

CHAPTER 8

MAINTENANCE

AND

TRAINING

CHAPTER 8 MAINTENANCE AND TRAINING

8.1 Present State of Employee Training at TANESCO

TANESCO has a well-equipped training center^{*1} in Morogoro 200 km west of Dar es Salaam. This center provides various type of training to technical and clerical workers of all job types as classes. In addition to fresh person training for the change of jobs, re-education for improving the levels of skill of employees, etc. is offered here. The training for the maintenance personnel of the distribution department is divided into two courses i.e. the linesman course and the supervisor course according to duties and level of skill.

The training at TANESCO can largely be divided into domestic training and overseas training. Overseas training has been implemented with the aid of foreign donors, including JICA, SIDA, and NORAD etc. Domestic training consists of studies at the University of Dar es Salaam, intensive training at the Training Center in Morogoro, and on-the-job training (OJT) at the departments where employees are assigned.

With the privatization near at hand, TANESCO is in a severe financial condition. Since 1994, it has not recruited any new employees at all. With the aim of cutting expenses, the company is entrusting its security operation to an outside company and this brought forth a massive scale of excess personnel. It has been striving to make the most effective use of its existing manpower by, for instance, re-education its excess personnel and redeployment them to the other departments. Those who were formerly working in the security department are encouraged to change their jobs to the linesmen for the maintenance of distribution facilities, because the shortage of manpower is very severe in the job of linesman. For that purpose, TANESCO offers introductory training to them at the Training Center frequently. The trainers are mostly members of the DAMP staff. They carry training materials with them each time they give a training session.

*1: The Training Center has various sizes of classrooms, conference rooms and a dining room and even a big auditorium capable of accommodating 400 persons. For the people who come from afar to receive training, there are two hostels, each of which has 80 rooms. In addition, the Center has a guesthouse for VIPs with two suite rooms. It is equipped with a gymnasium and outdoor athletics facilities for soccer and track athletics. On the premises there are wooden poles for the distribution line works training, and steel towers for the transmission line works training. There are also materials for training in hot-line works. When these facilities are not used, they are made available to outsiders on a chargeable basis.

8.2 Background of the Dar es Salaam Power Distribution and Maintenance Project (DAMP)

With the sharp increase in power demand by the business booming after trade liberalization and lack of systematic maintenance have caused many part of system in Dar es Salaam left under poor operating condition. In order to improve the situation, TANESCO, with the fund cooperation of European countries and a series of assistance of grant aid from

Japan, carried out extensive distribution network rehabilitation projects quite successfully. Nevertheless, there are still many old facilities those were kept in operation without proper maintenance. In order to bring the distribution network in the city to a satisfactory operating condition, considerable input and energies were still required.

In the greater part of Tanzania, including Dar es Salaam, the power supply systems that were far from reliable were impeding the progress of social and economic activities. Under those conditions, it was an extremely important task to improve the maintenance capabilities of TANESCO and implement proper maintenance of both the existing and rehabilitated facilities of the company.

Eventually, TANESCO, at its own expense and with its own know-how, launched the "Dar es Salaam Power Distribution and Maintenance Project (DAMP)" in Dar es Salaam. DAMP on inception has some problems regarding technical capability and skill on maintenance and tools and equipment necessary to maintain the Dar es Salaam power supply. For that reason, the Ministry of Energy and Minerals (MEM) asked the Japanese government for technical cooperation needed to carry out the DAMP project.

In response to the request from the MEM, the Japanese government carried out a mini-project to back up the DAMP. The project period was three years, from January 1996 to January 1999. The project consisted of the supplying of tools and materials needed for training maintenance personnel for the DAMP project and the providing of technical guidance to TANESCO staff in Japan and in Tanzania. Throughout the project period, a JICA expert resided in Tanzania to support the project management as an advisor and coordinator. In addition, four Japanese experts in power distribution technology stayed in Tanzania for a short period of time to provide TANESCO technical staff with practical training in techniques to control maintenance data, technology for work execution, etc. During the project period, three TANESCO engineers received training in Japan, on control and management of power distribution systems.

Under the guidance of Japanese engineers, the DAMP steadily improved its technical strength and came to conduct various types of work on distribution lines, maintenance of equipment, control of materials, technical education and training, etc. for itself. The activities of DAMP that is armed with appreciable mobility (large-scale equipment and vehicles) and high standard maintenance technology, are greatly contributing to the improvement of the power distribution system in Dar es Salaam to date.

Since JICA technical cooperation ended, the DAMP project has been carried on under the management of TANESCO (Kinondoni North Regional Office) and achieved the following works.

- (1) 5 engineers, 2 technicians, 24 linesmen and 30 casual laborers are trained to a competent level as far as distribution lines construction and maintenance.
- (2) Those technical staffs who returned to regional offices after company restructuring are performing well. They are leaders and trainers of others.
- (3) DAMP always dispatches trainers to a Training Center at Morogoro to conduct training/seminars to linesmen, supervisors, senior engineers and managers as far as maintenance as concerned.
- (4) All 11kV poles are numbered for identification. This facilitate planning and execution of maintenance work.

- (5) As part of OJT, DAMP executed big projects which regional offices were unable to execute because of lack of appropriate tools, equipment and expertise. To mention some, such big projects are;
- A) Construction of 33kV line feeding Chang'ombe 33/11kV substation and 11kV lines from the substation. The substation was constructed to improve power reliability at Chang'ombe industrial area.
 - B) Construction of 33kV line feeding Bahari Beach 33/11kV substation and 11kV lines from the substation. The substation was constructed to improve power reliability at Kunduchi area including all Beach tourist hotels. The new substation also released the load of Mbezi substation.
 - C) Rehabilitation of Mbegani 33/0.4kV substation at Bagamoyo.
 - D) Low voltage distribution lines maintenance at Upanga and Kariakoo. The maintenance works in these areas involved changing of old wires, rotten poles and improving line connections. After the exercise, Upanga and Kariakoo residence are now enjoying electricity with minimum interruptions.
 - E) Relocation of electric facilities allowing roads expansions. Facilities located were along Kawawa road, Ubungo-Mlandizi road, Bagamoyo road and Kijitonyama street roads.

