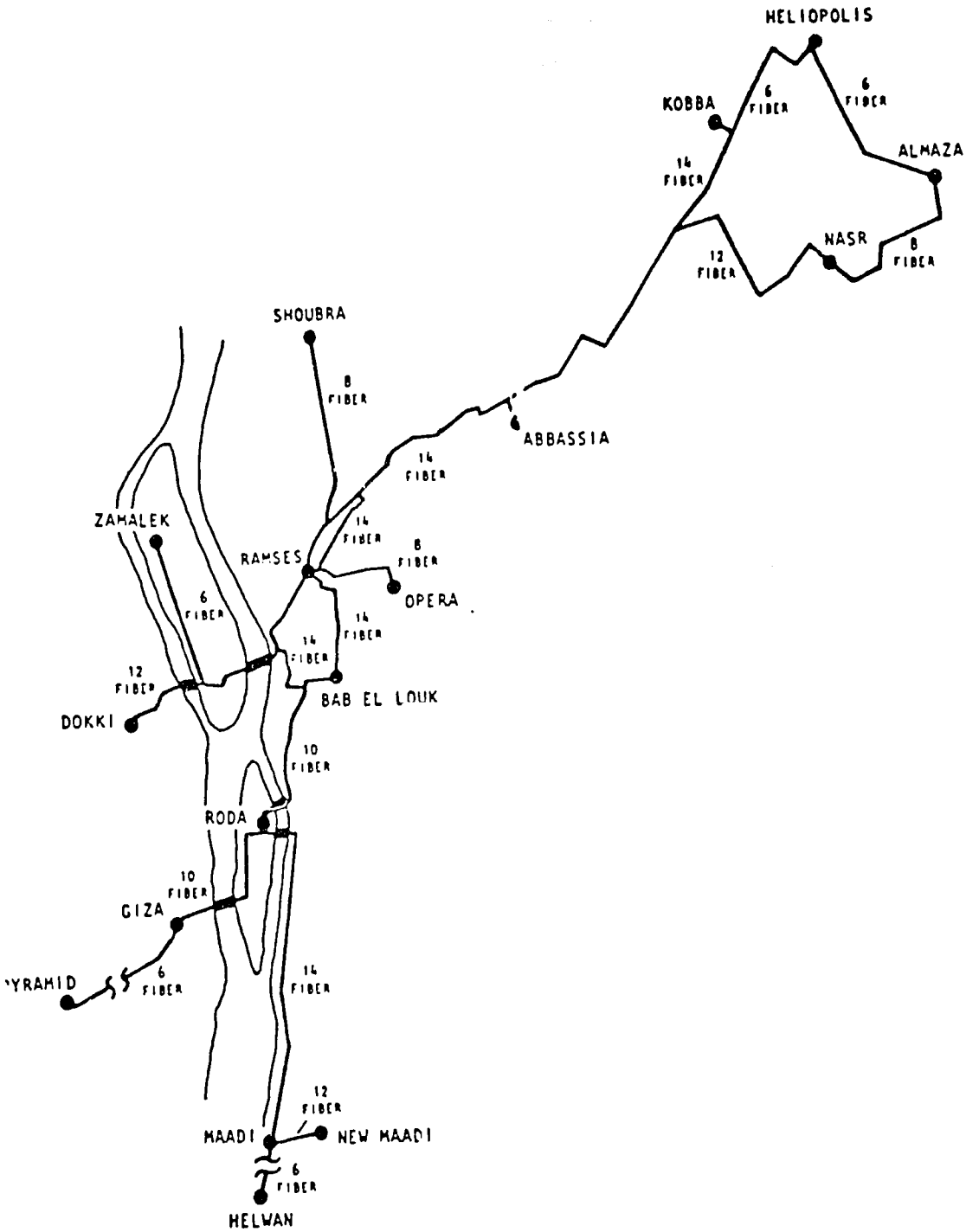
The method for handling requests for service vary somewhat from area to area. Alexandria's three zones each have a single Commercial Office that handle requests from many exchange areas. In Cairo, each exchange studied has it's own Commercial Office. This however, effects management more so than work flow. A composite method for processing service orders is explained in the following paragraphs. A customer places an order for service in person at a Commercial Office. A preliminary contract is written with all pertinent information including type of service and address. Assuming the requested type of service is available, the potential customer is advised that he/she will be notified if facilities are available.

Commercial or a Project Group then checks a vacant facility list that is furnished and updated by the Maintenance Department and selects a secondary cable pair in the appropriate DCT and a primary cable pair in the serving SAI cabinet. In some areas this assignment is sent to the test room for testing and availability verification. If facility availability is confirmed, commercial is informed either directly or via a project group and the customer notified to return to the commercial office to sign a contract and pay the connection fee.
When contract conditions are satisfied, Commercial selects a telephone number, gives it to the customer, sends pertinent information to the ESS switch room and forwards a service order to the Installation group to install the telephone. In some areas the Maintenance group is notified to make the necessary cross - connect in their serving SAI cabinet. The ESS switch room makes required data input into ESS memory and sends the LEN position to the MDF for jumper connection.

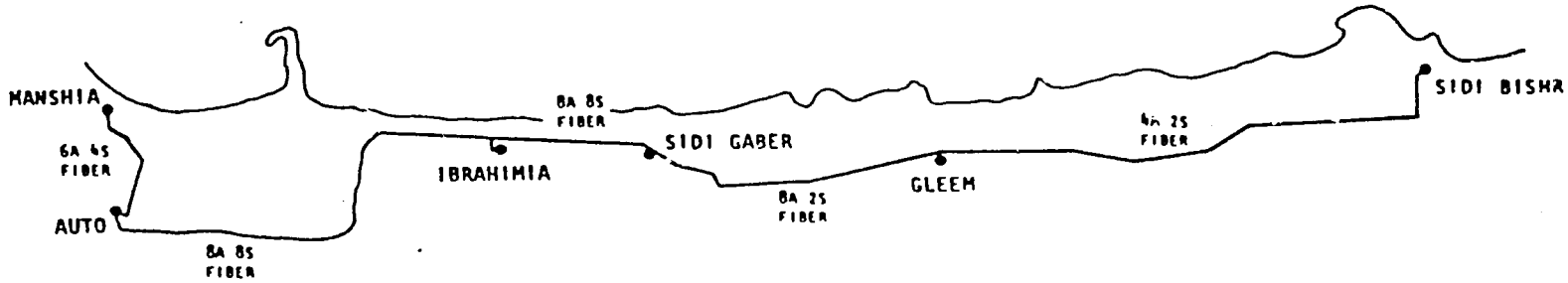
Following the complete installation, the test room m makes a final test and prepares a Station Record Card. The Data group is informed and the cable records posted. As Egypt advances technologically and expands the access and use of existing and future data bases, the existing convoluted method of processing service orders should be rectified.

Fiber Optic and Transmission Systems.

The fiber optic network falls under the management and control of a department head responsible for the total junction network and associated equipment. The portion of this transmission department that maintains the fiber system is divided into two areas of responsibility, Alexandria and Cairo. Each has an engineering manager that supervises the O&M for the electronic equipment associated with the fiber optic and microwave networks in their respective areas.



CAIRO FIBER OPTIC JUNCTION NETWORK



ALEXANDRIA FIBER OPTIC JUNCTION NETWORK

SECTION 3

RECOMMENDATIONS

3.1 INTRODUCTION:

The recommendations given below are based on impressions, observations, conversations and judgments of the telecommunications experts which were accumulated during the course of this study. Sufficient information was gathered to permit practical recommendations with reference to the USAID-funded equipment and supporting systems to be made.

Considering only the USAID-financed equipment, and supporting systems, the overall conclusion is that these equipments are generally in good condition and are maintained to an acceptable standard. There are potential improvements, however, that are associated with, and which affect, this equipment and its operation and maintenance, either now or in the future. These covered in the following recommendations.

The recommendations have been divided into two broad categories:

a. General:, those of a general nature, relating to the overall environment in which the USAID-funded equipment has to work, specifically the Cairo and Alexandria telecommunication networks.

b. Specific: those that can be related specifically to the primary objective of this study, the O&M of the USAID-funded equipment.

In each of these categories, the recommendations are listed by priority, with the most urgent recommendations listed first.

GENERAL RECOMMENDATIONS:

3.2 NETWORK PROBLEMS:

There is an urgent need for an USAID/ARENTO study to investigate, diagnose and solve serious network problems and it is recommended that this be done without delay. Some form of public education by ARENTO in the use and treatment of the telephone could well be part of the solution.

From the data that has been obtained and from conversations with the switching center supervisors there is no doubt that there are serious problems in the network which should be investigated further and corrected. These problems do not originate within

the switching centers themselves.

False Traffic

There is obviously a serious problem that is originating from the subscriber's telephone line. It adds a large percentage of unnecessary traffic to the originating traffic load on the exchange equipment. Without an investigation in some depth, it is difficult to say precisely what is the principal cause of the problem at this time. It would appear that subscribers are removing the telephone instrument and replacing it without dialing, or are partial dialing and replacing the instrument. It is also possible that some people are removing the telephone receiver before going to bed and leaving the line busy. Another possibility is that subscribers are buying and connecting additional telephones to the line without ensuring that the telephone set meets standard specifications or that the installation itself is not causing problems. It is also possible that many telephone sets require maintenance and although they function correctly sometimes, they could be putting problems into the system on other occasions.

The monthly performance summary data shows clearly a great number of false starts every day, about 24% of the total originating traffic. This is not a problem that has only just come to light, neither is it a problem which is confined to a particular exchange area, although data shows that it is worse in some areas than others. The following figures have been taken from recent data:

False Start Traffic (as a percentage of the total originating traffic)

1A ESS OFFICES

AUTO	34%	NEW MAADI	28%
IBRAHAMIA	27%	HELIOPOLIS I	26%
ABBASSIA	24%	HELIOPOLIS II	24%
GLEEM	24%	MAADI	23%
ZAMALEK	17%	BAB EL LOUK	16%

No.5 ESS OFFICES

EL KALAA	18%	MARIOTEYAH	26%
HELIOPOLIS III	21%		

The 1A manual defines a "false start" as line service requests with no succeeding digits dialed during the peak traffic hour. This type of mis-use of the telephone occurs throughout the day but the peak traffic hour is when this false traffic has the greatest effect on the operation of the office. False calls can occur on any system, anywhere in the world, and they do. However, the percentage of such calls to the total call attempts should not be more than a few percent.

Fortunately, the 1A and No.5 offices are not heavily loaded in the peak traffic hour, even though the majority of these offices are achieving a line-utilization rate of about 92%. Abbassia and New Maadi each have a line-utilization rate of 96/97%! The line-utilization rate is a measure of the total lines in service and the total lines available.

The problem of false traffic in the network is not new. The Invitation to Bid documents issued in 1980 for the 1A ESS offices gave the following figures for false traffic in the network at that time:

. Local Traffic	21%
. National Traffic	25% Automatic & Via Operator
. International Traffic	25% Automatic & Via Operator

It should be noted that the reference here to national and international false traffic is an attempt to cover such events as repeated attempts, congestion in the network, operator call-back, etc, and should not be confused with false starts which go no further than the subscribers local exchange. Nevertheless, the fact that the subscribers telephone is off-hook due to the false start situation means that many incoming calls are receiving a busy signal when in fact the called subscriber is not engaged at all. This leads to repeated attempts and congestion in the network. Reliable information shows that the call completion rate for incoming calls from the USA is only about 36%! A lot of revenue is being lost due to this problem.

3.3 NETWORK MANAGEMENT SYSTEM:

General.

It is recommended that ARENTO should seriously consider the provision of network management facilities with a network management center to be installed in Cairo.

Within the time constraints of this study, it is only possible to touch upon the important subject of network management. This general recommendation provides the basic guidelines to allow a USAID/ARENTO sponsored study group to proceed with the preparation of a network operating plan and to prepare the technical guidelines for the eventual implementation of such a system. It is understood that ARENTO is discussing with AT&T the provision of a Network Operations Center (NOC). No details are available but it would appear to be along the lines of the AT&T Network Management Architecture, as briefly described in the following text.

Type of system recommended

When considering the development of a network operating plan, the one most important issue is how to integrate all the different types of systems in a national

network into one unified network management architecture. A great deal of thought has already been given to this problem by many large manufacturing and operating telecommunications companies around the world. Of these, the AT&T is very prominent with their network management system based on the Unified Network Management Architecture (UNMA). This architecture provides a stable framework for network management with a three-tier system that integrates management systems that control separate pieces of a network.

> Network Elements: The first tier includes the network elements e.g. devices on the customer's premises such as modems, multiplexers, local area networks, PBXs and local, interexchange or international network services including analog or digital facilities, packet switching and other forms of data networks.
>
> Element Management Systems: The second tier is comprised of systems that manage the network elements, including operations, monitoring, control, administration, maintenance, and provisioning functions.
>
> Network Management Integration: The third tier ties the element management systems together and provides overall facilities that allow users to operate, administer and maintain a network from end to end.

Implementation of UNMA requires a standard intersystem interface (machine-to-machine protocol) that can easily be supported and which is powerful enough to allow for full network control. AT&T has produced Network Management Protocol (NMP). The UNMA can be planned as a system which initially is comparatively simple but which can be expanded and developed.

Other Considerations

When planning this type of network system facility, it is vital that the existing centralized operations and maintenance centers be fully taken into account. Without an extensive study of the application of network management here in Egypt, the future role of the existing O&M centers within a centralized network management scheme cannot be clearly defined at this time. However, it is logical that these centers should continue in service and that they should be incorporated into any future network operations plan.

The new Fault Clearance Center Network with its extensive subscriber line data base, now being implemented in Cairo and Alexandria, must also play a part in the overall network management plan.

Initial objectives

The initial objectives for the system plan are to:

- Formulate a standard network operating plan.

- Define the information flow among the various systems and plan the automation of the communication between the switches and the center.

- Clearly define the services to be performed at the center.

- Develop service criteria for the services at the center.

- Develop protocol and input/output standards for interfacing between switches and the center.

The initial services to be provided at a network control center should include the following:

- Service Order/Recent Change - The need to update the switching systems as quickly as possible has led to a centralized service order that can take the information to the system in what is commonly known as a recent change format. Recent change is the information the switching machine needs to update the customer data. Links would have to be established to the various switches if this function is to be centralized, which is the preferred way to operate. Combining service order and recent change will not only improve operations (less personnel, quicker response) but will eventually allow for an electronic directory.

- Traffic Data Analysis - The traffic data analysis package collects call count and usage data for items within the system that are traffic sensitive. This information is necessary for the instantaneous indication of overload or trouble, to determine whether the present equipment is meeting the service criteria established for the system, and for long-term trend analysis. This will allow centralized network control to reconfigure the network in real time to maximize the call carrying capabilities of the network, particularly in times of emergencies.

- Failure Detection and Alarm System - The network communications center should be capable of monitoring each switch within the network and performing remote diagnostics. It should also be capable of monitoring the transmission facilities between the switches and, if a major problem arises, to be alerted via an alarm from these units.

- Trouble Log - Three major sources of trouble reports should generate a trouble log at the center: reports from centralized testing, alarms or other reports from the various switches, and customer complaints. Suitably detailed reports should be made available with corrective actions

taken, etc.

∘ Centralized Remote Testing - The testing of all links within the network is a vital feature of any system, and the network must initiate this testing from a centralized point. The center also serves as the place where the routine testing of lines, links or common control can be initiated.

∘ Automated Directory - The automated telephone directory provides an on-line source of information for any user of the network. The present compiling and printing of directory information is a long and laborious process, with the information being outdated before printing.

SPECIFIC O&M RECOMMENDATIONS

3.4 TRANSMISSION LINKS BETWEEN SWITCHING CENTERS:

It is recommended that a team of experts be assembled to check the affected transmission routes and to make their report together with recommendations for appropriate corrective measures as necessary.

There is evidence that the performance of some of the transmission links carrying connecting trunks between exchanges in the Cairo area are erratic, causing problems to inter-exchange traffic. Without a serious investigation as to the causes of this problem, only very broad suggestions as to possible causes can be made at this time. A program is needed to review and evaluate the performance of the interoffice microwave and fibre optics links in Cairo. The monthly performance summary sheets for the 1A offices show that on some links there are intermittent faults and these are causing abnormal peg count readings of incoming calls.

A few examples of peak hourly traffic counts are given below:

Ibrahamia	Orig.+ Inc.+ False Starts	=	388504
	Inc.	=	349458 !!!
	Orig.	=	28696
	FS	=	10350

Incoming traffic counts are registering 90% of the total traffic counts !

At Gleem, the same peak hourly traffic counts show incoming counts to be about 37% - this figure is normal.

At Auto exchange the figure is 86% !
At Zamalek exchange the figure is 56%.
At Heliopolis I it is 34%.

These figures show the peak hour traffic, in other words, the total of the four heaviest 15-minute periods during the total period covered by the performance data. They do not mean that this situation continues during the whole period of data recording. For example, the incoming traffic counts for Ibrahamia taken over the total period of observation, show them to be about 30% of the total originating, incoming and false starts. What these figures do show however, is that during certain periods of operation, problems with the incoming trunk or multiplexing facilities (at either end) or the connecting transmission equipment is causing these extraordinary levels of peg counts and corrective action should be taken.

3.5 CENTRALIZED OPERATIONS AND MAINTENANCE CENTERS (COM CENTERS):

It is recommended that a study be made of the present operation and functions of the 1A COM Centers, in detail, and that a plan be prepared to utilize these centers more effectively and efficiently. This plan should consider the use of the facilities as described below, the integration of other exchanges into the Cairo center and the linking together of the 1A and No.5 centers.

Thought should also be given to the use of the subscriber line data base now being built up in the fault clearance centers.

At present there are two COM Centers for the 1A ESS switching centers and one COM Center for the No.5 ESS switching centers. The COM Center serving the No.5 equipment is completely state-of-the-art, having been installed only recently.

The COM Center serving the 1A ESS equipment is older and has been in service since 1984. From the information provided by ARENTO staff, the prime use of this center is to monitor the function of all the 1A offices even though a full maintenance team still attends each switching office during normal working hours. It should be pointed out that a primary purpose of the No.2 SCCS was to provide savings in manpower with gains in both efficiency and proficiency. This does not appear to be happening to the extent that it should.

The 1A COM Center can also be used to monitor and provide surveillance, control and analysis functions for electro-mechanical switching systems by the application of minicomputer techniques at each electro-mechanical switch. Such an extension of the facilities of the Ramsis COM Center would add enormously to the overall monitoring capabilities of the Cairo switching network.

In addition to extending the monitoring capabilities of the No.2 SCCS, there are additional facilities available which should also be considered for use within the Cairo and Alexandria networks. CAROT is a computer-based system that runs routine and demand transmission tests on trunks between offices that are equipped with remotely controlled test lines. Results are checked for being within design limits, and those that are outside of these limits are reported to the SCC for trouble location and repair.

Another facility available is the Central Office Maintenance Management System (COMMS) which schedules and tracks preventive maintenance work.

A fourth application which can impact SCC operation is the computer-based Engineering and Administrative Data Acquisition System (EADAS), which measures traffic characteristics of switching offices and trunks and can report abnormal conditions that appear to be maintenance related to the SCC.

In addition, the COM centers and the 1A ESS and the No.5 ESS offices are designed to produce traffic information which is extremely valuable to establish historical trends for forecast projections. This traffic data is vital to the future planning of the network. It would appear that ARENTO is not taking full advantage of its availability. It is recommended that suitably qualified ARENTO personnel should receive intensive training in the interpretation and use of this data, either in the USA or through US Instructors coming to the ARENTO training center for this purpose.

The use of these systems should greatly improve the maintenance of the switches and transmission systems in addition to reducing outage times and improving the efficiency of the ARENTO staff. The improved maintenance and reduced outage times will result in increased revenues for ARENTO.

3.6 TRAINING:

Switching Equipment.

With the installation of many more lines of No.5 ESS equipment in the near future, it is recommended that a new, complete training unit be installed in Cairo for training on No.5 ESS operations, administration and maintenance (O&M). This unit should be staffed, initially, by US instructors. Their duties would be taken over eventually by ARENTO staff. This would obviate the need, and expense, of sending ARENTO personnel to the USA and would ensure that the maximum benefit was derived from any training funds made available. The location of this equipment should be carefully selected and the air conditioning requirements must be met and maintained at all times. This new training unit should not be fitted into "available space", as appears to be the norm, under any circumstances.

It is further recommended that all central office supervisors and other senior O&M staff be evaluated for their knowledge of the telephone network and the necessary interworking requirements. This should include call routing, signalling, interfacing with the transmission systems, and some instruction in quality of service measurements, etc. Refresher courses for those personnel in need should be designed to address these subjects.