TANESCO intends to develop the efficient functions of the DAMP, not only Dar es Salaam but throughout the country in the future.

8.3 Present Condition and Problems of DAMP

In recent years, continual rehabilitation and reinforcement have appreciably improved the condition of the distribution network of TANESCO. However, service interruption still occurs almost everyday. The maintenance force is almost always put into construction of new facilities and emergency work, including restoration of troubled facilities: it is seldom used for preventive patrol or training of technical personnel. Under this condition, the level of maintenance has been coming down.

8.3.1 Shortage of Manpower (Competent Staff)

The initial purpose of DAMP was to improve the reliability of power supply in Dar es Salaam through enhancement TANESCO maintenance capability on power distribution networks, and implementation of proper maintenance of all the distribution facilities (rehabilitated and obsolescent ones) in Dar es Salaam and to train technical staff engaged in maintenance of the facilities.

Looking at the present activities of DAMP, however, DAMP is extremely busy with urgent field operations, such as construction and restoration of distribution lines. The drastic reduction of manpower² make DAMP conduct only OJT to the remained staff and casual laborers attached to DAMP. In other words, DAMP is also functioning as a mere construction agency. It is true that practical training of linesmen has been carried on, but very few linesmen benefit from this training due to the fact that only a small number of linesmen are now engaged to DAMP. Since the period of JICA cooperation expired, the training in preventive maintenance that is very necessary for facility management, such as preparing and updating maintenance data (line ledger, records of measured loads, etc.), has been shifted to individual region. The trainers for preparing, updating maintenance data are

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the ex-DAMP staff who returned to their respective regions under company restructuring in anticipation that they share their acquired knowledge and skills with their fellow work mates. This was the plan right from the beginning.

*2: As of July 1998, when the Japanese engineers were in Tanzania, DAMP had a staff of 40 (see Fig. 8.1). However, the number of staff members decreased to 17 in March 2001 (see Fig. 8.2), although there were some 30 casual laborers employed to help with maintenance work.

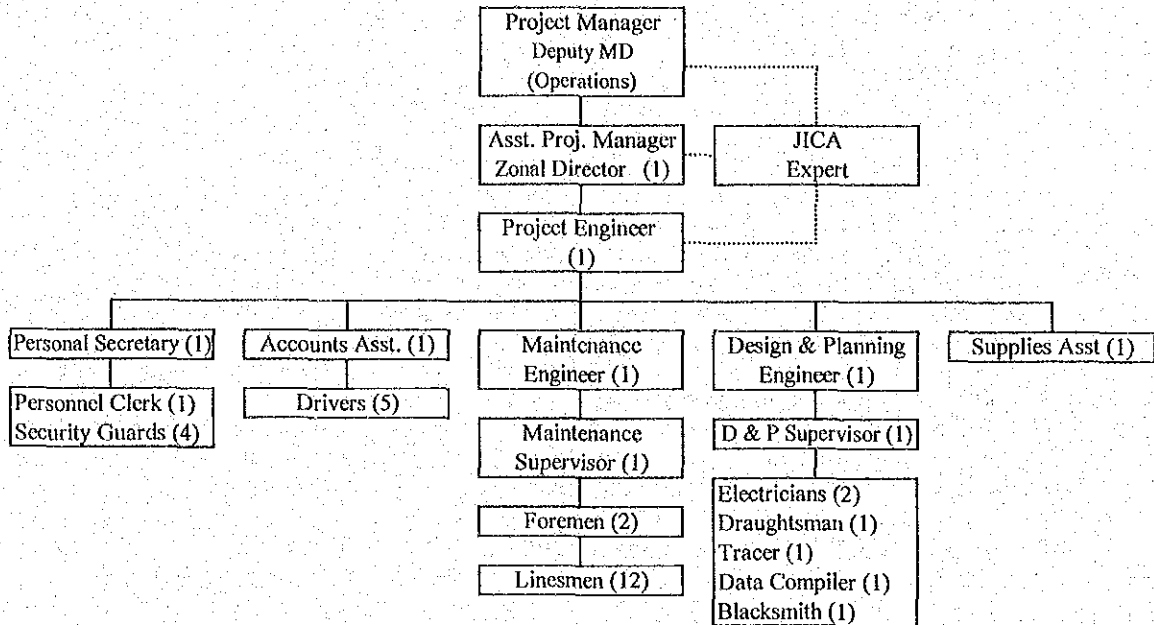


Fig. 8.1 Organization Chart of DAMP (1998 July)

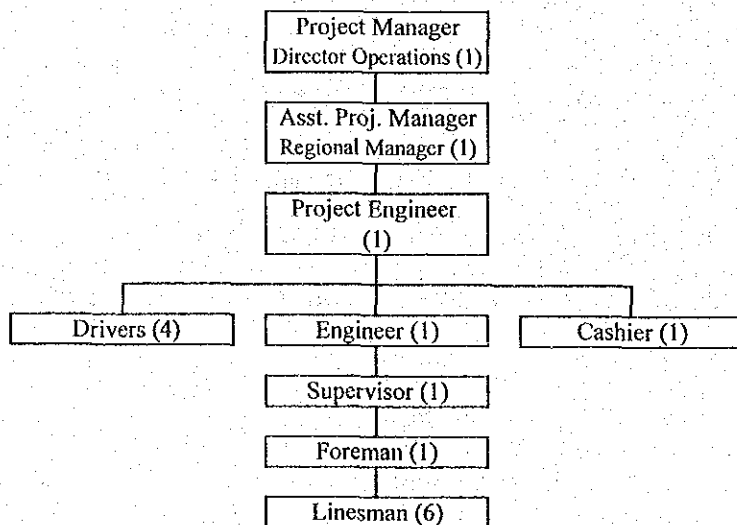


Fig. 8.2 Organization Chart of DAMP (2001 March)

In Arusha and Kilimanjaro, as well as Dar es Salaam, there is an acute shortage of maintenance personnel, especially competent (skilled or experienced) persons who have sufficient technical knowledge and can manage field maintenance work properly. While those experienced persons are ever dwindling in number due to retirement, death from a sickness, transfer to some other workplace, etc., vacancies are not filled at all. As a result, in Arusha and Kilimanjaro, even though routine maintenance work is done, there is much delay in initial response and the finishings of sloppy workmanship, making the person concerned deplore that there is no progress in maintenance technology.

In order to stop such a technological setback, DAMP must enhance its training function and strive to acquire effective new techniques and transfer them to the younger generation.

8.3.2 Shortage of Maintenance Tools and Equipment

The shortage of maintenance tools and equipment is a problem common with all regional offices of TANESCO. In Dar es Salaam, the tools, large-scale equipment, and vehicles owned by DAMP are expected as a biggest support to improve the level of maintenance work. However, many of those tools and equipment have become useless because of aging, rough use, improper maintenance, etc. Equipment which has become useless is seldom replaced, and only the few pieces of equipment that remain are used excessively. In Arusha and Kilimanjaro regions, the service area is so wide that making a round trip can take much time. However, there are too few vehicles that can be used to carry maintenance gangs and equipment. This is one of the factors of inefficient maintenance.

8.3.3 Shortage of Repair Materials

TANESCO has a system that enables the 22 regional offices throughout the country to utilize stocked repair materials mutually. When it comes to replenishing repair materials, however, the regional offices in Arusha, Kilimanjaro, etc. often find it hard to secure the required repair materials because of chronic shortage of funds.

Some materials, such as wooden poles and wires can be procured locally but on the other hand, materials such as insulators and hardware are all imported. For that reason, it takes much time that the necessary materials are delivered to the regional offices.

8.3.4 Organization

At the present, DAMP is responsible mainly for planning and executing maintenance and repair work required to improve the reliability of power supply with the 33 kV and 11 kV distribution network in Dar es Salaam. Concerning the low voltage (240V/415V) distribution lines, emergency repair work is outside the scope of responsibility: DAMP only performs maintenance of those lines when requested by regional offices. DAMP is also responsible for training maintenance personnel. Although the linesman training are provided as required, the supervisor training for the engineering staff has only based on OJT. Trainings of engineers was done in Japan during the project period.

Since DAMP is administratively supported by Kinondoni North region and serves also other 3 regions i.e. Kinondoni South, Ilala and Temeke regions, more support is

required from the regions so that DAMP functions satisfy the need of all four regions. In addition, the local regions of Arusha and Kilimanjaro strongly wish to benefit from the function of DAMP (training of maintenance personnel, improvement of maintenance techniques, introduction of advanced maintenance, etc.).

8.4 Improvement Measures

8.4.1 Reviewing the Functions of DAMP

The present condition of TANESCO's maintenance is in extremely hard situation due to shortage of manpower, materials and equipment those are attributed to the shortage of funds and the cost-cutting measures of the company. At the site of maintenance, the work executed at the right time and by the right method is seldom found. This is due to shortage of skilled technical staffs who are equipped with adequate practical knowledge and skill required to properly the whole thing about maintenance work.

DAMP is contributing much to the fostering of ordinary linesman by, for example, dispatching trainers to the Training Center at Morogoro on a regular basis. However, its function of training skilled-technical staffs needs strong reinforcement and be continuous so that DAMP can foster personnel required for proper maintenance of facilities. As a result, TANESCO will no longer suffer frequent equipment troubles which, in the worst case, have resulted in an equipment breakdown, fire, etc. In order to dissolve the problem of shortage of capable maintenance personnel, it is indispensable to restore and reinforce the training function of DAMP. In this respect, we propose that TANESCO should review the following functions of DAMP.

(1) Separation the function of executing works

At present, the principal function of DAMP is to help carry out works which relate to improvement of power supply reliability (installation of new equipment, expansion, maintenance etc.) which can hardly be executed by individual regional offices alone, by using the machines and tools that DAMP owns. Through doing such works, DAMP performs both actual maintenance and OJT to the staff. But some of the works have already become such routine jobs that the individual regional offices should be able to carry them out for themselves, only they have to be provided with necessary tools and materials. DAMP should be providing them with proper guidance and advice as required. Therefore DAMP must strive to assure the required level of quality of work by, for example, mobilizing members of the former staff of DAMP. TANESCO should make DAMP concentrate on the training by executing carefully selected maintenance works as OJT which are directly related to the required technique and skills at the sites.

(2) Positioning DAMP as organization for fostering technical staffs

DAMP should focus on fostering personnel who train linesmen and fostering SV trainers of supervisor level who are supposed to become leaders, especially in the field of maintenance. DAMP is also required to prepare a plan for creating an environment in which the people who have been trained by DAMP and dispatched to local offices can work comfortably and efficiently.

(3) Scope of training at DAMP

- (a) Training of linesmen
- (b) Training of trainers who train linesmen
- (c) Training of supervisors who supervise maintenance work
- (d) Re-training of trainers and supervisors for improvement of their skills
- (e) Monitoring of maintenance sites and providing of emergency support

(4) Spreading and transferring maintenance techniques

- (a) Each of the persons who have completed the DAMP training course shall become the leader at the place of assignment and provide education and guidance to his group.
- (b) DAMP shall monitor the conditions of field operations and grasp the degree of dissemination of maintenance techniques.
- (d) In case a difficult maintenance problem arises, DAMP shall help solve it.
- (e) Trainers who have accumulated practical experience in the field shall return to DAMP as trainers there and reflect their experiences in the DAMP training courses.

By repeating the above steps, TANESCO should maintain and improve its maintenance technology.

(5) Training trainers

In order to recover the maintenance capacity of TANESCO to at least the level at the time of completion of the DAMP project (January 1999), it is desirable to assign to each office at least one person (leader) who has completed the DAMP training course and to make him train trainers in the office. In the area covered by the present project, the number of leaders required for this purpose is 4 in Dar es Salaam and 2 in Arusha and Moshi, respectively.