It is understood that ARENTO plans to raise the telephone density from its present figure of 4 per 100 population to around 7 by the year 2000. Assuming a population of around 71 million by that time, about 5 million lines will be required. To meet this total for the year 2000 and assuming the present total to be 2,500,000, a yearly increase of about 360,000 lines will be required. This does not take into account the replacement of obsolete crossbar and other older switching systems. Include the replacement of obsolete equipment and the yearly requirement of new lines will be well over 400,000.

Considering only USA-provided equipment, and assuming that the USA-provided share would be about 140,000 lines per year, the total required between now and the year 2000 would be about one million lines. If this equipment is distributed with average exchange sizes of 40,000 lines, including remotes, then some 25 principal sites will be required. Assuming that the No.5 switch (or equivalent) would be used only in the larger cities then these 25 sites would be in Cairo or Alexandria. Centralized O&M facilities should reduce the number of No.5 ESS technicians required to no more than 40 over the next 7 years.

It should be appreciated that the estimated No.5 ESS manpower requirements refer only to O&M. Some allowance must be made for the requirements of the installation and planning departments.

Proficiency in these types of courses should be linked to pay scales. Serious consideration must also be given to proficiency in the English language.

Finally, it is important that ARENTO begin training personnel for the maintenance of air conditioning units, AC power equipment and emergency generator sets. There appears to be a shortage of maintenance skill in these particular areas.

Outside Plant.

It is recommenaed that a study be made of the Outside plant training facilities with a view to improving the both the training curriculum and the OSP training facilities.

Observations and interviews with ARENTO managers indicate an urgent need for an ongoing quality OSP training program. The existing Technical Training School needs to have course material updated and new equipment that will insure that graduates have sufficient knowledge of all test equipment and are able to maintain the OSP network. Currently employed engineers and technicians should receive periodic schooling to stay

abreast of technological changes, new materials and up-to-date methods. Very few current staff technicians have benefited from this type of program, yet they are entrusted with the safekeeping of a huge investment. Training provided by new projects should be given first to employees that are destined to remain and work in the area treated. This at least insures some consistency in methods of maintenance following the guarantee period of the contract. Often times this training, due to the selection process, benefits only the student and not ARENTO. This is particularly true for schooling conducted in the U.S.

3.7 EXCHANGE BUILDINGS AND AIR CONDITIONING:

It is recommended that a plan be developed to improve the environmental conditions of central office exchange buildings.

Some of the existing buildings could be adapted without too much cost, to alleviate as much as possible, the present dirt and dust problems. A separate entrance for the commercial office is needed so that the public does not have to enter into the body of the building. A great deal of the commercial office activity could be reduced considerably if the method of paying telephone bills was modernized. All offices that do not relate directly to the every day operations and maintenance of the installed equipment should be located elsewhere. A dining/recreation room should be allocated only for the O&M staff. Much more attention should be paid to the regular cleaning of the building interior. Building maintenance services should institute a program for cleaning all buildings and it should be their responsibility to ensure that this program is maintained.

Telecommunications equipment, and the buildings in which it is housed, should be kept as dust free as possible. Cairo is a particularly dusty city and this lends added emphasis to giving this problem special attention in order to maintain telecommunications equipment buildings as dust free as possible. Alexandria is cleaner and the problem is less severe, however, it is still a problem that must be solved. The Bab El Louk building is an example. Most windows are open - the large main doors are completely open, and people are in and out for most of the working day. The result is that the building interior is covered in dust and dirt. The No.1A office area does have full air conditioning and the doors to the equipment room are generally shut, however, with the quantity of dust in the air, some will invariably penetrate and this is clearly what is happening. The air conditioning filters clog very quickly and the air conditioning plant is then unable to perform as efficiently as it should.

In the new digital No.5 ESS offices, the temperature of the equipment bays is controlled by cool air ducted in from below. Once again, this air at source is dusty and without doubt, given time, fan filters will suffer and equipment bay temperatures will rise unless special attention is given to this problem of building design. Preventive maintenance schedules for No.5 offices show that all fan filters must be cleaned every week.

In most buildings which house either a 1A ESS or No.5 ESS office, the new switching equipment has been adapted to the existing building space. While this may be necessary for economic reasons, every effort should be made to provide a building that is constructed for the principal purpose of accommodating modern telecommunications equipment. Unused equipment space can be used temporarily for administrative purposes until the space is required for equipment growth, but access to the administrative space must not be through equipment areas.

The Kubba exchange building is a good example as it was apparently designed as an equipment building for switching equipment. This building is an example of the type of exchange building architecture required and recommended. Even here, although the principal entrance is well regulated from a security point of view, there are still far too many people entering and leaving the building. A good deal of this activity could be avoided if: the commercial offices were located elsewhere, the method of paying the telephone bills was modernized, ARENTO had its own space for technical staff.

To combat the dust and dirt problems in future exchange buildings, and to understand their accommodation requirements, it is recommended that ARENTO send selected personnel from their architectural offices to the USA for a short course in the design of telecommunications buildings.

3.8 REPAIR CENTERS, TOOLS AND EQUIPMENT:

Considering the fact that the 1A ESS equipment will remain in service for a long time to come, it is recommended that a review be made of the functions of the 1A repair center at Bab-El-Louk with the intention of improving and/or renewing its present test and repair facilities.

The 1A ESS repair center in the Bab-El-Louk building is a valuable asset to the overall 1A ESS operation, and it is performing well. However, its personnel have indicated that their repair capabilities could be greatly improved with the inclusion of certain additional 1A-type circuit board testing facilities.

To operate a maintenance program, sensitive to rapid restoration of service and overall care and preservation of the network, certain tools and equipment are necessary. Test equipment is beginning to age and requires recalibration and general maintenance. Some sets remain inoperative due lack of repair facilities. A program to repair and replace test equipment is in dire need. Vehicles available for use are inadequate in number and generally are reaching the end of their serviceability. A vehicle per team is recommended as well as a scheduled maintenance and replacement program.

Power tools and equipment is almost nonexistent and should be part of each manager's

inventory. Specifically, jackhammers, compressors, large and small water pumps, portable generators, blowers to ventilate manholes and tank trucks for hauling away water removed from manholes are all items that facilitate maintenance. Small hand tools are also in short supply and should be replenished. One item of material suggested for purchase, in various sizes, is the split duct plug. This device is used in manholes to fill the area between a cable and it's associated duct, producing a seal that prevents the flow of water and gas. To realize maximum benefit from the Fault Clearance Center (FCC) operations, the dispatchers should have wireless communication with the repairmen in the field. To date only one FCC area has this capacity.

The Telecom IV contract does not request a repair center for the No.5 ESS equipment and these facilities are not required in Egypt. The numbers and types of printed circuit boards used in the design of the No.5 ESS have been reduced to a minimum, however, their repair has increased in complexity. All repairs will be made in the USA.

3.9 O&M ORGANIZATION:

It is recommended that a review of the O&M organization be made with the full cooperation of ARENTO. This could be completed within a short time frame. If the resulting recommendations were implemented by ARENTO, the present O&M organization could greatly improve its functional capabilities resulting in an extended useful life of the USAID funded equipment.

The O&M organization, from information obtained, does not appear to be very flexible. The line of command is too rigid. One is left with the impression that the organization is composed of a number of small self-contained sub-systems, with very little liaison between them. There appears to be a lack of coordination between personnel at the manager level and below, particularly between those managers in different sectors such as switching and transmission for example. Transmission personnel will take out of service a block of circuits for whatever reason and fail to inform the switching personnel of their actions. This type of situation, which has been reported on a number of occasions, is probably indicative of the lack of coordination in general between these sectors, and can have a serious affect on the performance of the connecting exchanges.

It should be understood that these are only impressions gathered during the course of this study from observations, conversations and a small amount of information. However, it is felt that there are sufficient grounds for pursuing this matter further in order to verify or refute these early opinions.

Immediate improvement in Outside Plant O&M could be obtained without further study if ARENTO would limit O&M manager's responsibility to activities concerning the OSP cable network. These duties would include routine, preventive and emergency,

maintenance; engineering and installation of small cable and terminal extensions; construction drawing and as-built drawing preparation; posting and maintaining the OSP drawing file; and coordinating with other departments in the exchange.

Overall management of the maintenance effort could be enhanced by the collective adherence to the same guidelines for operating and maintaining an OSP network. Upon completion of Telecom II & III, the contractor furnished ARENTO copies of "OSP Operation and Maintenance Handbooks", but none could be found at the exchanges. These practices should be a part of each O&M manager's library and used religiously to insure a safe, trouble free operation over an extended period of time. Also, provide all equipment locations with a copy of the "O&M Handbook - Fiber Optic Inside/ Outside Plant Facilities of Cairo and Alexandria" furnished by Ford Aerospace. Insist that engineers, responsible for equipment, become familiar with this document.

Further, Maintenance and Exchange Managers should hold monthly meetings to discuss transfer of information between the two departments, problems that arise where responsibilities overlap, potential solutions, and various other common items of interest, with meeting minutes going to regional or zone managers.

3.10 QUALITY OF SERVICE PERFORMANCE OBJECTIVES:

It is recommended that an active program to enable ARENTO to monitor service performance and to measure that performance against a set of performance objectives to be developed and instituted.

The Bell System in the US, prior to its breakup, was extremely successful in providing a good grade of service to its customers through the use of service measurements and indices. Friendly competition was established between like geographical units to see who could be Number One each month or each quarter. Service performance measurements are a very valuable tool to improve the service provided and the efficiency of operating units.

At the present time, it would appear that quality of service performance objectives are not in use, and that ARENTO does not have an active service performance monitoring scheme. *The* service objectives required should be both technical and operational, and should be specified for both the short and the long term, allowing the operations to first meet a set of interim short-term objectives and then to make progress towards the final long-term high quality service that customers have the right to expect.

In brief, Quality of service planning should consider two basic components:

1. A set of service objectives.
2. An effective scheme for monitoring service performance.

The proposed service quality objectives are as comprehensive as possible and may be applied to more than one kind of service. However, as the network expands and new services are introduced, it will be necessary to consider the possible introduction of additional performance factors, as required.

In order to meet the obligation to provide quality service, certain questions must be answered, for example:

a) What service levels will satisfy the customer, and at what point is the added cost of improving service no longer commensurate with the accompanying increase in customer satisfaction?
b) How should technical objectives be set for network elements so that final end-to-end connections meet desired levels for customer satisfaction?

c) How can system performance be monitored to ensure that the objectives are being met?

It should be recognized that performance standards, and their regulation, must strike a balance between level of service and the cost to the public. To set the standards so high would be impractical. Not only would they be extremely costly to implement but probably unattainable. On the other hand, inadequate service has a negative influence on the subscriber and the country, producing a high degree of public annoyance and dissatisfaction.

The setting of technical objectives will, in the case of Egypt, draw heavily upon the experience of foreign operating companies and the general recommendations of such international bodies as the CCITT. These objectives serve, not only to meet subscriber satisfaction levels, but as a guide in the design and layout of equipment and systems, and in setting operational and maintenance requirements.

It is essential to understand the importance of apportioning, or balancing, the various service objectives among the different segments of the network. Some objectives should be clearly specified within the national plans such as Transmission Plan; Switching and Routing Plan, etc. The remaining objectives, those of a more general nature, would be specified in accordance with generally accepted standards of telephone administrations throughout the world.

The monitoring and evaluation of system performance must be a continuing effort to ensure that objectives are being met and that service problems are recognized and solved without delay. This evaluating data will be available from a variety of sources, to be discussed later in this text, and a well prepared plan for its collection, evaluation and storage, is essential.

As part of an overall program for measuring the efficiency of the network and

performance of the service, it is necessary to adopt a set of service, (or performance), objectives. Each objective will set the desirable performance limits for selected areas of operation, each being regarded as a performance factor.

A measure of service quality cannot be expressed by any single performance factor, neither can it be expressed by attempting to combine a number of performance factors into a single composite indicator. Service quality measurement involves a number of performance factors, each of which deals with a different aspect of overall operation. These include the following:

a) Availability of telephone service, (length of the waiting list).
b) Availability of new and modern services.
c) Time necessary to provide service after application has been accepted.
d) Speed of operation - time required for significant events to occur during the establishment of a call.
e) Service reliability - measured in terms of outages, faults, errors, irregularities and other significant qualities of performance of equipment, operators and subscriber, except speed.
f) Call disposal - recorded as calls completed and uncompleted, or in terms of other final disposition of the calls irrespective of speed and other qualities of the service.
g) Time to repair, (when the subscriber has a problem).
h) Quality of billing service - prompt presentation of bills, accounts, accuracy, methods of payment.
i) Transmission quality.

The CCITT classifies all such performance factors within the following five categories:

1. Service Support.
2. Service Availability.
3. Service Reliability.
4. Service Operability.
5. Transmission Quality.

Each of these categories should be developed into a meaningful Quality of Service Performance program, complete with objectives and training of O&M personnel.

3.11 MOTIVATION

A complete review and evaluation of ARENTO's salary structure is recommended in order to insure employee conscientiousness, dedication and loyalty.

This recommendation is probably one of the most difficult to undertake and ARENTO

management is obviously aware of the need. However, this report would not be complete without a recommendation on the subject, even though it may be impractical to implement.

Motivation in terms of financial compensation is probably the single most significant factor affecting the attitude and performance of ARENTO personnel. Wages in general are low and defy all rationalization as compensation for many levels of responsibility. Most employees are required to seek a second job or take a leave of absence to work overseas to make ends meet. As an added source of distress, salary increases have not kept pace with inflation and other factors that erode buying power. Wage earners today are under more financial strain than they were 10 years ago. Valuable employees who have been trained by ARENTO and have several years of telecommunications experience are leaving for the private sector or for overseas assignments where the compensation is greater, This is a serious loss to ARENTO.

Salary levels, which are generally poor to begin with, are based primarily on years of service rather than professional education, technical ability and overall capability. This obviously leads to grave anomalies in salary levels and is a primary cause of discontent and resentment. The need to hold down two jobs to make a living wage does not make for a truly efficient and dedicated employee.

Obviously, there is no easy answer or recommendation to solve this situation. It is recommended however, that ARENTO management review the present methods used to determine salary levels. As much as possible, salary scales must be broken away from Government restrictions and be reviewed upwards such that they resemble more closely those of commercial companies. This is particularly important for the upper grades of technicians and engineers.

UNITED STATES OF AMERICA

AGENCY FOR INTERNATIONAL DEVELOPMENT

TELECOMMUNICATIONS IV PROJECT

OPERATIONS AND MAINTENANCE STUDY

PROJECT NO. 263-0177

VOLUME II

APPENDICES 1 THROUGH 5

(TASKS)

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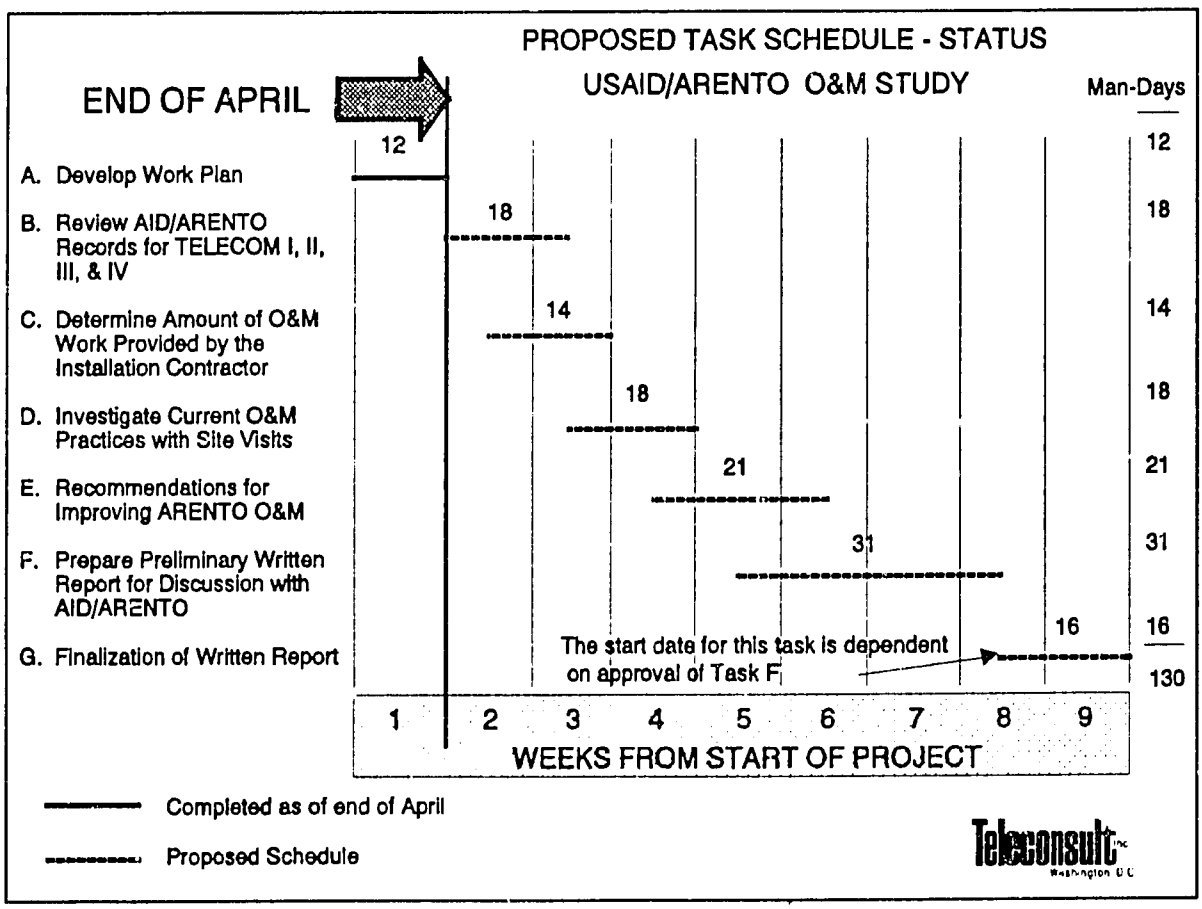
APPENDIX 1

TASK A - WORK PLAN AND GENENRAL COMMENTS

1.1 TASK A - WORK PLAN:

Objective - *Within one week of initiating work under the contract, the contractor shall prepare a workplan, for USAID and ARENTO review and approval, setting forth the sequence of activities, schedule, performance milestones, and personnel assignments and actions for each task.*

This section covers the Work Plan that was submitted to USAID at the end of the first project week. The Work Plan included a bar chart schedule by tasks and included the estimated work effort in man-days for each task. The bar chart is depicted below.



The Work Plan also covered the visit of all of the locations covered in Section 1 OF Volume 1.

1.2 GENERAL COMMENTS:

Several important observations should be made with reference to power plants in particular. While both Cairo and Alexandria have a high level of atmospheric pollutants which tend to clog filtration units and add impurities to the water supply which are crucial to the efficient operation of power plants, these conditions are even more pervasive in Cairo and require an even more diligent, labor-intensive O&M effort, in that city.

Second, whereas the No.5 ESS offices are relatively new - with power plants having been installed within the last two years and remaining under AT&T O&M oversight and control until ARENTO elects to final-accept these systems - the 1A ESS offices have been installed over a longer period of time, some dating back to 1983 and 1984. After 9-10 years of operation, it is normal to assume that battery cells, inverters and rectifiers will begin to reflect signs of aging. This again requires greater O&M efforts to detect early-on a failing component of the power plant before it adversely affects switch operation. This fact also supports the need for ample spares of components with observed failure rates that are higher than normal and for failure detection tools that allow for preventive maintenance of power systems. All told, this will go a long way toward extending the useful life of aging power plants to their 15 year life expectancy and toward avoiding costly replacements of total plants and their related switch system components that are adversely affected by faulty power supplies.

Finally, the condition of the commercial Egyptian 380V AC power is not constant within and between parts of either Cairo or Alexandria. AC source interruptions are unpredictable and depend on the amount electrical installation activity going on in any particular part of the city, as well as the overall integrity and operational safeguards that may have been built into one part of the city's system, but not yet to other sections. As a result, the diesel generators at certain ARENTO sites may have logged considerably more running time and would exhibit a higher level of oil leakage or spare part consumption. Likewise, certain battery plants may have discharged their loads more frequently and may show more accelerated levels of aging (scaling of battery plates, the inability of individual cells to maintain a constant charge, etc.). Consequently, it is imperative that O&M personnel identify individual components within given power plants that may require replacement in the near future. Also, they must have ample and readily available spares and tools that will allow for the selective substitution of certain cells, capacitors, or other subcomponents at a greatly reduced price than overall system replacement. Specific recommendations as to observed trouble areas and suggested supplies/tools required for an effective power O&M program are found in 2.3 of this report.