As the first step, each regional office shall plan to improve the quality of maintenance in terms of maintenance planning and skill by keeping the same numbers of linesmen trainers as that of SV trainers. Although it is important for each regional office to secure the required number of trainers as soon as possible, fostering personnel through education by a foreign lecturer and having them gain practical experience takes considerable time. In the education plan, each office is supposed to foster at least one-half of the required number of trainers by the end of the second year and the remaining half by the end of the third year.

Every candidate trainers dispatched from the individual regional offices to DAMP shall receive 3-month introductory and basic education provided by foreign lecturers, 6-month practical training (includes OJT) provided by the DAMP staff, and 3-month intensive education provided by foreign lecturers before he returns to his regional office. In order to enhance the effect of his guidance in his office, education of SV and linesman trainer shall be provided at the same time and for the same period of time, after which the SV and linesman trainer shall be assigned to the office in pairs.

8.4.2 Organization

The missions of DAMP are to foster personnel engaged in maintenance of the entire distribution facilities of TANESCO and improve the level of the company's maintenance technology. Therefore, it is undesirable that DAMP is under the control of Kinondoni North Regional Office that is only one of the many field operations departments. Since the activities of DAMP form part of the company's manpower development plan, DAMP should be an organization that is provided with reasonable budgetary measures from the standpoint of the entire company. In this context, DAMP should be put under the direct control of the Distribution Department of the TANESCO headquarters. The proposed position of DAMP is shown in Fig. 8.3.

Concerning the DAMP staff configuration, reinforcing the staff of trainers is an important point. At present, there are only three trainers, including the Project Engineer. It is to be desired that at least two trainers should be added. In addition, DAMP needs persons who control the training materials, training assistants, drivers of vehicles, etc.

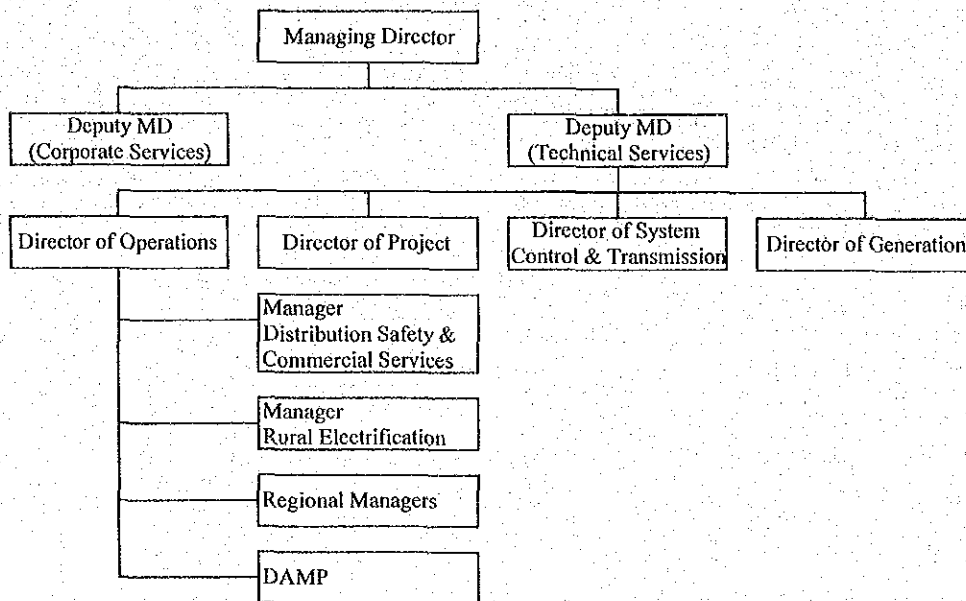


Fig. 8.3 Proposed Position of DAMP

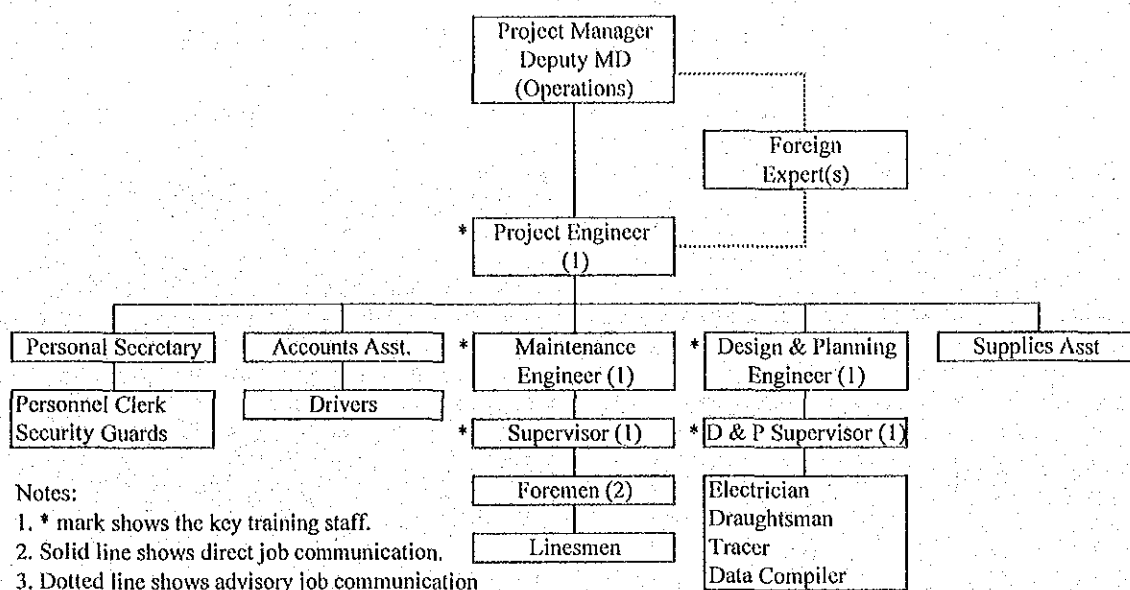


Fig. 8.4 DAMP Organization Chart (An idea)

8.4.3 Training Schedule

In order to maintain and increase the maintenance capacity of TANESCO, technical support of industrialized countries is considered indispensable. Therefore, it is important to plan and execute the following types of training for engineers and technicians who are supposed to become trainers who provide guidance to local staffs at DAMP.