APPENDIX 2

TASK B - REVIEW OF RECORDS AND DOCUMENTATION

2.1 GENERAL:

Objective - *Obtain from and/or review with ARENTO and AID all necessary records and documents defining the work performed under Telecommunications I, II, III and IV, including:*

1. *Contract Documents*
2. *Technical Specifications*
3. *Job History Reports*
4. *O&M Records*

All of the documents and records that could be obtained for the switching systems, power, outside plant, fiber optic and transmission systems were obtained from AEWNTO and AID in accordance with the SOW and the Work Plan as covered below.

2.2 RECORDS AND DOCUMENTATION :

The following records and documentation relating to the provision of switching equipment were made available:

a. Telecom I, II and III.

Contract ARENTO and AT&T International - Design Furnishing - Installation - Central Office Switching Facilities for Cairo and Alexandria - Turn-Key Basis

Volume I Contract Form and Terms & Conditions Feb.1982

Invitation to Bid Volume II AT&T International Dec.1980

b. Telecom IV

Contract ARENTO and AT&T International - Design Furnishing - Installation - Digital Electronic Central Office Switching Facilities - Cairo Telephone Exchanges of Pyramid West and El Kalaa.

Volume I Contract Form and Terms & Conditions Aug.1990

Volume II Technical Specifications Aug.1990

c. Project Papers

Egypt: Telecommunications IV (263-0177) Sept.25 1988
Amendment: Egypt: Telecom.IV (263-0177) Feb. 12 1992
Amendment: Egypt: Telecom III (263-0117) May 1982

In addition, AT&T 1A ESS Consultant's Monthly Summary, and various ARENTO power routine maintenance reports were provided.

Ford Aerospace, under contract to ARENTO, engineered, furnished, installed and maintained the OSP networks for the six exchanges involved in this undertaking. The Terms, Conditions and Technical Specifications associated with this contact were reviewed in detail to ascertain the type, degree and adequacy of the O&M program, including training, that was provided under this agreement. No additional documentation addressing O&M for the time period involved could be obtained.

APPENDIX 3

TASK C - CONTRACTOR - O&M WORK, PROGRAM AND TRAINING

3.1. CONTRACTOR RESPONSIBILITIES - O&M:

Objectives - *Review the obtained project documentation annd, as a minimum, determine the following:*

3.1.1 O&M Work performed by Contractor:

What amount of O&M work was performed by the installation contractors after provisional and final acceptannce of the installed equipment and materials?

Switching Equipment.

a. Telecom I,II,III Projects

In the Telecom I, II and III projects, the switching contractor was contracted to provide one year maintenance at each office after the final testing and the cutover into service was accomplished.
The daily and monthly O&M routines performed by the contractor were precisely those laid down in the office maintenance manuals.

It was not possible to establish if the Contractor performed extra maintenance after the contracted one-year period. It should be noted however that there is an AT&T contracted person who is
always available to support the ARENTO 1A ESS O&M staff when required. This person has maintained this position since all these offices were cut into service.

b. Telecom IV Project

The contractual agreement calls for one year maintenance from the Contractor. Both El Kalaa and Marioteyah have been in service for almost two years and although the one-year maintenance period has long since expired, it is understood that neither of these two offices have been finally accepted by ARENTO. Both offices are monitored by AT&T personnel on a full time basis from the COM Center in the El Kalaa building.

The Heliopolis III office is still under the AT&T one-year warranty and maintenance period.
See Annex 1.2 for preventive maintenance schedule for No.5 ESS switches.

Power Equioment.

Very little, if any, installer documentation relates to power. With the 1A ESS installations, there are no records that date back 10 years. ARENTO stated that these records have long since been disposed of and were therefore not available. ARENTO staff did manage to fill in the blanks by recounting through personal memory and numerous interviews what the respective roles of ARENTO and AT&T were at the time of installation and subsequent periods. ARENTO Power Engineer Hassen, who has been in his present position for the last seven years, also helped to reconstruct more recent history relevant to the 1A ESS and No.5 ESS installations. From all available data, it appears that AT&T-hired contractors remained on site at each switch/power installation for a contracted period of one year after provisional acceptance. AT&T provided contract options for these personnel to remain for extra years beyond the one year maintenance period, but these options were not picked up by ARENTO. Instead, ARENTO insisted that AT&T provide maintenance support until all outstanding items were corrected. At that time, ARENTO finally accept the installations and AT&T was released from its obligations.

During the one year maintenance period, AT&T provided all power maintenance work, which would include checking battery electrolyte levels, cell temperature readings, maintaining power plant cleanliness, checking low voltage alarm circuits, etc. (see the following text for full power O&M responsibilities actually performed, as well as those suggested to be added to routines).

ARENTO personnel from the power O&M group would periodically visit switch sites to take an accounting of the condition of the plant they were to accept, to learn power particulars from the AT&T contractor, but never to take an active role in the upkeep of the plant until after final acceptance. In cases where a switch has gone beyond the one year maintenance period and is not yet finally accepted by ARENTO, this could pose a problem, since it is unclear who is taking active responsibility to maintain power systems at those locations (see the following text and comments on Mariotiyia and El Kalaa). At present, with all No.5 ESS locations, AT&T is employing a company called J.T. Smith, which does not provide a continuous on site presence. They are available for call-out, but it is unclear as to who would respond at those sites which have exceeded the year maintenance period but have not been finally accepted. At the time of switch/power hand-off from AT&T to ARENTO O&M responsibility, AT&T provided a suggested list of routine maintenance activities associated with power plants. In addition, each 1A ESS site was equipped with a full set of Bell System Practices which detail the operation and maintenance of batteries, inverters and rectifiers. However, it is understood that ARENTO, who consider that they have more than sufficient expertise in the power business, have used AT&T's input on power O&M procedures as a means to modify or supplement their pre-existing program, as they saw fit. In cases where AT&T introduced new generics or varieties of generators, rectifiers, etc. (for example, No.5 ESS diesels have digital control panels with more elaborate diagnostic systems), ARENTO would

learn the operation of new types of power systems from AT&T and incorporate these unique procedures or operating instructions within their pre-existing O&M methodologies.

Outside Plant.

For exchanges Zamalek, Bab-El-Louk, Heliopolis, Gleem, Auto & Ibrahimia, Ford Aerospace maintained all OSP systems for the period between Provisional and Final acceptance or at least 12 months which will be called the "Guarantee Period". Following the Guarantee Period, ARENTO contracted with NSPO to provide extended maintenance in all six exchanges for various periods between one and two and one half years. During the Guarantee Period, each exchange area was maintained as a fully operational system from the line side of the MDF to the DCT's, inclusive, for local plant and from the MDF to MDF for junction plant. Local loops and junction circuits were maintained within acceptable limits of a performance level established at the time of provisional acceptance which included the following performance criteria :

- Noise (NM & NG)
- Power Influence (PI)
- Structural Return Loss (SRL)
- Longitudinal Balance
- Insertion Loss
- Ground Resistance
- DC Loop Resistance & Unbalance

Fiber Optic and Transmission Equipment.

Information obtained via interviews with ARENTO personnel indicate that the contractor operated and maintained the fiber optic network satisfactorily during the one year "Guarantee Period". ARENTO contracted with the Belsam Co. for an additional one to two years of maintenance.

3.1.2 O&M Program Developed by the Contractor.

What type of O&M programs was developed by the installation contractors? Was it adequate and is it being followed?

Switching Equipment.

The type of O&M program developed by the switching contractor is based on the standard routines and practices as specified for the particular switching equipment under discussion i.e. No.1A ESS and No.5 ESS. This type of O&M program is, in all respects, the same as that used in the United States where millions of lines of these two types of switching offices

are in-service.

This program is completely adequate when performed in accordance with the routines and schedules established by the manufacturer. From observations, conversations and the maintenance records made available, the contractors' O&M program is being observed and complied with in each office.

Power Equipment.

AT&T provided both formal course training back in the U.S. for ARENTO power engineers and on-the-job instruction at installation sites, as required. With the 1A ESS contracts, AT&T provided a D.C. power course only. Between Cairo and Alexandria O&M, it appears that only a handful of engineers received this training, and they were left on their own as to obtaining diesel generator training. ARENTO operates its power groups with two categories of personnel;i.e., graduate power engineers and technicians. ARENTO found the D.C. power course to be more suited to technicians than engineers. Because these courses are taught in English, only, ARENTO would pre-certify who was most suitable to attend, based in large part on the individual's ability to understand English. This does not necessarily ensure that the personnel most needing formal training would receive it. Perhaps an engineer with a good grasp of D.C. fundamentals would be most proficient in English and would thus be selected to attend stateside course training.

Conversely, a technician who knows little English would not be sent, but could have benefitted the most from the coursework had he or she been able to understand the language. With the No.5 ESS program, training has been supplemented to include diesel training, as well as D.C.coursework. The issue of language proficiency remains and will continue to remain, since the universal language used in telecommunications literature, instructions, manuals, specifications, etc. is English. As to spare parts provided by AT&T, contractual obligations required the installation contractor to provide ample spares to support the one year maintenance period. Beyond that, there were options to buy spares for an extended three years at set prices. ARENTO stated that they had found flexibility in working with AT&T in order to adjust what items and amount of items were provided under the one year allotment of spares, based on ARENTO's past experience as to the life cycle for selected components and sub-components operating in the Egyptian telephone system. Thus, over the years, provider and client have mutually established an ample set of spares for power systems. ARENTO has established its own spares warehousing facilities and distribution network for power supplies.

Outside Plant.

A program to effect the above stated maintenance was established by the contractor. This program consisted of three types of maintenance as defined below:

a) Preventive maintenance conducted on a regularly scheduled basis to detect

and clear sources of potential trouble before they affect service.

b) Routine maintenance to identify and improve circuits with performance levels outside acceptable limits.

c) Extraordinary maintenance required to locate and repair cable or equipment damaged by ARENTO, third parties or force majeure. Relative to the preventive and routine aspects of the program, the contractor made test measurements, on a quarterly basis, on each local loop or junction circuit in each exchange area. Examples of these tests are as follows :

- Identify and locate reported faults
- Test ringers
- Verify that line is connected to station equipment
- Test and measure loop resistance
- Test transmission of junction circuits
- Test for foreign potential
- Measure voltage on line
- Insulation resistance test between wires and between wire and ground
- Dial test

Where available contractor used test data provided by #1ESS switches. Generally, all maintenance work was handled on a priority basis with the restoration of service the first priority. One maintenance objective during the Guarantee Period was established at less than a 2% trouble report rate. This report rate was calculated on the number of subscriber trouble reports per month for each 100 working lines. A second objective was the clearing time following a service outage. This was set at clearing half of all troubles within 2 working days of report and the remaining half within 6 working days. The overall operation and maintenance program implemented by the installation contractor, during the Guarantee Period, is viewed to have been adequate and comparable with programs of the same level of technology and expectations.

Fiber Optic and Transmission Equipment.

To satisfy contractual obligations, Ford Aerospace developed and furnished ARENTO, an O&M manual entitled "Operation and Maintenance Handbook, Fiber Optic Inside/ Outside Plant Facilities for Cairo and Alexandria". The structure of this O&M handbook is as follows :

Chapter 1 - Contains introductory material, describes the handbook purpose, content and structure and identifies the documentation that has been delivered to support installation, operation and maintenance of the Fiber Optic cable and its associated equipment.

Chapter 2 - Provides a description of the Fiber Optic cable systems by specifying C.O. locations and internetwork paths.

Chapter 3 - Provides equipment description, installation, operation and maintenance for the DE-3/DE-4 PCM Channel Bank equipment. It includes vendor documentation supplemented by material that defines the specific ARENTO configuration and application.

Chapter 4 - Provides equipment description, installation, operation and maintenance for the RDM-428 Digital Multiplexer. It includes vendor documentation supplemented by material configuration and application.

Chapter 5 - Provides equipment description, installation, operation and maintenance for the M-90 Fiber Optic Terminal. It includes vendor documentation supplemented by material that defines the specific ARENTO configuration and application.

Chapter 6 - Provides equipment description, installation, operation and maintenance for the RDS 1010 1:N Protection Switch. It includes vendor documentation supplemented by material that defines the specific ARENTO configuration and application.

Chapter 7 - Describes the Fiber Optic Cable and provides installation and maintenance instructions.

Chapter 8 - Describes the manholes, handholes and duct system and provides safety, inspection, maintenance and repair guidelines.

Chapter 9 - Describes equipment and cable installation and provides copies of installation standards and practices.

Chapter 10 - Describes the special tools needed to accomplish maintenance.

3.1.3 O&M Training Provided by the Contractor.

What type of O&M training was provided to ARENTO employees by the installation contractors?

Switching Equipment.

O&M training is dealt with here, in two parts, and also under Sections 5 and 6 which address the problem of adequacy of staff and training recommendations.

Telecom I, II and III Projects.

Contractual obligations called for the training of personnel in sufficient numbers to allow

ARENTO to meet the complete operations and maintenance requirements at each of the new offices covered by these three projects. The available documentation and records do not provide sufficient information to allow an estimate to be made of the actual number of people trained for O&M work, either in the USA or in Egypt. However, from site visits and discussions with the O&M staff, it would appear that all 1A office O&M supervisors received extensive training in the United States, generally lasting a period of about 9 months. This training covered not only the functions and operation of the 1A machine but also provided general instruction in the field of telecommunications.

In addition, a 1A ESS training unit was set up at the ARENTO training school for instruction in Egypt. No firm figures are available as to the actual numbers of personnel that have attended this particular school or the numbers that have received on-the-job (OTJ) training but during the site visits, it became clear that each 1A switching office is staffed by a supervisor with USA training (9 months) and 3 or 4 technicians who have received OTJ training.

Telecom IV Project.

The training requirements as specified by ARENTO call for the contractor to provide the numbers, types and qualifications of instructors, and the number of man-months required to produce an output sufficient to properly staff all maintenance and operations jobs. Arento requested in their Request For Proposal (RFP), that all personnel needed to initially staff the maintenance and operations functions for all offered equipment undergo their training abroad.

From information received from ARENTO, 8 people have taken a 3-month No.5 ESS training course in the USA. For the 3 switching centers involved, this would appear to be sufficient. These trained supervisors are now providing on-the-job (OTJ) training in these offices, however, this OTJ training does not appear to be planned by ARENTO management and has no official schedule. It appears to be the sole responsibility of the exchange supervisor.

It is understood that the training given to the original 1A ESS trainees lasted a period of 9 months and included not only O&M instruction on the 1A ESS but a course in telecommunications in general. The No.5 ESS students receive 3 months instruction in only the necessary O&M for the No.5 ESS equipment. There is no immediate explanation for this variance between courses, however, it does make the selection of suitable trainees for No.5 ESS training all the more important, because obviously, they must already have reached a suitable level of education and have the necessary experience and background in telecommunications before taking the No.5 course.

Outside Plant.

The contractor was responsible for preparing and conducting a training program that

provided ARENTO personnel with the knowledge and skills necessary to expand, repair and maintain the Outside Plant Network following the end of the Guarantee Period plus any period of contract maintenance. The training developed by the contractor incorporated formal classroom instruction in Egypt (ARENTO TTRI) and in the United States as well as on-the-job training on the use of U.S. technologies and methods. The course was designed in a modular format with class sizes in the 8-12 range. The students were required to have education, experience and language profiles consistent with the level of course material taught. The contract allocated training for 201 students ranging in type from electrical engineers to craftsman.

ARENTO made all student selections and required that 80% of the trainees meet 80% of the performance criteria for each course taken before a "Certificate of Completion" for the training program was issued.

Training Modules Training Instructors

ARENTO personnel were trained as instructors in civil works, splicing and installation, and testing and maintenance. In addition, they were provided with instructional materials, training aids and documentation concerning the system components, their functioning, fault locating techniques and repair and maintenance procedures. This material also contained performance objectives and evaluation criteria for each course. Following is a breakdown of material and test equipment provided by the contractor and used for training purposes:

- Modules and handholes.
- Conduit
- Cable
- Load coils and buildout capacitors
- Spices closures
- Splicing tools
- Serving Area Interface (SAI) and Distribution Cable Terminal (DCT)
- Wire, U-Guards and mounting hardware
- T- Carrier Equipment
- Test Equipment

<u>OSP Planning Methods Course</u> - This course provided the knowledge and methodologies necessary for performing long range planning of outside plant systems. Upon completion a student should have been able to prepare a twenty year local and exchange network plan based on traffic matrices, determine junction circuit requirements in five year increments including new direct trunks, define five year incremental budgets using PWAC analysis and prepare a network transmission plan using voice frequency, T-CXR and fiber optic facilities. This training was conducted in U.S.

<u>Outside Plant Engineering Course</u> - This classroom training was offered in the U.S. to Engineers and Technicians, selected by ARENTO. The students were instructed in the

basic concepts of OSP engineering including construction drawing preparation. A student learned to identify all components of the OSP network and their relationship, interpret demand, design an addition to the network with correct transmission, cable and hardware considerations and prepare associated construction drawings.

T- Carrier Span Line Design Course - This course taught the basic understanding of digital transmission characteristics, including the ability to lay out a complete T1-C span line design using either single cable or compartmentalized cable applications. Design criteria encompassed the following :

- Cable pair assignment
- Repeater spacing
- Powering scheme
- Interrogation system
- Order wire
- Spare span line and automatic transfer system

Protection Civil Works Construction Course - This course provided the student with the knowledge to place manholes, handholds and SAI foundations as well as the techniques and methods of laying conduit in the various formations, sweeps and construction drawings and in using appropriate safety procedures.

Cable Placement Course - This course taught the skills required to place cable in underground ducts, install direct buried cable and make submarine river crossings including the operation, care and maintenance of tools and equipment. Also covered was the proper method for installing cables in manholes handholds, SAI's and DCT's.

Cable Splicing Course - In this course, the student learned to identify the component parts of a telephone cable, the color code system, read construction drawings, prepare cables for splicing, make straight and branch splices, test completed splice for faults, close splice with appropriate closure and connecting cable pairs to terminal blocks in SAI's and DCT's.

T- Carrier Installation and Repair Course - a student completing this course learned to install, operate, align, identify and correct fault conditions on T-CXR spans.

Cable Balancing Course - This course provided the necessary theoretical and practical knowledge to test telephone cable pairs for electrical balance and correct pair unbalanced where measured. The curriculum included instruction on cable capacitance and resistance, conditions that cause their unbalance and effects this has on circuit performance.

Cable Fault Location Course - This course taught how to use a digital cable test set and a wheatstone bridge to identify and locate grounds, crosses and splits. Insulation resistance tests and use of the test set for this purpose were also covered.

OSP Acceptance Methods Course - This course prepared a student to read and understand a contract to install an OSP network. This covered a wide spectrum including contractor responsibilities, material usage, units placed reports, inspecting and accepting all types of OSP units, as-built drawings and various forms and reports required for the inspection, acceptance and payment of a newly constructed network.

Station Installation and Repair Course - This course provided basic skills needed to install and repair station facilities including service wire, terminal blocks, telephone instruments, jumper wire, and the analysis, location and repair of faults in telephone installations.

Subscriber Loop Acceptance Testing Course - This course instructed students in the use of noise measuring sets, pulse echo instruments, level tracers, oscillators and voltmeters in order to make subscriber loop measurements of insertion loss, noise and open circuit measurements, including structural return loss and pulse return pattern methods.

Fiber Optic and Transmission Equipment.

Since contract documents for this system is not available for review, details of any contractor provided training could not be established. Meetings with ARENTO engineers that were familiar with the fiber optic network installation and contractor maintenance revealed a limited amount of training by Ford Aerospace. Most of the significant instruction on system O&M was said to have come from the Belsam Co. during a period of extended maintenance.

3.2 SPARE PARTS:

What constitutes "ample spare parts"?
Were warehouses and other facilities provided for O&M work?

Switching Equipment.

Telecom I, II and III Projects.

The spare parts storage center for all the 1A switching offices is located in the Bab El Louk building. This center maintains a minimum 3 years supply of spare parts for the 10 1A ESS switching centers in Egypt. In addition, some spares are kept in each office for immediate use, should an emergency situation arise.

The storage center is well organized and orderly in appearance, however, records are not computerized but kept in card files.

Telecom IV Project.

At the present time there is no centralized storage of spare parts for the No.5 ESS switching centers. This is due principally to the fact that these three offices, for all intents and purposes, are still under the maintenance supervision of AT&T. One of these offices is still under warranty. At each office, a complete set of spares are kept within the equipment room, and these are sufficient for one year operation.

After the final acceptance of each of these three switching centers, sufficient spares will be made available to meet 3-year requirements.

The quantity of spare parts provided by the manufacturer for each type of switching center is based on the reliability performance figures for the particular type of equipment supplied. These reliability figures are derived from the system design calculations and from extensive testing in the field. The compilation of on-site, in-service data during the first few years of regular operation is used to review the design figures and to allow for their finalization.

Assuming the environmental and operating limits and conditions as specified in the manufacturer's equipment specifications are observed, and the equipment is properly maintained in accordance with the detailed O&M standard practices, the types and amounts of spare parts supplied by the manufacturer for any particular office can be considered to be ample. It is recognized that during the first year of operation, the failure rate and therefore the quantities of spare parts required will be higher (cutover expectancy) than the requirements once the office has settled down (mature expectancy).

The supply of spare parts for the 1A ESS equipment maintained in the Bab-El-Louk storage center can be considered as "ample".

The design, and the built-in reliability, of the No.5 ESS equipment is such that the quantity and types of spare parts has been reduced to a minimum. The No.5 ESS has fewer circuit pack codes than earlier SPC-type equipment, which means easier maintenance and simpler administration of spares. The cutover expectancy of circuit pack replacements per 1000 lines per month was originally around 2. This reduced to 1 per month after the first year of service (mature expectancy). In recent years, these figures 0ave been reduced still further.

The quantities and types of spare parts specified by the AT&T for the No.5 ESS offices can be considered as "ample".

Outside Plant.

The contractor furnished, at the time of final acceptance, spare parts and consumables of the same standards of design and performance as those used for the initial installation. Spares were supplied in all material categories except manholes and handholes and were of ample quantities to support normal maintenance for an extended period.

ARENTO provided warehouse facilities in both Cairo and Alexandria that were used initially during construction and subsequently during the maintenance period. Adequacy can only be assumed at this point in time.

Spare parts for the six exchange areas under study, as well as the rest of the telecommunication network is stored at two locations in Cairo and one location in Alexandria. However, each exchange visited maintains a limited number of spares locally which is replenished via a requisition to the warehouse manager. The general consensus is that spare parts are not adequate in number or variety. New spares that are purchased are not of equal type or quality.

Alexandria, due to it's seaside location produces a corrosive climate that must be monitored constantly. SAI cable cross-connecting blocks in the Gleem Exchange are experiencing major breakdowns, the cause of which has not been confirmed. Corrosion is suspected but manufacture defect is not ruled out. Serious shortages now exist in this type material. In both areas spare parts designated for maintenance are used for impromptu cable and terminal extensions resulting in further depletion of the inventory.

Fiber Optic and Transmission Equipment.

It is reasonable to assume that the contractor provided levels of spare parts consistent with the contract and viewed to be adequate. Spare parts were stored at ARENTO provided warehouse facilities in both Alexandria and Cairo during construction. Currently, most spares are located at the equipment repair laboratory in Cairo.

APPENDIX 4

TASK D - SITE VISITS AND REPORT

4.1 SITE VISITS AND REPORT:

Investigate current O&M practices. Make site visits to exchange facilities, maintennance facilities and training facilities in both Cairo and Alexandria.

All of the offices listed in Section 1 were visited and all aspects of operations and maintenance pertaining to their particular equipment were discussed with the O&M supervisors. In addition, visits were made to the ARENTO Training School and to the three Fault Clearance Centers now in operation in Cairo and Alexandria.

Switching Equipment.

All the 1A ESS and No.5 ESS switching centers were visited during the third and fourth weeks of this study. The following abbreviated notes provide a general commentary on those visits.

Equipment Rooms

The 1A ESS equipment rooms are generally dusty and tend to be untidy. Only in Alexandria was there an exception to this general observation. It should be noted that the amount of dust in the air is noticeably less in Alexandria than in Cairo. Air conditioning units are all working and in some locations their numbers have been increased in recent months, such as in New Maadi. It is noticeable that equipment room doors are left open at times, generally because the O&M personnel have lost, or never had, a magnetic card to operate the security locks on the doors. An open door plays havoc with the air pressurization of the equipment room and throws an additional load on the air conditioning units. The design of the 1A ESS equipment does make use of electro-mechanical relays on certain frames which are vulnerable to dust. Tape units also, although they are enclosed, can eventually be affected by dust in the air. In New Maadi, pla0tic sheeting is in place over certain equipment frames to keep down the amount of dust getting to the equipment.

At two 1A ESS offices, problems with rodents getting into the equipment rooms were reported!

The three No.5 ESS switching centers are all comparatively new and placed in service within the last two years. The equipment rooms are clean and orderly. This particular type of equipment presents an exceptionally neat and orderly layout of equipment, being totally enclosed with all cabling concealed as much as possible. However, appearance is not the main reason for the No.5 ESS switch design. The doors on the front and back of the switch

are designed to:

- Uniformly cool the unit. The switch is air-cooled, which increases the reliability of the components. When a switch is air-cooled, the components last longer because it runs cooler.

- Increase the ability to contain electro-magnetic radiation.

- Protect the electronics.

The doors keep dust and dirt away from the equipment and O&M personnel cannot brush against the electronics as they walk past. The doors are therefore cost-effective.

Security devices on all doors are being used and the air conditioning of the whole e0uipment area is good.

One problem encountered at Marioteyah concerns the raised floor upon which the No.5 ESS equipment is installed. This floor, which was manufactured in Egypt under license from an Italian company, is already showing signs of surface irregularities.

Building problems in general

All telecommunications buildings visited were dirty, untidy and unkept. Doors are generally left open all day, and in some cases, the windows also. Due to the location of the commercial offices, and offices for the technical staff within these buildings, there is a steady stream of people passing in and out all day. Under these conditions, dust, dirt and maintaining a clean and conditioned equipment room must be problems.

O&M staffing

The general impression received at each location is that the O&M staff are qualified and capable of maintaining the equipment in accordance with manufacturer's standards. Office supervisors have all received training in the USA and their support staff have all received OTJ training. In the case of the No.5 ESS centers, the supervisors are now providing staff with OTJ training.

Some 1A ESS supervisors expressed doubts as to the adequacy of the OTJ training and this is considered in 1.4.3.

The O&M staffing of a 1A ESS office calls for a supervisor and three or four support 0ersonnel during regular working hours. When these offices are unmanned, the 1A ESS COM Center at Ramsis, which monitors the operation of all the 1A ESS offices on a 24-hour basis, takes over the supervision of all these centers.

The No.5 ESS offices which are also unmanned after normal working hours, are monitored and supervised from the COM Center, installed in the El Kalaa building, by AT&T personnel with ARENTO people in attendance.

There is a tendency to overstaff both the 1A ESS and the No.5 ESS offices. One important purpose of the COM Center is to reduce the personnel requirements at the switching centers it monitors. Nevertheless, ARENTO maintains a full O&M staff at each office during normal working hours.

It is interesting to note that although the last 1A ESS office was placed in service in Egypt in 1987, AT&T still provides a 1A ESS O&M Consultant. He is located in the Ramsis COM Center and apart from the routine task of providing OTJ training and generally monitoring the ARENTO maintenance of these 10 offices, he is also available for emergency situations, should they arise.

Other Observations

At each of the 1A ESS offices, the supervisor was asked if there was any suggestion, comment or recommendation they wished to make which would help to improve the operation and maintenance of the equipment. In every case the response was about the same - everything is fine. However, everything is not fine if one analyzes the performance data given out by the machine. There are problems which originate outside of the office and if these problems are allowed to continue, there will come a time when the performance of the switching equipment will be affected. These problems are discussed in Section .5.

The disturbing fact is that although the 1A ESS O&M staff appear to be aware of these problems, and the office performance sheets are available for analysis by the pertinent ARENTO staff, as far as can be discovered, no action has been taken to solve these problems.

Power Equipment.

Certain broad generalities can be made about the overall state and condition of each 1A ESS and No.5 ESS power plant. AT&T has installed turn-key facilities, and ARENTO has not altered or modified the basic make-up of any given plant. AT&T's role was to install and provide initial O&M; ARENTO's role has been to continue with the ongoing operation of fully accepted plants. It is obvious that the power and generator rooms have been properly maintained and that the plants are performing as expected and appear to be able to reach their full life expectancy without wholesale changeout of major numbers of power components.

In general, each 1A ESS power room looks the same as any other 1A ESS plant, and the same can be said of the No.5 ESS power systems. AT&T was consistent in its installation of Bell Regulation cables, connectors, power distribution boards, etc. Although different

sites required different floor layouts, given the nature of the individual buildings selected to house both the switches and adjunct power supplies, all the same components of a basic power plant were consistently engineered and delivered uniformly. Each power plant visited is operating in accordance with specifications. As mentioned in 2.1 above, Cairo's overall climate and operating environment are harsher to deal with than that of Alexandria. Consequently, Alexandria offices appeared to be more sanitary and less prone to pollution problems.

While Cairo buildings as a whole were more contaminated from dust and dirt. all ARENTO-maintained power rooms, where separated from the switching equipment, were generally clean and in good repair.In both city areas, power O&M personnel take great pains to ensure that only pure, distilled water is used in battery cells. Although AT&T installed water distilling plants as a part of the turn-key operations at each site, most units were not in operation, because of problems in consistent water pressure or availability at those sites. Cairo personnel would carry water from a centralized distilled plant to each power room. Alexandria has distilled water provided from a medical supply firm.

Criteria for judging the adequacy of ARENTO's power O&M practices were derived from both the power manufacturer's operation and maintenance manuals and from the AT&T power practices. Recommended operating procedures were derived from both sources and uniformly compared to the actual practices and conditions found at each of the 1A ESS and No.5 ESS sites, as well as through interviews with ARENTO power engineers. These criteria encompass the categories of operational review detailed in the following text.

Battery Plants

In general, all 1A ESS and No.5ESS battery strings had the following positive characteristics of proper installation and O&M:

- electrolyte levels were between high and low marks
- proper cable support clamps were used
- cells were numbered for reference and record keeping
- no corrosion on connectors, nuts, bolts or washers
- no cell cracks
- only a handful of electrolyte spills on cells
- clean vent caps and cell surfaces
- cell temperatures within recommended operating ranges
- all connections were tight
- racks were properly grounded
- no bootleg cabling added after installation
- standard racks were in good condition
- no excessive gassing of hydrogen
- almost all battery plants had 8-hour capacities which is well in excess of actual plant loads although Marioteyah and El Kalaa were close to actual

load.

A. Environmentally:

- room ventilation was adequate and operational
- room temperature was controlled and within recommended range
- working access to cells was adequate
- cabling distances to switch were within spec
- no leaking pipes overhead
- floor loading was within weight tolerances
- HVAC and louvered panels provided venting of gas to outside

B. Safety:

- eyewash stations were available and accessible
- fire extinguishers were readily available

C. Accessories, Procedures, Maintenance Routines & Records:

Both Cairo and Alexandria power O&M personnel kept a number of standard battery plant fixtures and records in a centralized location. This was due to the fact that both power organizations were centralized groups that traveled to individual switch sites to perform routine maintenance. No one assigned to an individual switch site was authorized to perform any work on power systems.

While individual sites may have limited supplies of fuses, grease, etc.; as a whole, the power O&M personnel carried their tools, supplies and engineering data with them to the sites being maintained. Each 1A site had a complete set of Bell Practices, which provide proper guidance in the upkeep of power plants. These same practices could not be found in the No.5 ESS offices, although ARENTO had not yet assumed O&M responsibilities at those sites.

A review of both Cairo and Alexandria routine maintenance programs showed that an acceptable level of basic O&M work was being conducted with respect to monitoring electrolyte density/specific gravity, electrolyte levels, cell temperatures, connector integrity, corrosion, pilot cell voltages, and string voltages; as well as to cleaning battery cells, connectors and their associated components (vent caps, racks, cables, etc.). All activities conducted were appropriately documented, with copies of the same going to the switch supervisors and Engineer Hegazy (for Cairo, only).

D. Battery Plant Discrepancies

The following operational anomalies were observed with respect to certain battery strings:

◦ scaling of lead plates and accompanied sediment deposits were observed at the following sites. In general, +24 volt strings seemed most susceptible to these conditions:

*Bab-El-Louk +24v (8 year old site)
*Maadi, limited throughout (10 year old site)
*Heliopolis II, +24v & -48v D pitted (7 year old site)
*Abbassia, minor on +24v/1 or 2 -48v cells (6 years old)
*Zamalek, nearly none (9 years old)
*Ibrahamia, pervasive throughout all end cells (8 years)

◦ plate expansion on end cells at the following sites reflects signs of aging:

*Maadi -48v E string, only
*Zamalek, minor throughout
*Auto, minor throughout (9 years old)
*Gleem, minor throughout (8 years old)
*Ibrahamia, minor throughout

◦ environmental cleanliness affects the likelihood that contaminants will be introduced into cell electrolyte (reducing the useful life) and dry out connectors (increasing the likelihood of corrosion and voltage depletions), and was observed at:

*Mariotiyia- a new No.5 ESS. (thick dust)
*El Kalaa- a new No.5 ESS. (light dust)
*Heliopolis III- same condition as El Kalaa

◦ windows in the battery room should be painted over, so that direct sunlight will not fall on cells and affect their temperatures. The No.5 ESS sites at Mariotiyia, El Kalaa and Heliopolis III had clear pane windows that should be darkened.

◦ floor drains were not readily adjacent to the battery strings or available to allow for flushing of spilled acid from electrolyte (either from overfilling or cell cracks), except for the newly installed No.5 ESS's. This could cause toxic problems or personal injury as the 1A's age, especially at sites such Bab-El-Louk or Zamalek where people spaces and other equipment are located below the battery plant's floor.

◦ safety equipment was generally missing at all locations. Each site had eyewash stations and fire extinguishers. While power O&M personnel stated that they brought the needed safety gear with them, when working on batteries, AT&T had provided gloves, goggles, sodium bicarbonate solution to neutralize acid, aprons, and first aid kits for each site. In cases of emergency leakage of older cells, when power O&M personnel are not readily on site and switch site personnel may attempt to contain

a hazardous condition, these items should be readily available. In addition, there was an absence of any "No Smoking" signs at all sites, despite the fact that some battery strings were adjacent to switch rite people areas. Hydrogen gas is released from batteries and present a readily flammable work environment.

∘ room temperature for batteries should be between 70 and 80 degrees F. Ibrahamia was cooler than that range, and random cell readings showed temperatures as low as 64. Unusually low temperatures can cause reduced battery capacity. The HVAC system at Gleem was not operational at the time of the site visit, with room temperature at around 80 and random cell readings as high as 78. This is believed to have been a temporary anomaly, although battery life can be reduced when temperatures consistently stay above 80 degrees F.

∘ O&M personnel should have complete and easy access to all cells for purposes of routine or emergency maintenance. AT&T had clearly laid out battery strings to meet that requirement. However, loose gear, boxes, equipment, furniture, etc were obstructing access at Maadi, Abbassia and Ibrahamia.

∘ visual inspections of most all Cairo 1A ESS sites reflected a general shortage of cell thermometers, hydrometers, and routine maintenance tools (such as non-metallic & paint brushes, insulated torque wrenches, clean rags or sheets), although ARENTO indicated all required materials were centrally stored.

∘ maintenance records failed to indicate whether regular plant routines were being performed in the following areas:

* check voltage on each cell (quarterly)
* detailed visual inspection on each cell (annually)
* check all bolt connections and torque per IEEE 450. After torquing, check resistances of each cell-to-cell and cell-to-terminal connection and record findings (annually)
* check integrity of racks (annually)

Rectifier Plants

All AC to DC power plants had sufficient rectifiers to charge all batteries plus leave one spare for full-float charge operation. The rectifiers operated in parallel and shared the load power requirement. All +24v and -48v rectifiers were operating within spec as to the following measurements and operational characteristics:

∘ typical 1A ESS +24v plants had 3-5 200 amp rectifiers with plant loads ranging from a low of 260 amps at Gleem to a high of 520 amps at Heliopolis I. In each case, plant loads supported by the rectifiers were less than 50% of the total rectifier capacity. Typical plant voltage was 26 volts (26v/12=2.2v

per cell). Each rectifier was specified as to amps of AC input/DC output, which was in conformance with the battery plant as a whole. Battery amp-hour discharge exceeded the recommended minimum of being at least 4X the charger rating. All rectifiers had AC/DC breakers for disconnect. All rectifiers had capacitors to retain electrical loads during disconnect.

- typical 1A ESS -48v plants had 7-9 180 amp rectifiers with plant loads ranging from a low of 250 amps at New Maadi to a high of 600 amps at Gleem. In each case, plant loads supported by the rectifiers were less than 50% of the total rectifier capacity. Typical plant voltage was 52.5 volts (52.5v/24=2.1v per cell). Each rectifier was specified as to amps of AC input/DC output, which was in conformance with the battery plant as a whole. Battery amp-hour discharge exceeded the recommended minimum of being at least 4X the charger rating. All rectifiers had AC/DC breakers for disconnect. All rectifiers had capacitors to retain electrical loads during disconnect.

- typical No.5 ESS -48v plants (the only voltage used with these digital switches) had 9-10 200 amp rectifiers, while the new No.5 ESS at Heliopolis III had only 6 200 amp rectifiers, as it was only equipped with 20,000 ports. Heliopolis III had a plant load of 550 amps, while El Kalaa ran at 800 amps and Mariotiyia supplied 1000 amps. In each case, plant loads supported by the rectifiers were 50% or less of the total rectifier capacity. Typical plant voltage was 52-52.5 volts (52.5v/24=2.1v per cell). Each rectifier was specified as to amps of AC input/DC output, which was in conformance with the battery plant as a whole. Battery amp-hour discharge exceeded the recommended minimum of being at least 4X the charger rating. All rectifiers had AC/DC breakers for disconnect. All rectifiers had capacitors to retain electrical loads during disconnect.

Interviews with power O&M personnel and reviews of power routines indicate that ARENTO is proficient in checking output voltages, adjusting individual rectifiers outputs to better load balance the entire rectifier plant by use of the thumb screws, checking no/full load switching, checking power distribution board readings for plant load and DC output voltages, checking fuse protection circuits, calibrating meters with voltmeters, and checking both the high voltage and low voltage alarm circuits. As with the battery records, routine maintenance performed was adequately documented and shared with both the switch supervisor at each site and the O&M manager in Cairo.

A. Rectifier Discrepancies

The following operational anomalies were observed at specific sites visited during the O&M review:

- Maadi's +24v rectifier bay 2A/lineup 0003 was running very hot and showed over

200 amps being provided from this one rectifier. This amounted to over one-half of the total plant load, which was an excessive burden. The power technician who accompanied the visiting study group attempted to balance the load between the four rectifiers, but he had no success. The questioned rectifier was also humming excessively, and it is questioned whether the rectifier was exceeding the recommended specification of "less than 65 dBA at a point 5 feet above floor and 2 feet in front of any rectifier." It is questioned as to whether the rectifier, if left uncorrected, would introduce excessive noise to the switch equipment, itself. There was no noise monitoring equipment available to test for this condition, while at the site, nor was there any heat monitoring test gear. This rectifier must receive some maintenance attention, or ARENTO may face costly equipment replacement in the not too distant future.

- Heliopolis II's +24v rectifiers were also humming excessively, although there was not the same overheating problem that was detected at Maadi. Refer to the Maadi commentary (above) in order to understand the possible operational problems this condition could introduce to live traffic.

- Heliopolis III's G2 -48v rectifier was also running very hot, and its digital amp meter was not operational. This power plant is still under the No.5 ESS warranty period, and the on-site AT&T O&M person indicated that he would have the trouble called-out to the O&M power contractor.

- access to the inside of rectifier panels revealed the need for more cleaning around power contact areas. The majority of rectifiers were locked and not accessible for internal maintenance assessment.

- Cairo and Alexandria power engineers indicated that they take individual cell voltage readings on regular schedules and by means of discharging whole batteries taken off of rectified AC power. Given the high number of commercial 380v AC power interruptions (both planned and unplanned), rectifiers and their adjoining battery strings are already undergoing a high number of discharge and equalizing charge (recharge) cycles. The frequency of these day-to-day demands on both rectifiers and batteries can lead to shorter life expectancy of these power system components. Alexandria power O&M indicated that in addition to the discharging/recharging cycles that occur in response to commercial outages, they are discharging, equalizing and taking cell voltage readings on a monthly basis. It is surmised that this monthly process is imposing too much of a demand on rectifiers and batteries, given the age of the plants and the nature of unstable commercial power. The combined effect is to hasten the deterioration of existing power systems. As an example, it was noted that the Ibrahamia batteries had a much higher level of scaling and sediment deposits, than other sites visited.