(1) Training Abroad

Each year, at least two engineers should have training abroad. The training course covers management and maintenance of distribution facilities, latest maintenance techniques, etc.

(2) Training in Tanzania

Twice a year, two foreign lecturers are required for 3-month training of field supervisors and linesman trainers in the practice of maintenance and the application of maintenance techniques.

(3) Training of trainers

Training of local staff (in maintenance skill of supervisor level) by persons who have completed the DAMP training course or by existing trainers shall be provided as required. DAMP shall plan the training for itself, and the trainers who belong to DAMP shall provide the training.

(4) Training of linesman

This training shall be provided to linesman as required. DAMP shall plan the training for itself, and the trainers who belong to DAMP shall provide the training.

Our proposed training schedule is shown in Fig. 8.5.

			1st Year												2nd Year												3rd Year																							
Month	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12														
Supervisor Course																																																		
Foreign Instructor			Basic												Conclusive → to be assigned to regions												Basic												Conclusive											
1st Term (3)	Fundamentals	One each from Dar, Arusha & Moshi	Basic												Conclusive → to be assigned to regions												Basic												Conclusive → to be assigned to regions											
2nd Term (3)	Fundamentals	One each from Dar, Arusha & Moshi	Basic												Conclusive → to be assigned to regions												Basic												Conclusive											
3rd Term (3)	Fundamentals	Three from Dar, one will remain in DAMP	Basic												Conclusive → to be assigned to regions												Basic												Conclusive											
Linesman Course																																																		
Foreign Instructor			Basic												Conclusive → to be assigned to												Basic												Conclusive											
1st Term (3)	Fundamentals	One each from Dar, Arusha & Moshi	Basic												Conclusive → to be assigned to												Basic												Conclusive → to be assigned to regions											
2nd Term (3)	Fundamentals	One each from Dar, Arusha & Moshi	Basic												Conclusive → to be assigned to regions												Basic												Conclusive											
3rd Term (3)	Fundamentals	Three from Dar, one will remain in DAMP	Basic												Conclusive → to be assigned to regions												Basic												Conclusive											

Fig. 8.5 Proposed Training Schedule

8.4.4 Training Courses

The contents of training shall be based on the DAMP curriculum that had been used until January 1999. The Linesman Course covers mainly safety education, construction of distribution lines with wooden poles (excavation of ground and erection of poles), assembling, stretching of cables, and maintenance. The Supervisor Course includes safety education, construction work planning, keeping and updating of equipment ledger, recording and analysis of service interruptions, measurement of grounding resistance, load current control by feeder, voltage measurement, and other techniques to collect data necessary for proper maintenance work, etc. In the recent equipment expansion and operation at TANESCO, the shortage of personnel for the following types of work has become conspicuous, hence it needs to be reflected in the above training courses.

(1) Cable work

In recent years, the opportunities to handle cables at maintenance sites are increasing (e.g., in line relocation work during road repair work). DAMP has no persons who have know-how of cable work, hence asks the Substation Department for help whenever it becomes necessary. However, even this department has only a few persons who can handle cables properly. Under this condition, an accident or delay in work has occurred from time to time. Since it is necessary for each regional office to be able to perform cable work for the 11 kV/33 kV distribution lines, DAMP shall foster personnel for cable work.

(2) Operation of substation equipment

Controlling the operation of distribution substations is the responsibility of the System Control Department. However, the shortage of qualified operators has often prevented smooth distribution service. Since the substation devices are operated according to instructions of the department, it is necessary to foster a staff for correctly operating them as instructed, thereby reducing the duration of accidental service interruption and improving the level of customer service.

8.4.5 Providing of Adequate Training Materials

Many of the tools and equipment JICA supplied to DAMP during the last DAMP support project have become unusable from aging deterioration or excessively hard use: only a few of the tools and materials are in sound condition. Since those useless tools and equipment are seldom replaced with new ones, the usable tools and equipment are ever decreasing in number.

Concerning types, specifications, etc. of the training materials that will become necessary in the future, it is desirable to decide them after DAMP prepares a detailed training plan in consultation with JICA expert. The training materials we consider the minimum requirements are shown in Table 8.1.

Table 8.1 Training Materials to Improve DAMP

S/N	DESCRIPTION	Q'TY	REMARKS
A. WORKING TOOLS			
1	Screw anchor (provisional type)	5	

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2	Stretching roller	50	Model 5R - 4010
3	Earthing gear	6	Model MA 121A-20 for 11/33 kV
4	Rubber gloves 20kV with protector	3	
5	Rubber gloves 1000V with protector	15	
6	Safety belt	20	Model 630-27
7	Work platform (small size)	10	
8	Work platform (big size)	10	K-4
9	Climbing spike with belt	40	F-G with belt
10	Wire cutter (small size)	3	BC-0775 (G & J MMC)
11	Wire cutter (big size)	3	ABC-900 (G & J MMC), RC-800
12	HT fuse extractor (insulated switch operator)	3	Model SA109c3-6
13	Insulated ladder 9mts	3	FRM
14	Insulated ladder 13mts	3	FRM
15	Aluminum extension ladder	5	
16	Wire rope with Accessories	2	Main wire for 7 tone crane
17	Wire rope with Accessories	2	Sub wire for 7 tone crane
18	Wire rope with Accessories	2	for 3 tone crane
19	Portable winch with wire	3	1000D, MR-5
20	Welding torch kit with horse 10m	3	Yamato sangyo YM-B
21	Double snatch block 100mm	3	
22	Single snatch block 100mm	3	
23	Adjustable angle wrench 300mm	20	
24	Cutting pliers 200mm	20	
25	Ratchet wrench	20	
26	Pliers case	20	NP-3
27	Spare safety rope	20	
28	Electrician tool kit	3	
29	Sling wire 1.5 tone	10	
30	Sling wire 3 tone	10	
31	Insulation distance measuring rod 12m	2	
32	Waist bag	20	
33	Traffic safety cone 700mm c/w cone stick	50	
34	Auger bit 5/8" for drill machine	20	
35	Auger bit 3/4" for drill machine	20	
36	Auger bit 5/8" with handle	20	
37	Auger bit 3/4" with handle	20	
38	Canvas bucket	20	
39	Pull lift	20	
40	Drum jack	6	
41	Clamp stay	18	
42	Logger fixer	2	
43	Spanner holder	20	
44	Ratchet holder	20	
45	Tape measure 3.5m	10	KS19-35B