In contrast, Cairo power indicated that the discharge/recharge cycle is conducted every six

months. This may be too infrequent, given the age of some of the power plants, where O&M personnel should be paying closer attention to individual cells that are showing signs of deterioration. A recommended solution for both cities is to adjust to quarterly schedules for individual cell voltage discharge readings. In addition, AT&T is providing stationary battery chargers with the installation of the No.5 ESS power plants. ARENTO now has an additional tool that can be used in isolating individual "trouble cells" from the whole string, without having to excessively discharge/recharge whole strings for cell voltage readings or equalization requirements. Refer to the "Recommendations", Section 2.3 of this study, for particular guidance on how to maximize 1A ESS power life expectancy through the use of the battery chargers and spare cells.

Converters

In general, the 1A ESS 130v DC to DC converters were in good operational order. Only minor loads of 130v power are required for switch testing capabilities. All converters observed are self-contained units requiring little maintenance or upkeep. Power O&M records indicate that personnel are monitoring required output voltages, as well as high and low voltage alarm circuits, as is recommended. Meters appear to be calibrated, and the converters do not appear to show any signs of aging, leakage or malfunction. As with any other piece of power equipment operating in the Egyptian environment, diligence to cleaning, air ventilation, etc. cannot be minimized, in order to maximize life expectancy, which appears to be good at present.

Inverters

All sites visited employed Lorain 5 KVA inverters. New No.5 ESS sites have state-of-the-art small, self-contained units which are maintenance-free and solid state units that would be replaced in whole, upon failure. 1A ESS sites utilize the older, bay frame-work vintages with more operational components requiring O&M attention. Most sites have one inserter, although COM Center and 3B remote monitoring sites will have a second unit installed (as was the case at Auto and El Kalaa). In general, inverters were run on-line, given the nature of commercial power interruptions and operating norms established for telecom applications. Inverters were providing from 220 to 227 volts for standard #1E applications and from 120 to 123 volts for COM Center and 3B usage. Typical plant loads supplied were 3 to 5 amps. All units observed had bypass circuits and static switches for system transfers. Meters appeared to be calibrated, and power O&M records indicated proper maintenance awareness of checking output voltages and testing the transfer system.

A. Inserter Discrepancies

The following operational anomalies were observed:

- inverters at New Maadi and Maadi were down, due to the need to replace capacitors. This is a common condition with these systems as they exceed 5 years in

age. Although power O&M indicated that they are able to procure capacitors locally, in Egypt, it was not known why these inverters would be out of operation for overnight, until power personnel could return with the required parts. This is especially a concern given the volatile nature of commercial AC interruptions in and around Cairo. AT&T noted problems in Maadi since 3/93.

- in connection with the first anomaly (above), Cairo O&M provided a list of required spare parts that are in the process of being procured. One-fourth of all required spares were associated with the inverters. Four different types of capacitors made up the bulk of this list, along with four different types of relays; all of which the power engineer indicated were available in Cairo. Various thyristors and diodes completed the list. A concern is raised that critical power supplies to overall switch O&M efforts (without an uninterruptible power supply, switch maintenance can go down in times of commercial power outages) appear to be jeopardized by the inability to supply timely spare part replenishment to the sites. See "Recommendations".

- inverters are showing natural signs of aging and evidence that a great deal of corrective maintenance is being expended on these units. Yet, interior cabinet areas showed a great deal of dust accumulation, indicating that greater attention is needed to preventative maintenance.

Diesel Generators

Various configurations of emergency diesels were found between both 1A ESS offices and between 1A's and No.5 ESS sites. The standard 1A employed Detroit engines manufactured by General Motors, with Stamford electrics. 1A sizes ranged from having two 250 KV diesels to the standard of two 500 KV units. The Abbassia generator room was exceptionally clean, with no oil spillage, loose gear or dust accumulation. Zamalek was also in good order, given its age of nine years. Alexandria diesels had logged the most time in the operation of the engines, with Auto Diesel #1 at around 600 hours of usage. This is a further indicator of commercial AC problems, and the need for close monitoring of battery cell voltages in a limited discharge/recharge cycle. Each 1A switch-room had a generator control panel to indicate when the emergency generators were running and the office was off commercial AC.

Maintenance records for the diesels were excellent, indicating that close attention is paid to emergency AC power at both Cairo and Alexandria. Routines indicated an awareness for the need to check oil and water levels, check the starter battery voltage, check the generator frequency and voltage, check the diesel fuel supplies, check the transfer switch, load the alternator, clean the louver ventilation filters, and to clean the engine, control panels and emergency protection circuits.
In general, all generator rooms had ample supplies of oil, oil filters (which appeared newly installed, in all cases), rags, drain pans, etc. Requested spare parts for control panels, diesel

battery chargers, and the engines made up the majority of items being procured in Cairo, at present; i.e., another indicator of the importance ARENTO places on its emergency generator plant. Diesel fuel reserves were consistently kept at the ARENTO-recommended level of 3/4 full, except at Heliopolis III, a site not yet accepted from AT&T.

No.5 ESS generator rooms revealed state-of-the-art control panels and digital technology, associated with the typical configuration of three 200 KV Caterpillar diesels. Man-machine interface panels clearly display all diagnostics that can be read from one position by pushing icon buttons. It is a fool-proof, simple to understand system, which has also been equipped with its own air conditioning system, in order to prevent excessive heating. Digital meters scroll through a variety of system readings to give the observer a quick overall readout of the condition of the generators without having to do anything on one's own.

A. Diesel Generator Discrepancies

- although the diesels get a lot of use (cutting on a few times a week on average and running from 15 minutes to an hour at a time; 3-4 hours total a month), there does not appear to be a regular annual routine to run the engines under supervision for a minimum of one hour, so that leaks, bad seals, oil pressure problems, etc. can be detected under preventive maintenance conditions.

- most 1A ESS generator rooms had oil spills on the floor. It was unclear as to whether this was caused through the process of changing oil, but records indicated no leakage conditions.

- overall upkeep was not neat or clean, making it difficult for people to get around and do their work. Most all vent filters looked as if they needed cleaning, which is critical to proper ventilation and the avoidance of overheating. Although all generators appear to be performing adequately, it is questioned whether diesels housed in outside trailers do not have excessive operating temperatures, especially when performing under the summer sun.

- there are no records to indicate that the following readings are being made, in order to stay within specifications:

*oil pressure
*low oil pressure
*water temperature
*high water temperature
*ambient temperature
*governor droop
*voltage droop
*frequency droop
*no load RPM

*overspeed stop condition

- despite being the newest sites and naving the most up-to-date generator rooms, the No.5 ESS's looked a since installation. There was a thick coat of dust. This can adversely affect the operation and life of generator diesels and/or require more frequent maintenance to be performed (oil changes, vent cleaning, etc.). The problem appears to be that Mariotiyia and El Kalaa have exceeded their one year maintenance period, with neither ARENTO or AT&T taking direct responsibility for oversight and maintenance, at present; i.e., no one is actively watching out for these systems in the interim. This is an important problem, given the high number of commercial AC outages and the need for reliable emergency AC power. By contrast, the Heliopolis III No.5 ESS is under the maintenance period. The AT&T maintenance man noted that the emergency generators were kicking on too frequently, since they were set to a low voltage alarm of 360 volts which is considered to be too sensitive to area brown-outs. It was also noted that diesel fuel reserves at Heliopolis III were too low, at 1/4-1/3 capacity. While AT&T readily admits responsibility for these two anomalies, they still have not been corrected by the power subcontractor to AT&T, as of the writing of this report.

- water heater jackets (for hot standby operation) were generally not engaged at most sites. While this is probably not a problem during warmer seasons of the year, this may be an issue during winter months.

The power O&M engineers at both Cairo and Alexandria are considered to be very proficient in their knowledge of DC and AC power systems. In Cairo, there are two power O&M engineers and four technicians for USAID-financed equipment. There is another power group in Cairo to handle other power plants other than AT&T switches, plus a group that handles power installation jobs. In Alexandria, the O&M power section is comprised of about 4 engineers and 15 technicians. They handle the power equipment O&M for all Alexandria exchange systems.

In order to provide back-up to the Cairo power O&M group, ARENTO is sending an engineer to the U.S. this summer for No.5 ESS DC and AC training.

Power engineers were considered to have a good command of English, which is a prime requisite in being able to gain from AT&T-sponsored training and to work from manufacturer O&M manuals or Bell Practices. Technicians generally come from secondary level trade schools and do not have good English skills. Consequently, engineers train technicians through on-the-job (OJT) sessions. There are not enough power personnel in Cairo to assign a full-time O&M technician with the installer during new power system turn-ups. However, Cairo does have power people work with AT&T during the one year maintenance period, as time permits. Technicians are primarily trained on-site. They begin with the basics of cleaning, then work up to being able to take voltage readings, add water to electrolyte and doing system disconnects. Next they advance to doing interactive routine

maintenance, such as placing an equalizing charge on a battery string. Finally, they would progress up to reading drawings and to trouble shooting problems.

Engineers read manuals, explain to others their content, concentrate on drawings, and move up in terms of overall responsibility when they are observed to be ready for independent actions. ARENTO also runs a training process, where the O&M manager invites in personnel from each maintenance staff every two weeks and reviews maintenance problems of the last two weeks, so that these O&M members can get practical experience in understanding the thought process involved in troubleshooting and corrective actions required.

Since power O&M is centralized, COMM Center troubles are called out to power. They then dispatch to individual sites. No power work is done by local switch site personnel, and they do not have the tools or supplies to attend to power conditions. Cairo power O&M states that they have enough centralized spares, tools and power accessories to carry to the sites and do their work. It should be noted, however, that there are shortages such as with the inserter capacitors. Alexandria power appears to be adequately staffed to carry out their jobs, given the limited number of sites there. Cairo does appear to be shorthanded, with a total of six power personnel for 10 existing sites and more No.5 ESS's to come. Cairo power indicated that they are not introducing new technology or procedures to help with their O&M efforts.

4.2 CRITERIA FOR JUDGING THE ADEQUACY OF THE O&M:

Objective - *In judging the adequacy of O&M, what criteria are utilized?*

Switching Equipment.

The criteria to be discussed relates solely to the types of equipment under study although some criteria factors would also relate to switching equipment in general. In order to judge the adequacy, or the quality of the O&M effort in any office or network, one must evaluate the following factors:

a. The training and capabilities of the O&M staff.

b. The O&M facilities built into the equipment.

c. The performance data of the switching equipment under study.

d. The quality of service delivered to the public.

4.3 FUNDING FOR O&M:

Objective - *Are sufficient funds provided for O&M to maintain a reliable and efficient network? How are O&M funds budgeted and reported for financial administration?*

Funding of any kind linked with O&M is somewhat of an enigma. Managers do not receive a budget as far as can be determined and admit only to receiving salaries and bonuses for themselves and their people. Shortages are made known to immediate supervisors and subsequently to higher management via monthly status reports. Funding and allocation of manpower and material apparently occurs at the highest levels of government authority with dispersals made on an as-needed basis. This, however, is speculation since information concerning the subject is not available.

4.4 TRAINING AND CAPABILITIES OF THE O&M STAFF:

Objective - *Are there sufficient, adequately trained and equipped personnel for O&M work?*

Switching Equipment.

It is concluded that the ARENTO O&M supervisors have had adequate training and from discussions with them, appear to be quite capable of operating and maintaining the equipment.

The O&M facilities built into the equipment

Modern technology and switch design has reduced the role of the O&M supervisor to a man-machine interface. The No.5 ESS routines itself, analyses the problem when one occurs and displays and prints out the necessary action to be taken. Diagnostic efficiency is such that a diagnostic can detect the problem around 98% of the time. A single board replacement can clear the problem 95% of the time. The No.5 ESS switch uses hardware and software error detectors, automatic fault recovery procedures and duplicated units to:

. Locate and reconfigure around faulty units
. Schedule and run diagnostics
. Generate trouble reports without interrupting service.

Also, you can manually control:

. Diagnostics
. System configuration
. Office data base parameters

All in all, the No.5 ESS switch was designed using the latest technology, with O&M (and

Administration) efficiencies a primary consideration.

The 1A ESS is a design of earlier years. It too employs stored program control with automatic and sophisticated routine test facilities, but requires a little more intervention on the part of the humar interface in its O&M.

The employment of the No.5 and 1A ESS switches is a most important factor in meeting the "adequacy" and the efficiency of requirements for the network O&M overall.

Monthly performance ummary data

The 1A ESS will produce a data sheet, in hard copy, summarizing the performance of the office, upon request. The No.5 ESS has all this same type of information available and the domestic model will produce a summary sheet when required. It appears however, that the No.5 ESS international model installed here in Cairo does not have the necessary software to collate the data and produce this same type of report on demand. The collation must be done manually.

The monthly performance sheet provides an excellent indicator of how well, or how badly, the office is working. It also highlights other problems which are outside of the office but, nevertheless, can affect its performance.

Attached is a performance sheet for each 1A ESS office in service. It should be noted that although the performance sheet is referred to as a monthly performance sheet, the actual number of days recorded will depend on the particular day within the month that the information is requested. Monthly performance data for the 3 No.5 ESS offices is also included in Annex 1.2, together with other relevant data.

Outside Plant.

A respectable maintenance program begins with reliable equipment, hardware and material that is installed and or constructed to high standards. Given this type of network, an agenda of preventive, routine and emergency maintenance, diligently followed, will produce objective results. This, of course, is the ideal situation and in Egypt a utopian state rarely, if ever, prevails. However, with regard to the six exchanges in this study, ARENTO received associated OSP networks that were installed in strict accordance with Bell System Practices (BSP) resulting in outside plant that was of high quality and comparable to U.S. standards. As determined in the previous section of this study, the contractor developed and implemented a maintenance program that also equaled U.S. standards. Therefore, this study reviews ARENTO's current O&M program based on the condition of the network relative to when it was installed, the level of adherence to contractor established practices and results in terms of service quality as expressed by customer reported troubles.

ARENTO's overall O&M effort relating to the Outside Plant Facilities installed on Telcom

II and III is determined to be satisfactory. This evaluation is based on knowledge of the installed network in terms of quality, visual inspections, interviews with ARENTO personnel and a history of cable faults for the last 12 months. The network is judged to be experiencing normal ageing relative to it's expected lifespan which is presumed to be a function of inherent quality as well as maintenance effort.

Performance objectives for clearing cable troubles are within acceptable limits as compared to Western standards. The addition and expected effective management of the Fault Clearance Centers will undoubtedly raise ARENTO's Operation and Maintenance Program to a higher plateau.

Fiber Optic and Transmission Equipment.

ARENTO's current O&M program is evaluated on adherence to contractor established O&M practices and effectiveness measured by the current condition of the plant and trouble free operation.

The overall effort by ARENTO in operating and maintaining the digital transmission network is judged to be satisfactory. A combination of quality equipment and sufficient maintenance has resulted in a system widely regarded as the most reliable and easily maintained in Egypt. With continued care and timely repairs this network should continue to provide quality service throughout it's lifetime.

4.5 TRAINED PERSONNEL FOR O&M WORK:

Switching Equipment.

The question of training is addressed in several parts:

a. 1A ESS switching centers.
b. No.5ESS switching centers
c. Training in general.

1A ESS Switching Centers

At the present time, each 1A office has an O&M supervisor of engineer ranking with a support staff of 3 or 4. Generally, the supervisor has had 9 months training in the USA at a AT&T school. Most of his staff have received training at the ARENTO training school and all are receiving on-the-job training under his supervision. The senior member of the support staff is, in most cases, also ranked as an engineer. Several of the senior personnel on the support staff will go to the USA in June of this year for No.5 ESS training. In no case was there a 1A office O&M supervisor who had not received AT&T USA training, in

fact, several had already been to the USA a second time for advanced 1A training relating to the more difficult problems associated with software rather than to hardware.

All supervisors interviewed appear to have a good knowledge of the equipment in their charge. The more senior members of the support staff also appeared to be quite competent. There is no scheduled on-the-job training. Technicians gain a knowledge of the equipment simply by association and from day-to-day O&M activities. This is not the best way to learn because they tend to do the same things over and over again without gaining a real knowledge of why they are doing them.

No.5 ESS Digital Switching Centers

At present there are only three No.5 ESS offices in service and of these, only two are now outside of the 1 year maintenance warranty period. There are, at present, 8 people trained for O&M on the No.5 offices, plus 2 more trained for No.5 power O&M. 18 more ARENTO personnel will travel to the USA in June of this year for No.5 training.

It should be pointed out that the No.5 ESS switching center requires fewer maintenance personnel than the older model 1A ESS. The modern digital No.5 equipment has been designed such that all switch maintenance functions can be performed from either a local or remote terminal. There is no preventative maintenance as such; only corrective maintenance.

The fact that the No.5 ESS offices have been in service only a short time makes it difficult to form an opinion as to the adequacy of the present staff available for No.5 O&M. These three offices are monitored from the COM center set up in El Kalaa by AT&T staff with ARENTO personnel receiving on-the-job training.

The selection of ARENTO staff for the No.5 US training course is based on evaluation tests performed by AT&T. The people are proposed by ARENTO, and it is understood that they have the last word on the final selection which could of course, make something of a mockery of the AT&T evaluation tests. See additional comment on this subject in 1.3.3.2.

It should be said that the present ARENTO No.5 O&M staff have all received 3 months training in the US and all are qualified by AT&T training school standards. These offices have only one shift of O&M personnel during the day. They are unattended from 5pm to 7am. During this period, the COM center monitors these three offices.

Training in General

There is an ARENTO training school in Cairo where young students are given up to 3 years instruction in various aspects of telecommunications. The courses include general subjects such as mathematics, electronics, digital technology and diagrams. The students then go on to basic telecommunications and finally are selected for the final year training in either

outside plant, switching or transmission. They graduate as switch technician, outside plant technician, etc. The intake is about 90 students per year with around 20 per year graduating in each discipline.

Recently, changes have been made because it became apparent that the educational level of the 16/17-year old students was not high enough to allow them to successfully master the switching course. This course for the younger students has now been dropped and will be replaced by new courses in electrical power and air conditioning. Switching courses will be given but the starting educational levels for students have been re-classified. The school also offers short refresher courses in switching and it is understood that at this time, 75% of all students are taking this type of course.

There are other regional training centers, distributed such that training is available to most ARENTO staff without the need for travel and accommodation. In addition, the National Technical Institute (NTI) runs academic courses in telecommunications.

Some of the information received at the school is interesting.

. Of the original 8 instructors taught in the USA to teach the 1A ESS at the training school, most have now left for other work overseas.

. Some students trained at the school as outside plant technicians are now employed as security guards.

. The training school was not consulted in any way about the educational levels and technical background requirements for those people chosen to receive No.5 training in the USA, nor were they consulted in the important matter of the length of the training.

There is a Model 1A ESS office installed at the school. At the time of the visit, the air conditioning was not working and the temperature inside the equipment room was close to the upper operating limits. It is understood that this situation had existed for some time. These 1A training facilities are not used that much any more.

There are no No.5 ESS training facilities at the school at present.

Summary

It would appear that a large percentage of the O&M staff rely very much on OTJ training, however, there does not appear to be any documented OTJ training material or training course schedules. Much of this important training activity is left to the discretion of the O&M supervisor, and this is wrong. Personnel undergoing OTJ training should be working to well prepared and documented courses of instruction, even though the instruction takes place within a working exchange. The exchange O&M supervisor should ensure that the

course is completed in accordance with the schedule. The person receiving the training should be tested at the school for level of proficiency and for pay scale grading. All training must have some incentive and this can only be applied by instituting a system of proficiency grading tied to a revised system of pay scales.

Outside Plant.

There are three basic methods by which ARENTO personnel receive training. First, through schools conducted by installation contractors as a condition of a contract with ARENTO. This type of schooling generally includes instruction in the United States as well as in Egypt and covers subject matter and methods consistent with current U.S. technology. Second, in a technical vocational school operated by the government in collaboration with ARENTO. Students in this school participate in a three year program that teaches the technical aspects of the Telecommunication business. These students are prep school graduates, 15 to 16 years of age and attend this school in lieu of receiving secondary level public education. A student that successfully completes this program is given a Technician Certificate and is obligated to work for ARENTO for five years. This institution graduates between 20 and 26 students per year from the Outside Plant Network course. The curriculum also includes courses in Switching/Power and Transmission systems.

The training center also offers refresher courses that is reported to occupy 75% of the training effort. However, schooling of any kind related to the American OSP systems under study has deteriorated over time as course materials and equipment were exhausted and emphasis shifted to new systems and providers.

The third avenue for gaining knowledge is by on-the-job (OJT) training. This method is generally relegated to the lower level employee such as helpers and diggers.

Fiber Optic and Transmission Equipment.

Virtually all training for operating and maintaining the fiber optic system in this study is conducted on the job. New technicians receive instruction in ARENTO's technical school but the level of knowledge regarding this equipment could not be quantified.