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46	Tape measure 5.5m	10	KS19-55B
47	Tape measure 50m	4	VR 50
48	Tensioning hoist 1.5 tonne	20	
49	Bolt clipper 750mm	4	
50	Skinning knife	20	
51	Conductor cleaning brush copper	10	
52	Conductor cleaning brush Aluminum	10	
53	Wire lope	30	NIKO WR-12S, WR-14S, WR-16S
54	Hammers	30	OH HK-10

B. INSTRUMENTS			
1	Digital measure	3	
2	Earth tester	3	Hioki 3150
3	Phase rotation tester	3	
4	Megger (Insulation) tester	3	Hioki 3117-13
5	Clamp tester (analogy)	3	Hioki 3127
6	Clamp tester (digital)	3	Hioki 3266
7	Sequence tester	3	
8	Measuring stick	2	
9	Power analyzer	2	
10	Voltage recorder	6	Hioki 8202-11
11	Current recorder	6	Hioki 9008
12	AVO meter (Analogy)	3	Hioki 3030-01
13	AVO meter (digital)	3	Hioki 3200-01
14	Voltage detector 11/33kV	6	
15	Phasing equipment	3	
16	Tension meter	3	
17	LV detector	20	

C. EQUIPMENTS			
1	Base station radio call	1	
2	Vehicle mounting radio call	8	
3	Hand radio call	4	
4	Mobile telephones	6	
5	Blue printing machine	1	
6	Photocopying machines (heavy duty)	1	Canon NP 6621
7	Photocopying machines	1	Canon NP 6220
8	Laser printer	2	HIP 1100/1200
9	Personal computer	4	
10	TV set	1	
11	Video deck	1	
12	Compaq Deskpro Computer c/w Plotter	1	Plotter type- HP Design jet 750C plus
13	Projector	2	
14	Camera	4	
15	Video camera	1	
16	Binoculars	4	

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17	Portable computer	1	
18	Scientific calculator	3	

D. MACHINERIES			
1	Air compressor c/w digging accessories	1	DENYO DPS-950SS
2	Pole hole excavator	1	
3	Bench drilling machine	1	KIWA KUD-700
4	Bench vice	3	G&J RV-150
5	Power hacksaw (sawing machine)	1	TSUNE BSM-190/240
6	Chain saw	2	Shindaiwa A303C
7	Hand drill	3	Toshiba RH-38E
8	Hand grinder	2	Toshiba DGP-180B
9	Welding glasses ⁴	4	DPM WI HD
10	Compression machine	4	LOBSTER AKH-150S
11	Burner	2	NEW FUJI S-2B

E. VEHICLES & MOTORCYCLES			
1	Truck with crane	2	4-ton truck, 3-ton crane
2	Crane truck	1	8 tones
3	Bucket wagon truck	1	
4	Pickup double cabin	1	
5	Pickup single cabin	2	
6	Motorcycles	2	

8.4.6 Dispatch of Foreign Experts

The level of facility maintenance at TANESCO is far from satisfactory. Preventive maintenance (i.e., maintenance for preventing accidents and equipment troubles) has never been implemented. Although the DAMP project was quite successful, the functions of DAMP have been continually deteriorating since the Japanese engineers left the site. Building a reliable maintenance system requires much time and labor. TANESCO should make sure that the DAMP activities would continue on a lasting basis.

It is to be desired that foreign experts should be dispatched to TANESCO so that they can provide advice on and monitor the DAMP activities and coordinate the three parties concerned—TANESCO, donor agency, and DAMP. In order to improve TANESCO's maintenance technology and make it deep-rooted, it is considered necessary to have foreign experts stay at TANESCO on a long-term basis.

8.4.7 Deployment of DAMP Functions to Local Areas

After the present DAMP is restructured which focuses on fostering maintenance personnel, training trainers shall be started. And one year later, dispatch the persons who have finished the course to Arusha and Moshi so as to deploy the activity to transfer the maintenance technology to the local areas.

As already mentioned, in the first and second assignment of trainers, each pair of a SV trainer and a linesman trainer shall jointly provide technical training in the regional office they are assigned. When the trainers are assigned to the new offices after their

training is completed, especially in case of the first assignment, it is considered important to provide materials required at the minimum for ordinary maintenance operations. An example is given in Table 8.2.

Table 8.2 Training Materials to Extend DAMP to Arusha and Kilimanjaro

S/N	DESCRIPTION	QTY	REMARKS
A. WORKING TOOLS			
1	Stretching roller	20	Model 5R - 4010
2	Earthing gear	4	Model MA 121A-20 for 11/33 kV
3	Rubber gloves 20kV with protector	3	
4	Rubber gloves 1000V with protector	15	
5	Safety belt	20	Model 630-27
6	Work platform (small size)	5	
7	Work platform (big size)	5	K-4
8	Climbing spike with belt	20	F-G with belt
9	Wire cutter (small size)	2	BC-0775 (G & J MMC)
10	Wire cutter (big size)	2	ABC-900 (G & J MMC), RC-800
11	HT fuse extractor (insulated switch operator)	2	Model SA109c3-6
12	Insulated ladder 9mts	2	FRM
13	Insulated ladder 13mts	2	FRM
14	Aluminum extension ladder	2	
15	Portable winch with wire	2	1000D, MR-5
16	Welding torch kit with horse 10m	2	Yamato sangyo YM-B
17	Double snatch block 100mm	2	
18	Single snatch block 100mm	2	
19	Adjustable angle wrench 300mm	20	
20	Cutting pliers 200mm	20	
21	Ratchet wrench	20	
22	Pliers case	20	NP-3
23	Spare safety rope	20	
24	Electrician tool kit	1	700SG-Maedakinzoku, HOZAN HKC-S51
25	Sling wire 1.5 tone	10	
26	Sling wire 3 tone	10	
27	Insulation distance measuring rod 12m	1	
28	Pull lift	2	
29	Drum jack	4	
30	Tensioning hoist 1.5 tonne	6	
31	Bolt clipper 750mm	2	
32	Skinning knife	4	
33	Conductor cleaning brush copper	4	
34	Conductor cleaning brush Aluminum	4	