4.6 AVAILABILITY OF REPLACEMENT PARTS AND SUPPLIES FOR O&M WORK:

Objective - *Are ample replacement parts and other supplies available for O&M work? Is a program in place for controlling and maintaining a suitable inventory?*

Switching Equipment.

The contract with the manufacturer calls for the availability of spare parts for a period of 20 years after the provisional acceptance of the last of the offered equipment. In the event

of the manufacturer discontinuing the supply of spare parts, ARENTO would be informed such that they can make adequate provision for the purchase of sufficient spare parts to cover the remaining life of the switching equipment. This applies to both the 1A and the No.5 offices.

When additional spare parts are required for the 1A offices, an ordering procedure has been set up and ARENTO state that replacements can usually be obtained within a few months.

The contract with the manufacturer for the 1A equipment also called for the establishment of a Repair Center. This center is installed in the Bab-El-Louk exchange building, near to the Spare Parts Storage Center. It is equipped with automated processor controlled test gear and conventional test equipment. The original specification was for capacity sufficient to allow for the repair of modules, PCBs and equipment associated with a 200,000 line switching system, in one work period.

This center was visited and ARENTO informed that they receive about 70 units and boards for repair each month. The type of boards repaired are all single layer. Multi-layer boards are sent to the USA for repair.

One particular fault which occurs frequently is a problem with the front panel power switch on trunk units and multi-frequency signalling units. This simple pushbutton-type on and off switch fails to stay in the "on" position and has to be wedged in with a paper clip or something similar. This is a long standing problem which has not been solved.

The repair center personnel complained of a lack of certain repair facilities which, if available, would improve their overall repair capability. See 1.5.6 for recommendations.

A list of the repair center activities for one month is given in Annex 1.2.

Fiber Optic and Transmission Equipment.

Although defective equipment is repaired when possible at the repair facility in Cairo, serious shortages exist in spare parts. The situation in Alexandria is reported to have deteriorated to a point where cannibalizing existing equipment is the only avenue open for maintaining service. Waveguides associated with microwave transmission in this area, are under constant attack from corrosion and spares have been exhausted.

4.7 GENERAL CONDITION OF INSTALLED FACILITIES:

Objective - *What is the general condition of the installed facilities, equipment and materials relative to their nnormal life expectancy?*

Switching Equipment.

1A ESS Switching Equipment

The general condition of each of the ten 1A ESS switching centers, taking into account the chronic dust and dirt problem, is about that which would be expected after an average of 8 years in service. They function well and outside of some calamitous event such as fire or explosion, there is no reason why they should not go on providing a good quality of service for many more years to come. To understand better the full implication of providing a good quality of service, reference should be made to 1.5.8.

The equipment is generally solid state, is very rugged and built to stand the test of time with a normal life expectancy of more than 30 years. Nevertheless, the 1A ESS is an analog switch and as such is now of obsolete design. These days, the life expectancy of switching equipment is closely related to the advance of modern technology. Many telephone administrations around the world have reached saturation point with respect to subscriber lines, and their objective now is to provide an all-digital network bearing in mind the need to offer their customers new sophisticated services such as Integrated Services Digital Network (ISDN) and Broadband-Integrated Services Digital Network (B-ISDN). This means replacing obsolete switching and transmission systems as fast as is economically feasible. This is obviously not going to happen here in Egypt in the short term, however, it is an important factor to bear in mind when discussing the "normal life expectancy" of the 1A ESS switching equipment.

ARENTO may rest assured that the 1A ESS offices will continue to function according to specifications for as long as they are required to do so, assuming a planned development to an all-digital network within the next 20 years.

No.5 ESS Switching Equipment

The three No.5 ESS switching centers are, for all intents and purposes, new. All have been placed in service within the last two years and as such, the question of their present condition and ability to provide an acceptable quality of service are not relevant at this time. The No.5 ESS equipment has a design life of at least 40 years with a reliability objective over that period of only 2 hours downtime. It represents the latest digital switching technology commercially available today. When operated and correctly maintained within a well designed, modern network, it will provide a quality of service second to none.

COM Centers

COM Centers are discussed in some detail in 1.4.9 below, and recommendations are made in 1.5.9. With respect to the particular questions of condition, quality of service, etc., the following remarks are relevant.

The 1A ESS Com Centers are in good order and well maintained. This is of course, very important, when one considers the fact that these centers, particularly the COM Center in Cairo, monitors the operation of all the 1A offices in the network. They are able to provide the necessary O&M support which is vital to the operation of the 1A ESS network as a whole, and should be able to continue meeting this requirement for many years to come.

What is not clear however, is if the COM Center facilities could be used more efficiently than they are at present. The questions that arise are those which relate to operating staff management, traffic measurement and the administration and maintenance of subscriber lines. The original "Invitation To Bid" requested the following facilities for the COM Centers:

a. Operation and maintenance through man-machine interfaces
b. Alarm treatment and supervision
c. Traffic measurement
d. Maintenance and administration of subscriber lines
e. Changes in day-to-day subscriber data
f. Changes in exchange data base

At this time, it has not been possible to determine precisely if the facilities requested under c, d, and e, are being used, and if they are, how they are used. From information made available, it would appear that ARENTO is not making full use of the facilities that these systems offer.

Outside Plant

The OSP facilities installed during the implementation of Telcom II and III and currently operated and maintained by ARENTO consists of six networks that approach 300,000 primary cables pairs, approximately 350,000 secondary cables pairs, in access of 700 SAI cabinets and about 17,000 DCT's. This total network carries a working line load that averages 72%. Individual exchange areas vary in cable fills between 50 and 90 percent. These facts are mentioned in order to establish the size and utilization of network facilities. Overall maintenance effort generally expands as network utilization increases.

Visits to all six exchange areas and interviews with respective ARENTO managers were held concerning operating procedures and maintenance programs. Tours of office and workspaces followed including inspections of records and documentation in the data group area as well as observations of test room activity. Availability of office space in exchange building complexes is more than adequate and the co-habitation of all groups related to providing and maintaining service appears wise at this stage of Egypt's technological evolution. Office furnishing, however, are generally in disrepair except for upper management levels.

Workspace has almost no air-conditioning which results in open doors and windows for

ventilation. With Egypt's dusty atmosphere, especially in Cairo, this creates a working environment filled with dust that permeates the smallest crevice making the whole workspace grimy. Field visits were also carried out in all six exchange areas for the purpose of inspecting that portion of the OSP network subject to deterioration and damage due to inadequate maintenance or workman apathy.

All primary cables and associated tip splices installed by Ford Aerospace in the cable vaults remain neatly racked and arranged and are in good condition. Subsequently placed cables, although not covered by this study, are draped haphazardly along the racking, some lying on the floor and no plan for arrangement of tip splices is evident. This type of installation is typical of most local national contractors and there is no reason to believe the same situation does not exist in the manhole conduit network where recent cables have been placed.

Randomly selected SAI cabinets, IDCT's and EDCT's were examined in all areas both in Cairo and Alexandria. With few exceptions, the SAI cabinets reflected care and management of cable cross - connecting blocks, jumper wire and overall housekeeping. Most cabinets were padlocked with access limited to the technician responsible for all activity in his respective SAI's. Some hardware deterioration in the form of broken latches was witnessed in Heliopolis as well as missing locks.

All subscriber line carrier (SLC) installations visited, in this same area, had exposed tie cables between the SAI's and SLC's creating potential service and maintenance problems. Responsibilities for cable network maintenance and telephone installation come in contact at the IDCT's and EDCT's. Accordingly, the inspection of these two items of plant were made with a view towards the condition of the terminal block, terminal housing and cable installation only. All terminal components and u-guard installations were in good condition with only normal weathering of painted surfaces.

However, future problems could arise in Alexandria as salt air from the sea continues to attack all metal objects. Because the method of placing and terminating station wire in distribution terminals could effect cable network maintenance, a comment on this aspect of providing service is warranted. In nearly every case observed where station wire was placed in terminals following the initial wire runs, the wire was installed without regard to methods and practices taught at school and in the field during the OSP construction phase. Consequently, wire is not dressed down properly in terminals resulting in a jumbled mass and potential troubles.

Fiber Optic and Transmission Systems.

ARENTO's current program for operating and maintaining the PCM equipment related to the digital transmission network, financed by USAID, is by all indications adequate by western standards and above the norm for Egypt's environment and culture. The system has been operating successfully for a considerable number of years and is highly regarded as

being the most reliable in country and easiest to maintain. Random inspection of the equipment rooms and workspaces were made and found to be relatively clean and sufficiently air-conditioned. Equipment showed little signs of ageing and no unusual maintenance activity. Trouble report history for this department was not available since no routine periodic fault report is generated. Only those instances when the infrequent and substantial outage occurs is a report made and forwarded through the lines of organization.

4.8 MAINTENANCE AND EMERGENCY REPAIRS:

Objective - *Do suitable written plans and procedures exist for routine maintenance and emergenncy repairs?*

Switching Equipment.

Routine Maintenance

Plans and procedures for routine maintenance are available in every 1A ESS and No.5 ESS office, and these are contained within the Bell System Practices provided with each installation. They are very extensive and provide full coverage of every possible maintenance situation likely to arise. Routine maintenance sheets are completed every month at each office and this information is circulated within ARENTO for comment and discussion.

Emergency Repairs

An emergency situation is assumed here to mean a serious switching equipment problem rather than an emergency that develops as the result of insurrection or an accident to personnel. When an emergency arises, particularly outside of normal working hours, the COM Center should be aware of the situation immediately. Routines exist for the speedy dispatch of senior O&M staff to the office in question if the office is unmanned at the time. Such emergencies within individual offices must be dealt with on a real time basis.

The AT&T also provide a contracted O&M consultant who is available to attend to all 1A ESS emergency situations.

4.9 INTRODUCTION OF NEW TECHNOLOGY AND PROCEDURES TO IMPROVE O&M PRACTICES:

Objective - *What effort is being taken to introduce new technology and procedures to improve O&M practices?*

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Switching Equipment.

1A ESS and No.5 ESS Switching Equipment

With respect to the AT&T-supplied switching equipment, the procedures and practices for the operation and maintenance of this equipment have been very carefully planned and fully specified.

The No.5 ESS machine represents the latest technology in the digital switching field. The Bell System recognizes the primary importance of O&M (note the inclusion of A - Administration) and the No.5 has been designed with O&M efficiencies a top priority.

In the case of the 1A ESS machines, these too have powerful O&M programs and facilities which have been carefully human engineered to provide a high level of O&M efficiency throughout the life of the equipment. The O&M design has been made as user-friendly as possible.

Overall O&M Facilities

The improvements to the overall O&M facilities for the 1A ESS machines and their connecting networks are due to the new features which can be added to the Switching Control Center System (SCCS) equipment (COM Centers). These new facilities have been added to the original SCCS design since the first COM Center was placed in service in Miami, USA, in June of 1974. These facilities are discussed in 1.5.9.

Associated Technology

ARENTO are now installing a network of Fault Clearance Centers which will eventually serve the whole Egyptian telephone network. At present, there are two centers in Cairo and one in Alexandria. These centers are located at Mohandaseen and Kubba in Cairo and at Ibrahamia in Alexandria. Each serve a variety of exchange types, depending on the particular area. The Mohandaseen Center, which went into service August 1992, serves 164,000 lines including ARF Crossbar, EWSA (analog), EWSD (digital), 1A ESS and NEAX 61E. A similar mix of switching equipment types are served by the other two centers. It should be emphasized that the type of switching equipment is not important here for these centers are only concerned with the subscriber's line. A metallic pair between the center and the exchange to which the subscriber's line under test is located is required to perform the necessary line tests. One test line is allocated per each 5,000 subscriber lines.

These centers, designed and built by Reliance Inc. of Texas, USA, provide state-of-the-art facilities for the processing of "188" repair service calls, from the reception of the repair service call to the dispatching of the fault repairman, the subsequent action taken and its satisfactory completion. The entire operation is computerized and represents the application of modern technology in this particular type of activity.

Each center will have a complete data base including all the necessary details of the subscriber's line and location for all the exchanges served from that center. The link between the dispatching consoles and the repair faultsman is perhaps the weakest part of the ARENTO system.

At Ibrahamia, a Motorola radio link is in service and at the other two centers, the faultsman is contacted via special telephone lines. This requires the faultsman to report back to the center the details of the fault and the action taken, completion time, etc. In all cases, the availability of ARENTO transport is limited and most faultsmen are required to operate on foot.

Outside Plant.

ARENTO is introducing to the maintenance network, and has already established, several central fault reporting and processing centers. These Fault Clearance Centers (FCC) cover specific areas or zones and will ultimately provide centralized trouble reporting, testing and dispatching throughout the network. A total of twelve FCC's are planned for the Cairo-Alexandria network with one of three in Alexandria and two of nine in Cairo already in operation. The remaining FCC's are scheduled for completion in two to three years. This state-of-the-art system along with already planned software additions will provide Egypt with an enhancement to their O&M program that is comparable to western standards.

The aforementioned software additions and proposed computer terminals will give the data groups in each exchange the ability to access and update the data base as changes occur. Also, new software will permit preventive maintenance tests on all working lines to be performed in the FCC's.

4.10 PRESENT ARENTO O&M ORGANIZATION:

Objective - *What are ARENTO's existing network structure and goals for O&M?*
What is the organnizational structure for network O&M?

Switching Equipment.

Very little detailed information with regard to the overall organization, departments, numbers of personnel, etc, has been made available. However, a general outline of the structure and organization based on information received from ARENTO O&M personnel at Manager and General Manager level has been drafted and is shown in Figure 1.1. The basic intention is to cover that part of the O&M organization which deals with the USAID-financed

O&M switching equipment and support systems, however, other areas have been included where information is available. There is insufficient detail to allow for a thorough analysis

of the present O&M organization, in fact, such an analysis should be part of an independent management study. The following commentary reflects the generally accepted management practices within the industry for a commercially oriented organization.

The line of command does not appear to be flexible. Assuming very little delegation of authority, management could become a bottleneck, planned or otherwise. There appears to be very little allowance for horizontal or lateral communications between managers. Without the full ARENTO organization it is difficult to judge the number of personnel at the manager level, however, from the information available, there appears to be more than required. A long chain of command with many links is usually an indication of inefficiency. It must also be remembered that as new services become more readily available and sophisticated in nature, the grouping of resources becomes complex and more important to the efficiency of the organization. To continue the present arrangement of a manager for every different type and model of equipment in the company would eventually lead to a great deal of confusion, to say the least.

It is known that the present ARENTO organization totals somewhere in the region of 55,000 employees. A good indication of the efficiency of a telephone company can be obtained by calculating the number of personnel employed for every 1,000 lines of telephone equipment in service. This is a recognized measure of operating efficiency within the industry. An exceptionally good figure, as registered by some of the Bell companies in the USA, would be in the region of 5 personnel per 1,000 lines. Not all large international companies can match this kind of figure, however, a figure below 10 would be considered very satisfactory.

Assuming that ARENTO has, at present, about 2,500,000 lines, and assuming the total number of personnel to be 55,000, the ratio of personnel per 1,000 lines in service would be 22. This plainly indicates an inefficient organization with too many employees. This is generally the case where the company is under the control of Government and the need to create jobs is a primary consideration.

Outside Plant.

Generally, each exchange is divided into two areas of interlaced responsibility. An Exchange Manager accountable for the commercial office, subscriber telephone installations, the test room and in some cases general building upkeep. The other is a Maintenance Manager who is responsible for the overall condition and maintenance of the outside plant network. The exception to this arrangement is in Heliopolis where one manager has total exchange control. The exchange and maintenance managers report to a Zone or General Manager who in turn reports to a District Manager that answers to the Vice Chairman of Operations and Maintenance. See the attached organization chart for the exchanges in this study.

The OSP Maintenance Manager's department is comprised of a maintenance group and a data group each with duties and responsibilities that contribute to the overall performance

and results of the network. Although some variations exists from one district to another, following is a composite functional breakdown of each type of group :

Maintenance groups consist of an engineer that supervises up to six teams of men, each of which includes a technician, a joiner and helpers. Supporting all teams, as required, are men that do all excavation work associated with repairing and installing buried cable. These groups are responsible for preserving the integrity of the outside plant cable network from the Main Distribution Frame (MDF) to and including the exchange distribution cable terminal (EDCT). Included in this task are fault location, fault clearance, fault tracking, cable and hardware damage repair, preventive and routine maintenance testing and scheduled recurrent housekeeping inspections of manholes (MH), Serving Area Interfaces (SAI) and EDCT's. Although not an O&M function, the maintenance groups are charged with engineering and installing small cable extensions and EDCT additions in their respective exchange areas. Junction cable that terminates in a maintenance manager's exchange is also his responsibility.

Data groups are primarily responsible for preparing and maintaining records, maps and drawings of the OSP network. Generally, each exchange has an engineer that supervises personnel that perform the following tasks :

a) Post all telephone, cross-connect and defective pair activity to the Exchange Cable Count Records (ECCR).

b) make new ECCR's for newly installed cables.

c) Post EDCT additions to ECCR's.

d) Prepare construction drawings for cable and terminal additions.

e) Post all changes and additions to the outside plant as-built drawings.

f) Prepare lists of vacant and defective cable pairs for the maintenance group and commercial office.

The departments are provided workspace, usually in the exchange building complex which appears to be adequate. This observation however, must be viewed in accordance with what is considered the norm for Egypt's environment and culture.

4.11 O&M PROGRAM AND GOALS.

Outside Plant.

ARENTO's current program for operating and maintaining the outside plant network in the six exchange areas, involved in this study, is virtually that which was established by the contractor during the guarantee period. This was deduced from visits to the exchange areas and through conversations with managers and group supervisors. The program includes procedures for routine and preventive maintenance as well as emergency repairs. All maintenance managers have enacted schedules for routinely testing all vacant and defective primary cable pairs from the main distribution frame (MDF) and the same test for the secondary cable pairs from the SAI's. The cycle frequency of these test vary from once to 6 times per year depending on the size of the exchange network and manpower which is not necessarily proportional.

Never-the-less, a respectable effort is being made to preserve the quality and integrity of the network. As primary and secondary cables are tested all pertinent information is given to the data group for record updating. Also, SAI's and EDCT's are inspected and cleaned on a routine basis. Preventive maintenance, if necessary, is usually done at this time generally in the form of jumper replacement and sprung contact repair. Manholes are opened, emptied of water if required and given a cursory inspection as well. Cable vaults, because they are dry and experience almost no activity are rarely visited. These inspections are repeated every 2 months to annually depending also on the size of the network.

It is the Maintenance Manager's objective to clear the same day, all cases of cable trouble received before 10am. For trouble reports received after 2 pm, the goal is to clear them all the following day. These respectable targets will necessarily be mitigated by digging permit delays, lack of sufficient transportation, spare parts and absence of powered equipment. Monthly reports listing total faults, faults cleared and faults remaining are sent to the Vice Chairman - O&M. See attached reports depicting the level of faults for the previous 12 months.

Fiber Optic and Transmission Systems.

The fiber optic network falls under the management and control of a department head responsible for the total junction network and associated equipment. The portion of this transmission department that maintains the fiber system is divided into two areas of responsibility, Alexandria and Cairo. Each has an engineering manager that supervises the O&M for the electronic equipment associated with the fiber optic and microwave networks in their respective areas.

4.12 COM CENTERS - FUNCTIONS AND INTERFACES:

Objective - *What are the functions and work flows within work centers and between related work centers?*

Switching Equipment.

1A ESS Switching Centers

There are two COM Centers serving the 1A ESS switching centers; one in Cairo and another in Alexandria. The COM Center in Alexandria is only staffed during normal working hours. During the hours that this center is unmanned, the three 1A ESS offices in Alexandria are monitored from the Cairo center. O&M personnel in Alexandria are informed by telephone of any problems requiring their immediate attention.

The Cairo COM Center which is located in the Ramsis Exchange building, 7th floor, has a staff of about 15, most of whom are engineers. The equipment installed is the No.2A Switching Control Center System (SCCS), designed in the Bell System Laboratories in the early 1970's and manufactured by the Western Electric Company in the USA. The basic design, solid-state circuitry and stored program control, results in great reliability of the system. The system has very extensive traffic and plant measurement, trouble detection, trouble diagnostic, fault isolation, routine testing, flexible input/output, translation memory management and service verification capabilities. The design objective specifies continuous high-quality service 24-hours-a-day for a 40 years life. When these centers were installed in the USA, an increase in productivity of the O&M staff of 40% was recorded. The No.2A SCCS will also support No.5 ESS switching centers.

The equipment involved consists of a crossbar switching network (Central Office Select Junction Unit), associated input/output devices, necessary data sets, various work stations and the visual and audible alarm equipment. The heart of the SCCS is a computer sub-system, PDP 11/70, and this connects to each ESS maintenance TTY channel, remotely, via data sets. All ESS messages that come over that channel are processed by the computer before display to the COM Center staff. All ESS TTY messages are stored in the computer by means of a moving head disk. TTY messages older than one day are written out to magnetic tape daily.

At the same location as the COM Center equipment building in Cairo there are two additional PDP 11/70 computers. One is used for traffic calculations and the other holds line information relating to all those subscribers who are connected to the 1A ESS offices such as subscriber name and address, cable pair, etc.

It is not known if the traffic information is constantly updated or even used in any way, in fact, it was not clear just how this computer would be updated and from what. This also applies to the other PDP 11/70 computer which holds 1A ESS subscriber line information,

particularly in light of the fact that ARENTO are now installing a network of Fault Clearance Centers. Each of these centers will hold all subscriber line information for each of the offices which they serve.

The arrangement of the two switching control centers in Cairo and Alexandria are shown in Figure 1.2. The Master Control Center (MCC) in each 1A ESS office provides alarm, status, display and control circuitry to provide continuous indications of system status and to permit manual override control; trunk and line test facilities and flexible teletypewriter channels functionally matched to specific O&M needs such as traffic measurement data, line trouble reports, service order input and maintenance input/output. The design of the 1A ESS equipment is such that the MCC can remote all these basic O&M facilities through suitable telemetry and data sets to the SCCS.

Each 1A office is polled at least once a second from the SCC and the status of all major components at that office are shown on the critical indicator panel. Each console will show the alarm status for each office and the lower part displays as a minimum, the last 16 messages that caused these alarms. In addition to the information relating specifically to the switch, the indicator panel also shows building and building power status, traffic out of limits and system emergency and checks on the remote telemetry links to the offices.

The alarm monitor displays office alarm information including date and time when the alarm was generated or received, alarm level and brief description of alarm.

No.5 ESS Switching Centers

There is a COM Center for monitoring the 3 No.5 ESS offices, and is located in the El Kalaa building. It provides 24-hour surveillance of these new offices and is presently manned by AT&T personnel.

Within the No.5 ESS design, centralized maintenance arrangements may be provided either by means of remote maintenance facilities or operations support systems that increase the effectiveness of operations and maintenance personnel.

The following work stations and terminals may be installed at maintenance facilities that are remote from the exchange.

- Master control center/trunk and line work station.
- Recent change and verify work station.
- Multiple trunk and line work stations.
- ALIT terminals. (Automatic Line Insulation Test).

Although the No.5 ESS switch provides the human interfaces necessary for performing all operations and maintenance tasks, it is also compatible with several operations and maintenance support systems. These support systems can be provided as options. In Cairo and Alexandria, these support systems are the Switching Control Center Systems (SCCS), described in this report. The No.2A SCCS has been designed to support not only the 1A ESS offices but all stored program control electronic switching systems manufactured by AT&T and other vendors.

Outside Plant.

The Maintenance Department and the Exchange Manager's department interact and join forces to achieve a common goal on two occasions. Otherwise they generally operate autonomously. For those exchange areas not under the control of a Fault Clearance Center (FCC), a trouble reported by dialing #188 is received in the test room of the respective exchange. A trouble ticket is prepared with all pertinent information and is forwarded to a test position where an initial test is made to determine the nature and location of the trouble relative to switching, cable or wire. The Maintenance Department becomes involved only when the fault is determined to be in the cable network. Should this be the case, a maintenance group is dispatched to perform their own routine of tests, fault locating, and repair procedures.

Upon completion of repair work, the test room makes a final test to confirm that the service has been restored. Any changes to the original circuit is sent to the test room for station record card updating and to the data group for cable record updating. Defective cable pairs are also recorded and tracked by the maintenance group for repair when the amount at one location justifies opening a primary cable splice or excavation of a buried cable. The procedure for handling trouble reports in those exchange areas controlled by an FCC is considerably different and more efficient. In these cases, the FCC's receive all trouble reports for their respective areas, make the appropriate initial tests, dispatch a repairman to clear the fault, make final tests, update the data base if necessary and generate meaningful reports.

The Maintenance Department gets involved only when the fault is determined to be in primary or secondary cables. Currently, most faults are occurring on the subscriber side of the distribution terminal. To date, two of the six exchanges (Zamalek and Ibrahimia) in this study fall within an FCC area. Another instance of cross-department activity occurs when a request for service is made at a Commercial Office. The Maintenance Department's role in this process is first by providing the commercial office with a current list of vacant cable facilities by updating this list as cables are routinely tested. Then, if there are no available pairs at the required location, to either clear defective pairs if possible or request permission to engineer and install a small cable and or terminal addition.

Should a major expenditure be necessary, the projects department must approve, fund and schedule this expenditure. Finally, if all facilities an equipment are available and the new

service contract is consummated, a maintenance group, in some cases, will make the cross-connect at the SAI and a final test. The facility information is forwarded to the test room for station record card preparation and filing and to the data group for cable record updating. The primary responsibility as well as most of the work operations related to service order processing falls within the Exchange Manager's control and is addressed in this section because of department interfacing only.

The method for handling requests for service vary somewhat from area to area. Alexandria's three zones each have a single Commercial Office that handle requests from many exchange areas. In Cairo, each exchange studied has it's own Commercial Office. This however, effects management more so than work flow. A composite method for processing service orders is explained in the following paragraphs. A customer places an order for service in person at a Commercial Office. A preliminary contract is written with all pertinent information including type of service and address. Assuming the requested type of service is available, the potential customer is advised that he/she will be notified if facilities are available.

Commercial or a Project Group then checks a vacant facility list that is furnished and updated by the Maintenance Department and selects a secondary cable pair in the appropriate DCT and a primary cable pair in the serving SAI cabinet. In some areas this assignment is sent to the test room for testing and availability verification. If facility availability is confirmed, commercial is informed either directly or via a project group and the customer notified to return to the commercial office to sign a contract and pay the connection fee.

When contract conditions are satisfied, Commercial selects a telephone number, gives it to the customer, sends pertinent information to the ESS switch room and forwards a service order to the Installation group to install the telephone. In some areas the Maintenance group is notified to make the necessary cross - connect in their serving SAI cabinet. The ESS switch room makes required data input into ESS memory and sends the LEN position to the MDF for jumper connection.

Following the complete installation, the test room m makes a final test and prepares a Station Record Card. The Data group is informed and the cable records posted. As Egypt advances technologically and expands the access and use of existing and future data bases, the existing convoluted method of processing service orders should be rectified.

Fiber OPtic and Transmission Systems.

ARENTO's program for maintaining the fiber optic digital junction network initially continued the routine and preventive test procedures established by the contractor. In some cases various degrees of this program still exist. In other areas frequent testing was determined to be self-destructive in that it was causing a multitude of workman induced troubles. Generally, intrusive routine and preventive maintenance is held to a minimum

while equipment monitoring and cleaning occur on a regular basis. Equipment is also monitored at alarm centers located in the Ramses Exchange for Cairo and in the Auto Exchange for Alexandria.

Numerous fault and potential trouble conditions can be detected and through direct link communication (order wire circuit), problems are addressed and solved. A repair facility has been established at the Almaza Exchange, in Cairo, and is capable of repairing most equipment associated with the USAID financed systems. This is advantageous since spare parts furnished by the installation contractors were used in the early life of the system and replacements often difficult to obtain.

APPENDIX 5

TASK E - RECOMMENDED OPERATIONAL IMPROVEMENTS

5.1 INTRODUCTION:

The recommendations given below are based on a summary of impressions, observations, conversations and judgments which have been accumulated during the course of this study. Considering the extensive area of O&M, the study has been of very short duration, however, it has been possible to gather sufficient information such that practical recommendations with reference to the USAID-funded equipment and supporting systems can be made.

Considering only the USAID-financed equipment, and supporting systems, the conclusions are that these equipments are generally in good condition and are maintained to an acceptable standard. The problems that are associated with, and which affect this equipment and its operation and maintenance, either now or in the future, are covered in the following text.

The recommendations given below have been divided into two broad categories:

a. Specific: they can be related specifically to the primary objective of this study, the O&M of the USAID-funded equipment.

b. General: of a more general nature, relating more to the overall environment in which the USAID-funded equipment has to work.

Due to the difficulty experienced in obtaining all the information requested and the fact that an ARENTO support team was not available has severely restricted Teleconsult's ability to respond to the SOW request for detailed recommendations within the very short time frame of this study. Every effort has been made to respond in an explicit manner, particularly in those cases where sufficient detail has been made available.

<u>Switching Equipment.</u>

No.5 ESS Requirements

Without knowing the short term planning details for the switching networks, it is difficult to formulate an opinion as to the overall training requirements for the next five years. It is understood that ARENTO are aiming to raise the telephone density from its present figure of 4 per 100 population to around 7 by the year 2000. Assuming a population of around 71 million by that time, then about 5 million lines will be required. To meet this total for the year 2000 and assuming the present total to be 2,500,000, a yearly increase of about 360,000 lines will be required. This does not take into account the replacement of obsolete crossbar

and other old switching systems. Include the replacement of obsolete equipment and the yearly requirement of new lines will be well over 400,000.

Confining the discussion to the USA-provided equipment, and assuming that the AT&T share would be about 140,000 lines per year, the total required between now and the year 2000 would be about one million lines. If this equipment is distributed with average exchange sizes of 40,000 lines, including remotes, then some 25 principal sites are required. Assuming that the No.5 switch would be used only in the larger cities then these 25 sites would be in Cairo or Alexandria. Centralized O&M facilities should reduce the number of No.5 ESS technicians required to no more than 40 over the next 7 years.

It should be appreciated that the estimated No.5 ESS manpower requirements refer only to O&M. Some allowance must be made for the requirements of the installation and planning departments, however, from information received, it appears that a percentage of those selected for the No.5 ESS training course in the USA are neither from the O&M or the Installation/Planning departments.

With the installation of many more lines of No.5 ESS equipment in the near future, it is recommended that a new, complete training unit be installed here in Cairo for the teaching of No.5 ESS operations, administration and maintenance (O&M). This unit should be staffed, initially, by US instructors. Their duties would be taken over eventually by Egyptian staff. This would obviate the need, and expense, to send ARENTO personnel to the USA and would ensure that the maximum benefit was derived from the training funds available. The location of this equipment should be carefully selected and the air conditioning requirements must be met and maintained at all times. This new training unit should not be fitted into "available space", as appears to be the norm, under any circumstances.

The Telecom IV specifications call for a No.5 ESS training unit, however, the ARENTO training school has no knowledge of this requirement.

It is recommended that all office supervisors and other senior O&M staff should be evaluated for their knowledge of the telephone network and the necessary interworking requirements. This should include call routing, signalling, interfacing with the transmission systems, and some instruction in quality of service measurements, etc. Refresher courses for those personnel in need should be made up to address these subjects.

Proficiency in these types of courses should be linked to pay scales. Serious consideration must also be given to proficiency in the English language.

Finally, it is important that ARENTO begin training personnel for the maintenance of air conditioning units, AC power equipment and emergency generator sets. There appears to be a shortage of maintenance skill in these particular areas.

Outside Plant.

ARENTO managers interviewed, all state in unison the urgent need for an ongoing quality training program. The existing Technical Training School needs to have course material updated and new equipment that will insure that graduates have sufficient knowledge of all test equipment and are able to maintain the OSP network. Currently employed engineers and technicians should receive periodic schooling to stay abreast of technological changes, new materials and up-to-date methods. Pitiful few have ever been the benefactor of this type of program yet are entrusted with the safekeeping of a huge investment. Training provided by new projects should be given first to employees that are destined to remain and work in the area treated. This at least insures some consistency in methods of maintenance following the guarantee period of the contract. Often times this training, due to the selection process, benefits the student only. This is particularly true for schooling conducted in the U.S.

Fiber Optics and Transmission Systems.

Provide formal training for all technical personnel with periodic refresher courses to keep abreast of new technology.

5.2 CENTRALIZED O&M SERVICES:

Trainees for centralized O&M services should be selected from the most competent personnel available and should receive their full training in the USA.

Power Equipment.

-have responsible building engineers keep ARENTO premises cleaner, in order to keep pollutants from entering power rooms. Arrange for ventilation and air conditioning filters to be cleaned more frequently.

-have acid-resistant floor drains installed in the immediate vicinity of battery strings, for flushing of spilled electrolyte.

-paint over the No.5 ESS power room windows.

-remove loose gear, boxes, etc. from battery string aisles.

-provide corrective maintenance to deficient rectifiers, inverters, and diesels.

5.3 EXCHAMGE BUILDINGS AND AIR CONDITIONING:

These two subjects are generally related and the commentary for the one generally applies also to the other. For this reason, they are covered under one heading with individual recommendations.

Problem Areas

Telecommunications equipment, and the buildings in which it is housed, should be kept as dust free as possible. This applies to all parts of the world regardless. Cairo is a particularly dusty city and this lends added emphasis to giving this problem special attention in order to maintain telecommunications equipment buildings as dust free as possible. Alexandria is cleaner and the problem is less severe, however, it is still a problem to be solved. From observation however, it is obvious that far from giving this problem special attention, the contrary appears to be the case. The Bab El Louk building is an example. Most windows are open - the large main doors are completely open, and people are in and out for most of the working day. The result is that the building interior is covered in dust and dirt. The No.1A office area does have full air conditioning and the doors to the equipment room are generally shut, however, with the quantity of dust in the air, some will invariably penetrate and this is clearly what is happening. The air conditioning filters clog very quickly and the air conditioning plant is then unable to perform as efficiently as it should.

In the new digital No.5 ESS offices, the temperature of the equipment bays is controlled by cool air ducted in from below. Once again, this air at source is dusty and without doubt, given time, fan filters will suffer and equipment bay temperatures will rise unless special attention is given to this problem of building design. See additional notes given in 1.4.1.1. Preventive maintenance schedules for No.5 offices show that all fan filters must be cleaned every week.

Exchange Buildings

In most buildings which house either a 1A ESS or No.5 ESS office, the new switching equipment has been adapted to the existing building space. An extract from the contract for Telecom IV runs as follows:

"The proposed digital exchange shall therefore comply with the available building".

The correct procedure is to ensure that the building is constructed for the principal purpose of accommodating modern telecommunications equipment. A good example is the Kubba exchange building which it is understood was designed by Siemens, and houses their equipment. This building is an example of the type of exchange building architecture required and recommended. Even here, although the principal entrance is well regulated from a security point of view, there are still far too many people entering and leaving the building. A good deal of this activity could be avoided if: the commercial offices were

located elsewhere, the method of paying the telephone bills was modernized, ARENTO had its own office building for technical staff.

Some of the existing buildings could be adapted without too much cost, to alleviate as much as possible, the present dirt and dust problems. A separate entrance for the commercial office is needed so that the public does not have to enter into the body of the building. A great deal of the commercial office activity could be reduced considerably if the method of paying telephone bills was modernized. All offices that do not relate directly to the every day operations and maintenance of the installed equipment should be located elsewhere. A dining/recreation room should be allocated for the O&M staff. Much more attention should be paid to the regular cleaning of the building interior. Building maintenance services should institute a program for cleaning all buildings and it should be their responsibility to ensure that this program is maintained.

Reference to the preventive maintenance schedules for the No.5 ESS offices given in Annex 1.2 will indicate the importance given to cleaning the fan filters in these offices.

To combat the dust and dirt problems in future exchange buildings, and to understand their accommodation requirements, it is recommended that ARENTO send selected personnel from their architectural offices to the USA for a short course in the design of telecommunications buildings.

Air Conditioning in Equipment Rooms

When the USAID-funded switching centers were purchased, the capacity of the HVAC (heating, ventilation and air conditioning) systems was based on certain criteria such as pressurized buildings, equipment temperatures, filtration of air, humidification and dehumidification, etc. Quite obviously, these criteria are now suspect due to main doors and windows being left open and the equipment room doors being opened more than necessary. This is imposing an extra load on the HVAC systems.

It is recommended that the air conditioning equipment suppliers be asked to check all their units in the 1A equipment buildings with the original specifications and to make their recommendations for improving the operating efficiency of installations as necessary. This review should also include door security arrangements.

Due to the extreme dusty condition in Cairo and the combination seaside - desert climate in Alexandria, it is recommended that all work areas be fully climate controlled. Doors and windows in exchange buildings should remain closed and access limited to workers and visitors on business. Greater emphasis on workspace cleanliness is also required.

Provide a climate controlled environment for all work areas and auxiliary AC power for equipment room air-conditioning. Commercial power failures and resulting lack of air-conditioning can raise room temperature to a point that affects equipment performance.

This is particularly true in the RF areas. Doors and windows should remain closed to limit dust intrusion and circulation.

5.4 NETWORK PROBLEMS:

From the data that has been made available and from conversations with the switching center supervisors there is no doubt that there are problems in the network which should be investigated further. These problems do not originate within the switching centers. Reference should be made to the information provided in Annex 1.2.

False Traffic

There is obviously a serious problem that is originating from the subscriber's telephone line. It adds a large percentage of unnecessary traffic to the originating traffic load on the exchange equipment. Without an investigation in some depth, it is difficult to say precisely what is the principal cause of the problem at this time. It would appear that subscribers are removing the telephone instrument and replacing it without dialing, or are partial dialing and replacing the instrument. It is also possible that some people are removing the telephone receiver before going to bed and leaving the line busy. Another possibility is that subscribers are buying and connecting additional telephones to the line without ensuring that the telephone set meets standard specifications or that the installation itself is not causing problems. It is also possible that many telephone sets require maintenance and although they function correctly sometimes, they could be putting problems into the system on other occasions.

The monthly performance summary data shows clearly a great number of false starts every day, about 24% of the total originating traffic. This is not a problem that has only just come to light, neither is it a problem which is confined to a particular exchange area, although data shows that it is worse in some areas than others. The following figures have been taken from recent data:

False Start Traffic (as a percentage of the total originating traffic)

1A ESS OFFICES

AUTO	34%	NEW MAADI	28%
IBRAHAMIA	27%	HELIOPOLIS I	26%
ABBASSIA	24%	HELIOPOLIS II	24%
GLEEM	24%	MAADI	23%
ZAMALEK	17%	BAB EL LOUK	16%

No.5 ESS OFFICES

EL KALAA	18%	MARIOTEYAH	26%
HELIOPOLIS III	21%		

The 1A manual defines a "false start" as line service requests with no succeeding digits dialed during the peak traffic hour. This type of mis-use of the telephone occurs throughout the day but the peak traffic hour is when this false traffic has the greatest effect on the operation of the office. False calls can occur on any system, anywhere in the world, and they do. However, the percentage of such calls to the total call attempts should not be more than a few percent.

Fortunately, the 1A and No.5 offices are not heavily loaded in the peak traffic hour, even though the majority of these offices are achieving a line-utilization rate of about 92%. Abbassia and New Maadi each have a line-utilization rate of 96/97%! The line-utilization rate is a measure of the total lines in service and the total lines available.

The problem of false traffic in the network is not new. The Invitation to Bid documents issued in 1980 for the 1A ESS offices gave the following figures for false traffic:

. Local Traffic	21%
. National Traffic	25% Automatic & Via Operator
. International Traffic	25% Automatic & Via Operator

It would appear that the problem of false traffic is not recent but one that ARENTO has been aware of for a long time. It should be noted that the reference here to national and international false traffic is an attempt to cover such events as repeated attempts, congestion in the network, operator call-back, etc, and should not be confused with false starts which go no further than the subscribers local exchange. Nevertheless, the fact that the subscribers telephone is off-hook due to the false start situation means that many incoming calls are receiving a busy signal when in fact the called subscriber is not engaged at all. This leads to repeated attempts and congestion in the network. Reliable information shows that the call completion rate for incoming calls from the USA is only about 36% ! A lot of money in revenues is being lost for no good reason.

There is an urgent need for ARENTO to investigate, diagnose and solve this problem and it is recommended that it be done without delay. Some form of public education in the use and treatment of the telephone may be part of the solution.

5.5 TRANSMISSION LINKS BETWEEN SWITCHING CENTERS:

There is reason to believe that the performance of some of the transmission links connecting trunks between exchanges in the Cairo area is erratic, causing problems to inter-exchange traffic. Without a serious investigation as to the causes of this problem only very broad suggestions as to possible causes can be made at this time. A program is needed to review and evaluate the performance of the interoffice microwave and fibre optics links in Cairo. The monthly performance summary sheets for the 1A offices show that on some links there are intermittent faults and these are causing abnormal peg count readings of incoming calls.

A few examples of peak hourly traffic counts are given below:

Ibrahamia	Orig.+ Inc.+ False Starts	=	388504
	Inc.	=	349458 !!!
	Orig.	=	28696
	FS	=	10350

Incoming traffic counts are registering 90% of the total traffic counts !