CHAPTER 8 MAINTENANCE AND TRAINING

B. INSTRUMENTS			
1	Digital measure	1	
2	Earth tester	1	Hioki 3150
3	Phase rotation tester	1	
4	Megger (Insulation) tester	1	Hioki 3117-13
5	Clamp tester (digital)	1	Hioki 3266
6	Sequence tester	1	
7	Measuring stick	1	
8	Voltage recorder	3	Hioki 8202-11
9	Current recorder	3	Hioki 9008
10	AVO meter (digital)	1	Hioki 3200-01
11	Voltage detector 11/33kV	2	
12	Phasing equipment	1	

C. VEHICLES & MOTORCYCLES			
1	Truck with crane	1	4-ton truck, 3-ton crane
2	Pickup single cabin	1	

For the moment, the individual staff members of the office shall strive to improve their abilities with the aid of the trainers who have received the DAMP training. Then, computers, tools, materials, etc. shall be introduced to improve the working environment. By the end of the third trainer training, both Arusha and Moshi will be able to secure required size of technical staff. The trainers assigned to the individual regional offices are required to strive to prepare standard specifications of machines and tools and standardize methods of maintenance and inspection in the field in cooperation under DAMP technical guidance.

DAMP is required to provide the individual regional offices with suitable support, including financial aid, to enable them to positively carry out the maintenance operations in a planned manner. By analyzing data obtained from the activities of the trainers at the individual regional offices, DAMP will be able to prepare more effective maintenance and manpower development plans.

For some time after start of the present project, there will be certain limitations to the technical guidance provided by trainers who have received the training at DAMP.

8.4.8 Project Cost

(1) Material Cost

Estimated material costs to improve existing DAMP and to extend DAMP function to Arusha and Kilimanjaro are shown in Table 8.3. Costs are estimated based on procurement in Japan and exchange rate is set 130 JPN/US\$

Table 8.3 Material Cost (Unit: 1000 US\$)

Item	Cost	Remark
DAMP Renovation (w/o Vehicles)	434	Foreign Currency
DAMP Renovation (Vehicles)	338	Foreign Currency
DAMP Extension to Arusha and Kilimanjaro (w/o Vehicles)	180	Foreign Currency 90/plase
DAMP Extension to Arusha and Kilimanjaro (Vehicles)	138	Foreign Currency 69/plase
Total	1,090	

(2) Office Refurbishment and Construction

Refurbishment cost of present DAMP and construction cost of maintenance management office in Arusha and Kilimanjaro are estimated below. These cost are estimated from former DAMP project cost

Table 8.4 Office Refurbishment and Construction (Unit: 1000 US\$)

Item	Cost	Remark
DAMP Renovation	100	Local Currency
Arusha	100	Local Currency
Moshi	100	Local Currency

(3) Other Expense

Foreign experts are supposed to be dispatch to DAMP under technical assistance scheme, therefore no expense is accounted for lecturers. TANESCO are supposed to pay administration and other minor expense, only oversea training of TANESCO staff is accounted in the project cost.

Table 8.5 Annual Cost of Training of TANESCO staffs abroad (Unit: 1000 US\$)

Item	Cost	Remark
Training abroad	40	2 persons x 2 months

(4) Total Cost

Cost of through (1) to (3) are summed up in Table 8.6

Table 8.6 Total Cost Needed to Improve DAMP Function (Unit: 1000 US\$)

		1st	2nd	3rd	Total
DAMP	FC	772			772
	LC	100			100
Arusha	FC		318		318
	LC		100		100
Moshi	FC		318		318
	LC		100		100
Training	FC	40	40	40	120
	LC				
Total	FC	812	676	40	1,528
	LC	100	200		300

8.5 Future Tasks

8.5.1 Organization for Equipment Maintenance

As an electric utility company, TANESCO should clearly recognize the importance of facility maintenance and consider suitable personnel disposition and budgetary measures.

(1) Enhancing recognition of importance of maintenance

During the recent field survey of the distribution facilities of TANESCO, we noticed that many of the facilities were deteriorating rapidly due to insufficient maintenance while the rehabilitation of facilities with foreign aid was going on. True, we had heard that there was nothing satisfactory about the manpower, repair materials, tools, transportation facilities, etc. But, the conditions of the field were surprisingly miserable. Many of the facilities showed no signs of having undergone cleaning, let alone inspection. We were wondering why such an awful situation had come about, when we came across a newspaper article about the maintenance enlightenment movement in Tanzania*3. It was an article introducing the open lecture meeting entitled "Maintenance Challenges for the Engineering Profession in Tanzania," given by Dr. R. J. Masika at Dar es Salaam Institute of Technology and Prof. B. A. Kundi at Dar es Salaam University. The article clearly explains the essence of maintenance problems in Tanzania. The explanation that the Tanzanian 'carefree' culture underlies the poor maintenance is very convincing. A text of the article of the article is given below.

*3 Appendix Maintenance: The missing link in Tanzania (By Zephania Ubuwani)

At the University of Dar es Salaam (USDM), researchers are studying the cost of 'no maintenance.' The Maintenance Center of Dar es Salaam Institute of Technology (DIT) and the Institute of Technology Management (TechMa) have carried on a maintenance culture enlightenment activity for several years. To improve the level of maintenance in Tanzania, it is considered indispensable to change the maintenance consciousness of the people, especially those who are engaged in maintenance work. In this respect, we were impressed by the intelligence and acting power of the persons who were propelling the enlightenment activity.

To create maintenance culture among the employees of TANESCO, it is recommended that TANESCO positively utilize the above organizations—making the employees attend lecture meetings held by those organizations or inviting their lecturers to the company's lecture meetings.