At Gleem, the same peak hourly traffic counts show incoming counts to be about 37% - this figure is normal.

At Auto exchange the figure is 86% !
At Zamalek exchange the figure is 56%.
At Heliopolis I it is 34%.

These figures show the peak hour traffic, in other words, the total of the four heaviest 15-minute periods during the total period covered by the performance data. They do not mean that this situation continues during the whole period of data recording. For example, the incoming traffic counts for Ibrahamia taken over the total period of observation, show them to be about 30% of the total originating, incoming and false starts. What these figures do show however, is that during certain periods of operation, problems with the incoming trunk or multiplexing facilities (at either end) or the connecting transmission equipment is causing these extraordinary levels of peg counts.

It is recommended that the equipment manufacturers be asked to check the affected transmission routes and to make their report together with the appropriate corrective measures as necessary.

5.6 USE OF AVAILABLE DATA:

The 1A ESS and the No.5 ESS offices, together with the COM centers, are designed to

produce all that information which is necessary for the efficient operation, administration and maintenance of the switching center and the connecting networks. Serious study and analysis of this data will provide ARENTO with a complete O&M data base, and allow it to operate, administer and maintain the network effectively and efficiently, in addition to providing the traffic data vital to the future planning of the network.

There is reason to believe that ARENTO is not using this data, or at least, is not taking full advantage of its availability. It is recommended that suitably qualified ARENTO personnel should receive intensive training in the interpretation and use of this data at the AT&T training center in the USA, or conversely, that US Instructors should come to Egypt for this purpose.

ARENTO should ensure that the maximum benefit is derived from this program by giving priority to all its recommendations.

5.7 REPAIR CENTERS:

The 1A ESS repair center in the Bab-El-Louk building is a valuable asset to the overall 1A ESS operation, and is performing well. However, its personnel have indicated that their repair capabilities could be improved with the inclusion of certain additional 1A-type circuit board testing facilities.

Considering the fact that the 1A ESS equipment will remain in service for a long time to come, it is recommended that ARENTO, should review the functions of this repair center with the intention of improving and/or renewing its present test and repair facilities.

The Telecom IV contract does not request a repair center for the No.5 ESS equipment and these facilities are not required in Egypt. The numbers and types of printed circuit boards used in the design of the No.5 ESS have been reduced to a minimum, however, their repair has increased in complexity. All repairs will be made in the USA.

Tools and Equipment.

To operate a maintenance program, sensitive to rapid restoration of service and overall care and preservation of the network, certain tools and equipment are necessary. Test equipment is beginning to age and requires recalibration and general maintenance. Some sets remain inoperative due lack of repair facilities. A program to repair and replace test equipment is in dire need. Vehicles available for use are inadequate in number and generally are reaching the end of their serviceability. A vehicle per team is recommended as well as a scheduled maintenance and replacement program.

Power tools and equipment is almost nonexistent and should be part of each manager's

inventory. Specifically, jackhammers, compressors, large and small water pumps, portable generators, blowers to ventilate manholes and tank trucks for hauling away water removed from manholes are all items that facilitate maintenance. Small hand tools are also in short supply and should be replenished. One item of material suggested for purchase, in various sizes, is the split duct plug. This device is used in manholes to fill the area between a cable and it's associated duct, producing a seal that prevents the flow of water and gas. To realize maximum benefit from the Fault Clearance Center (FCC) operations, the dispatchers should have wireless communication with the repairmen in the field. To date only one FCC area has this capacity.

5.8 FUNDING AND ORGANIZATION:

General

These are very important items, and each would qualify as a subject for an independent review. Within the limits of this O&M study, and considering the scarcity of available information, recommendations cannot be too specific. Nevertheless, the importance of these two topics is such that they should be addressed in this report and that recommendations should be made, no matter how general. The following comments and recommendations are based on observations, conversations and professional judgement.

Funding

The question posed in the SOW which refers to O&M funding asks if it is adequate to maintain a reliable and efficient network. No information on ARENTO funding of O&M is available at this time, however, there appears to be funds available for the purchase of spare parts when required and the fact that day-to-day O&M activities proceed in a routine manner would indicate that funding is available to maintain an essential level of O&M.

The maintenance of a reliable and efficient network is not dependent solely on funding. Training and motivation of the personnel are prime considerations coupled with the availability of proper test facilities and adequate maintenance procedures. Of these, the most important is motivation and this does raise the question of salary levels and the availability of adequate funding. This one very important component of overall funding, that of salaries, calls for special comment. From conversations with O&M personnel, it became quite clear that the one single item that causes the greatest concern amongst the ARENTO O&M staff is the very poor remuneration paid. Teleconsult was given to understand that salary levels, which are generally poor to begin with, are based primarily on years of service rather than professional education, technical ability and overall capability. This obviously leads to grave anomalies in salary levels and is a primary cause of discontent and resentment. The need to hold down two jobs to make a living wage does not make for a truly efficient and dedicated employee.

Obviously, there is no easy answer or recommendation to solve this situation. It is recommended however, that ARENTO management review the present methods used to determine salary levels. As much as possible, salary scales must be broken away from Government restrictions and be reviewed upwards such that they resemble more closely those of commercial companies. This is particularly important for the upper grades of technicians and engineers.

Organization

The O&M organization, from information received, does not appear to be very flexible. The line of command is too rigid. One is left with the impression that the organization is composed of a number of small self-contained sub-systems, with very little liaison between them. There appears to be a lack of coordination between personnel at the manager level and below, particularly between those managers in different sectors such as switching and transmission for example. Transmission personnel will take out of service a block of circuits for whatever reason and fail to inform the switching personnel of their actions. This type of situation which has been reported on a number of occasions, is probably indicative of the lack of coordination in general between these sectors, and can have a serious affect on the performance of the connecting exchanges.

It should be understood that these are only impressions gathered during the course of this study from observations, conversations and a small amount of information. However, it is felt that there are sufficient grounds for pursuing this matter further in order to verify or refute these early opinions. It is recommended that with the full cooperation of ARENTO, a review of the O&M organization should be made. This could be completed quite expeditiously within a short time frame. The results of this review should be very valuable and their application, as appropriate, would enable the present O&M organization to improve its functional capabilities.

Power Equipment.

-clarify who (AT&T or ARENTO) takes the initiative to detect and correct anomalies at #5ESS power plants that are beyond the one year maintenance period, but have not been final-accepted.

-either hire additional power O&M staff in Cairo or assign some routine cleaning to switch site personnel; thus freeing up power personnel time to do more elaborate maintenance such as cleaning within inserter bays or isolating & reading of individual trouble cells.

-in keeping with the above, provide sufficient personnel or available time to have power O&M apprentice with AT&T power installers for 1-2 months.

-document qualifications required of power personnel for them to advance.

-include training requirements in qualifications checklists and add English language training as part of the training program for individuals not skilled in that area.

-either require Arabic translators for U.S. based power training courses or have AT&T provide "suitcased" power training in Egypt with an instructor proficient in Arabic, so that a greater number of technicians can be formally trained.

Outside Plant.

Limit O&M manager's responsibility to activities concerning the OSP cable network. These duties would include routine, preventive and emergency, maintenance; engineering and installation of small cable and terminal extensions; construction drawing and as-built drawing preparation; posting and maintaining the OSP drawing file; and coordinating with other departments in the exchange.

Overall management of the maintenance effort would be enhanced by the collective adherence to the same guidelines for operating and maintaining an OSP network. Upon completion of Telcom II & III the contractor furnished ARENTO copies of "OSP Operation and Maintenance Handbooks", but none could be found at the exchanges. These practices should be a part of each O&M manager's library and used religiously to insure a safe trouble free operation over an extended period of time.

Maintenance and Exchange Managers should hold monthly meetings to discuss transfer of information between the two departments, problems that arise where responsibilities overlap, solutions, and various other common points of interest, with meeting minutes going to regional or zone managers.

Fiber Optics and Transmission Systems.

Provide all equipment locations with a copy of the "O&M Handbook - Fiber Optic Inside/ Outside Plant Facilities of Cairo and Alexandria" Furnished by Ford Aerospace. Insist that engineers, responsible for equipment, become familiar with this document.

5.9 QUALITY OF SERVICE PERFORMANCE OBJECTIVES:

At the present time, it would appear that quality of service performance objectives are not in use, and that ARENTO does not have an active service performance monitoring scheme.

It is recommended that ARENTO should commence an active program to monitor service performance and to measure that performance against a set of performance objectives. The service objectives to be proposed, both technical and operational, will be specified for both

the short and the long term allowing the operations to first meet a set of interim short-term standards and then to make progress towards the final long-term high quality service that customers have the right to expect.

Quality of service planning should consider two basic components:

1. A set of service objectives.

2. An effective scheme for monitoring service performance.

The proposed service quality objectives are as comprehensive as possible and may be applied to more than one kind of service. However, as the network expands and new services are introduced, it will be necessary to consider the possible introduction of additional performance factors, as required.

It is ARENTO's obligation to ensure that it provides good service to all their customers. Application of the principles stated here will clearly show how well, or how badly, this is being done.

Basic Considerations:

In order to meet the obligation to provide quality service, certain questions must be answered, for example:

a) What service levels will satisfy the customer, and at what point is the added cost of improving service no longer commensurate with the accompanying increase in customer satisfaction?

b) How should technical objectives be set for network elements so that final end-to-end connections meet desired levels for customer satisfaction?

c) How can system performance be monitored to ensure that the objectives are being met?

It should be recognized that performance standards, and their regulation, must strike a balance between level of service and the cost to the public. To set the standards too high would be impractical. Not only would they be extremely costly to implement but probably unattainable. On the other hand, inadequate service has a negative influence on the subscriber and the country, producing a high degree of public annoyance and dissatisfaction.

The setting of technical objectives will, in the case of Egypt, draw heavily upon the experience of foreign operating companies and the general recommendations of such international bodies as the CCITT. These objectives serve, not only to meet subscriber satisfaction levels, but as a guide in the design and layout of equipment and systems, and

in setting operational and maintenance requirements.

It is essential to understand the importance of apportioning, or balancing, the various service objectives among the different segments of the network. Some objectives should be clearly specified within the national plans such as Transmission Plan; Switching and Routing Plan, etc. The remaining objectives, those of a more general nature, would be specified in accordance with generally accepted standards of telephone administrations throughout the world.

The monitoring and evaluation of system performance must be a continuing effort to ensure that objectives are being met and that service problems are recognized and solved without delay. This evaluating data will be available from a variety of sources, to be discussed later in this text, and a well prepared plan for its collection, evaluation and storage, is essential.

Performance factors and service objectives

As part of an overall program for measuring the efficiency of the network and performance of the service, it is necessary to adopt a set of service, (or performance), objectives. Each objective will set the desirable performance limits for selected areas of operation, each being regarded as a performance factor.

A measure of service quality cannot be expressed by any single performance factor, neither can it be expressed by attempting to combine a number of performance factors into a single composite indicator.

Service quality measurement involves a number of performance factors, each of which deals with a different aspect of overall operation. These include the following:

a) Availability of telephone service, (length of the waiting list).

b) Availability of new and modern services.

c) Time necessary to provide service after application has been accepted.

d) Speed of operation - time required for significant events to occur during the establishment of a call.

e) Service reliability - measured in terms of outages, faults, errors, irregularities and other significant qualities of performance of equipment, operators and subscriber, except speed.

f) Call disposal - recorded as calls completed and uncompleted, or in terms of other final disposition of the calls irrespective of speed and other qualities of the service.

g) Time to repair, (when the subscriber has a problem).

h) Quality of billing service - prompt presentation of bills, accounts, accuracy, methods of payment.

i) Transmission quality.

Classification of performance factors

The CCITT classify all such performance factors within the following five categories:

1. Service Support.
2. Service Availability.
3. Service Reliability.
4. Service Operability.
5. Transmission Quality.

Each of these categories would contain the following performance factors:

Service support

a) Subscribers that have direct distance dialing facilities both national and international. Generally measured as a percentage of total lines.

b) Supplementary services such as pushbutton dialing, abbreviated dialing, conference calling, call forwarding, call waiting. General availability.

c) Digital telephone service, (this means service via a digital network; the introduction of digital telephones into the public network is some years away). General availability.

d) Special facilities such as data services, cellular (mobile) telephone service, video conferencing, leased circuits. General availability.

e)) Waiting list for service. This would be a measure of the operating company's ability, or inability, to provide service.

f) Number of principal telephones (generally measured per 100 inhabitants).

Service availability

a) Speed of installation of new telephone (from date of application to in-service).

b) Speed of repair of telephone, (from time the fault is reported till telephone is back in service).

c) Number of subscribers out of service at any one time, (time period to be specified).

d) Time to transfer telephone service to new location, (from date of application till restoration of service in new location).

Service reliability/operability

a) Outside Plant
- Trouble density
- Clearing time

b) Switching Plant
- No. of troubles/100 lines
- Repair time
- No. of troubles/100 trunks
- Repair time

c) Transmission Equipment
- Percentage of circuits out of service
- Routes out of service

d) Billing Services
- Billing errors per 1000 bills
- Current bills issued within specified time of due date.
- Final bills issued within 10 days

e) Grade of Service
- Call completion rate
- Dial tone delay
- Post dial delay
- Loss probability in the network

f) Operators - Speed of Service

- Long distance
- International

- Directory assistance
- Repair service
- Other service boards

Transmission quality

Transmission objectives for the design, engineering and development of the national network must be provided in the national transmission plan. These objectives must take into account, the existing analog network, the mixed analog/digital network and a future all-digital network.

For the purpose of setting performance standards, circuit loss and noise measurements should be sufficient to provide acceptable indications of transmission quality for voice circuits - see Annex 1.1, Table 1.1

Annex 1.1 covers the "Recommended Service Objectives for Egypt", and provides some guidelines for conducting performance surveys amongst the telephone public.

5.10 CENTRALIZED OPERATIONS AND MAINTENANCE CENTERS (COM CENTERS):

At present there are two COM Centers for the 1A ESS switching centers and one COM Center for the No.5 ESS switching centers, and both types have been described in 1.4.9. The COM Center serving the No.5 equipment is completely state-of-the-art, having been installed only recently.

The COM Center serving the 1A ESS equipment is older and has been in service since 1984. From the information provided by ARENTO staff, the prime use of this center is to monitor the function of all the 1A offices even though a full maintenance team still attends each switching office during normal working hours. It should be pointed out that a primary purpose of the No.2 SCCS was to provide savings in manpower with gains in both efficiency and proficiency. This does not appear to be happening to the extent that it should here in Egypt.

The 1A COM Center can also be used to monitor and provide surveillance, control and analysis functions for electro-mechanical switching systems by the application of minicomputer techniques at each electro-mechanical switch. Such an extension of the facilities of the Ramsis COM Center would add enormously to the overall monitoring capabilities of the Cairo switching network.

In addition to extending the monitoring capabilities of the No.2 SCCS, there are additional facilities available which should also be considered for use within the Cairo and Alexandria networks. CAROT is a computer-based system that runs routine and demand transmission

tests on trunks between offices that are equipped with remotely controlled test lines. Results are checked for being within design limits, and those that are outside of these limits are reported to the SCC for trouble location and repair.

Another facility available is the Central Office Maintenance Management System (COMMS) which schedules and tracks preventive maintenance work.

A fourth application which can impact SCC operation is the computer-based Engineering and Administrative Data Acquisition System (EADAS), which measures traffic characteristics of switching offices and trunks and can report abnormal conditions that appear to be maintenance related to the SCC.

It is recommended that a study be made of the present operation and functions of the 1A COM Centers, in detail, and that a plan be prepared to utilize these centers more effectively and efficiently. This plan should consider the use of the facilities as described above, the integration of other exchanges into the Cairo center and the linking together of the 1A and No.5 centers.

Thought should also be given to the use of the subscriber line data base now being built up in the fault clearance centers. These same subjects are touched upon in 1.5.10 which follows.

5.11 NETWORK MANAGEMENT SYSTEM:

General

It is recommended that ARENTO should seriously consider the provision of network management facilities with a network management center to be installed in Cairo.

Within the time constraints of this study, it is only possible to touch upon the important subject of network management. This general recommendation provides the basic guidelines to allow an ARENTO study group to proceed with the preparation of a network operating plan and to prepare the technical guidelines for the eventual implementation of such a system. It is understood that ARENTO are discussing with AT&T the provision of a Network Operations Center (NOC). No details are available but it would appear to be along the lines of the AT&T Network Management Architecture, as briefly described in the following text.

Type of system recommended

When considering the development of a network operating plan, the one most important issue is how to integrate all the different types of systems in a national network into one unified network management architecture. A great deal of thought has already been given

to this problem by many large manufacturing and operating telecommunications companies around the world. Of these, the AT&T is very prominent with their network management system based on the Unified Network Management Architecture (UNMA). This architecture provides a stable framework for network management with a three tier system that integrates management systems that control separate pieces of a network.

Network Elements: The first tier includes the network elements e.g. devices on the customer's premises such as modems, multiplexers, local area networks, PBXs and local, interexchange or international network services including analog or digital facilities, packet switching and other forms of data networks.

Element Management Systems: The second tier is comprised of systems that manage the network elements, including operations, monitoring, control, administration, maintenance, and provisioning functions.

Network Management Integration: The third tier ties the element management systems together and provides overall facilities that allow users to operate, administer and maintain a network from end to end.

Implementation of UNMA requires a standard intersystem interface (machine-to-machine protocol) that can easily be supported and which is powerful enough to allow for full network control. AT&T has produced Network Management Protocol (NMP). The UNMA can be planned as a system which initially is comparatively simple but which can be expanded and developed.

Other Considerations

When planning this type of network system facility, it is vital that the existing centralized operations and maintenance centers be fully taken into account. Without an extensive study of the application of network management here in Egypt, the future role of the existing O&M centers within a centralized network management scheme cannot be clearly defined at this time. However, it is logical that these centers should continue in service and that they should be incorporated into any future network operations plan.

The new Fault Clearance Center Network with its extensive subscriber line data base, now being implemented in Cairo and Alexandria, must also play a part in the overall network management plan.

Initial objectives

The initial objectives for the system plan are to:

a. Formulate a standard network operating plan.

b. Define the information flow among the various systems and plan the automation of the communication between the switches and the center.

c. Clearly define the services to be performed at the center.

d. Develop service criteria for the services at the center.

e. Develop protocol and input/output standards for interfacing between switches and the center.

The initial services to be provided at a network control center should include the following:

f. Service Order/Recent Change - The need to update the switching systems as quickly as possible has led to a centralized service order that can take the information to the system in what is commonly known as a recent change format. Recent change is the information the switching machine needs to update the customer data. Links would have to be established to the various switches if this function is to be centralized, which is the preferred way to operate. Combining service order and recent change will not only improve operations (less personnel, quicker response) bot will eventually allow for an electronic directory.

g. Traffic Data Analysis - The traffic data analysis package collects call count and usage data for items within the system that are traffic sensitive. This information is necessary for the instantaneous indication of overload or trouble, to determine whether the present equipment is meeting the service criteria established for the system, and for long-term trend analysis.

h. Failure Detection and Alarm System - The network communications center should be capable of monitoring each switch within the network together with the transmission facilities between the switches and, if a major problem arises, to be alerted via an alarm from these units.

i. Trouble Log - Three major sources of trouble reports should generate a trouble log at the center: reports from centralized testing, alarms or other reports from the various switches, and customer complaints. Suitably detailed reports should be made available with corrective actions taken, etc.

j. Centralized Testing - The testing of all links within the network is a vital feature of any system, and the network must initiate this testing from a centralized point. The center also serves as the place where the routine testing of lines, links or common control can be initiated.

k. Automated Directory - The automated telephone directory provides an

on-line source of information for any user of the network. The present compiling and printing of directory information is a long and laborious process, with the information being outdated before printing.

5.12 MOTIVATION:

Motivation in terms of financial compensation is probably the single most significant factor affecting the attitude and performance of ARENTO personnel. Wages in general are paltry and defy all rationalization as compensation for many levels of responsibility. Most employees are required to seek a second job or take a leave of absence to work overseas to make ends meet. As an added source of distress, salary increases have not kept pace with inflation and other factors that erode buying power. Wage earners today are under more financial strain than they were 10 years ago. Therefore, a complete review and evaluation of ARENTO's salary structure is justified in order to insure employee conscientiousness, dedication and loyalty. To reiterate what was stated in previous sections, replace the existing ARENTO wage plan and hiring philosophies with one more in line with a private sector telephone company.

5.13 SPARE PARTS AND EQUIPMENT:

Make a concerted effort to increase spare part levels to that furnished by the installation contractor. Purchase additional equipment in order to utilize spare fiber facilities.