(2) Maintenance cost

TANESCO—a public utility company—has the responsibility to supply the customer with high-quality, high-reliability electric power. To discharge this responsibility, the company must be ready to spend substantial amounts of maintenance cost for securing maintenance personnel and procuring maintenance materials. The poor condition of distribution facilities of TANESCO is ascribable primarily to the fact that even the minimum degree of equipment maintenance is not implemented. Neglecting the necessary maintenance on the pretext of a tight financial situation is wrong. TANESCO should strive to make its management sound and provide suitable budgetary measures to improve the present conditions.

Maintenance: The missing link in Tanzania

(By Zephania Ubuwani)

Potholes on the highways, vehicles idle on rocks, leaking pipes, cracked buildings as well as those which have not seen a coat of paint for twenty years, have something in common – lack of maintenance. Engineering experts say lack of proper maintenance in Tanzania has rendered worthless huge investments in roads, buildings and utilities and in the end, have negatively affected the country's economic performance.

Dr. Richard J. Masika of the Dar es Salaam Institute of Technology (DIT) and Prof. Beatus A. Kundi of the Dar es Salaam University (UDSM) are among the many experts who feel that the lack of a culture of maintenance in Tanzania must come to an end.

“The need to maintain facilities in order to fight against general wear and tear, aging and other associated functional deterioration which can lead to either complete breakdown or total loss of investments in facilities and infrastructure can not be over emphasized.” They said.

Dr. Masika and Prof. Kundi, who are both engineers, made the plea in Dar es Salaam recently during an open lecture organized by the Engineers Registration Board (ERB) on “Maintenance Challenges for the Engineering Profession in Tanzania.”

They said although no facility or infrastructure can be kept fully working without effective maintenance, experience in Tanzania has shown that the importance of maintenance has been overlooked for so long even by the industrial and business sectors.

Importance of Maintenance

“New industrial and business sectors in Tanzania appear skeptical as to the importance of maintenance in increasing efficiency and promoting productivity. This suggests a serious need to improve awareness on the important role of maintenance.” they pointed out.

Dr. Masika, who is the Director of Studies and Vice-principal of DIT, took the floor first to explain to technical experts and other members of the public at the British Council hall in the city the problems behind inadequate maintenance in Tanzania.

He singled out “wide spread negligence” in the care of facilities and infrastructure as problem number one, followed by inadequate capacity utilization, and high rate of breakdowns. He said: “The incidences of negligence and inadequate or lack of maintenance of buildings, roads, vehicles, industrial facilities and similar important assets is unfortunately, widespread in our country.” He told the audience that the direct and indirect costs arising from the purported negligence were “immense and constitute an unnecessary drain on our resources.”

According to him, many industries in Tanzania suffered economic losses due to low rate of capacity utilization caused by low availability of equipment, as a result of inadequate maintenance of the production facilities. An industrial survey conducted in Tanzanian industries in the 1990's, revealed that poor maintenance of installed equipment was a major factor contributing to the low capacity utilization. Low availability and reliability of the machines and equipment were mentioned in the study as significant contributors to low capacity utilization of the facilities. On the high rate of facility breakdowns, Dr. Masika said there was generally “more than usual high rates” of breakdowns in facilities in the country, involving the public and private sectors. “This is a result of lack of any adequate / systematic approach to maintenance and the tendency to rely mainly on breakdown maintenance,” he added.

Examples of facilities /infrastructures affected by poor maintenance include roads, water supply systems, electricity, schools, hospitals and fire brigades.

Effects of poor maintenance

The poor maintenance of road transport network hindered not only movement of essential goods, but led to higher vehicle operating costs, increased number of accidents and reduced reliability of transport and related services.

“When repair of road is delayed, the DIT Vice Principal said, it would lead to more destruction which would, in turn, involve extensive rehabilitation,” and even rebuilding entirely afresh at three times the cost of regular maintenance.”

Live examples include the on-going Urban Sector Rehabilitation Projects funded by IDA, running into millions of dollars, and the Dar es Salaam Road Improved and Maintenance Project (DRIMP). Unfortunately there are reports that some of the newly rehabilitated roads, in the latter projects, funded by JICA, have already started to deteriorate due to lack of timely and / or proper maintenance.

Prof. Kundi, a mechanical engineer and currently the Head of Department of Mechanical Engineering at USDM, underlined the causes of lack of maintenance, and what is currently being done to rectify the situation. He was explicit from the word go: the underlying cause of the maintenance problems in Tanzania is a weak or absent culture of maintenance in many sectors.

Lack of management systems

There is an inadequate appreciation of the need for maintenance, inadequate commitment to maintenance and lack of awareness by policy makers of the maintenance problem. Technical experts are equally to blame according to Prof. Kundi. In many cases they acquired facilities and developed new structures “without taking optimum consideration for maintenance.” Other causes include inadequate maintenance management systems, insufficient local capacity to handle maintenance of high technology systems, inadequate development of human resources for maintenance and inadequate resources allocated for maintenance. “However, the university don emphasized that whatever support was given, Tanzania would remain behind the maintenance of its infrastructure and facilities if the culture of maintenance remained weak. “The problem of maintenance and repair in this country is not only a matter of, or lack of manpower, technical know-how or spares. It is also a question of attitude and habits,” he said.

He admitted that the importance of maintenance was not well appreciated by institutions and individuals in Tanzania. Furthermore maintenance was sometimes regarded merely as a shop-floor activity such as lubrication of machinery and repair of a machine or machine part when it breaks down. “People do not seem to be bothered by the growing number of potholes in the roads or by cracking pavements. People do not get irritated by growing heaps of filth by the roadside or in the open drains,” he explained. Prof. Kundi added: “It is the problem of attitude of not caring, resulting in the loss of standards, accepting malfunctioning of technologies and ignorance of consequential costs.”

The varsity don talked of an on-going research on the cost of non-maintenance, the establishment of a Maintenance Center at the DIT, and the activities of the Institute of Technology Management (TechMa) which has been promoting the culture of maintenance for some years. In March 1996, TechMa in collaboration with UNESCO, organized a successful first ever working shop on the Culture of Maintenance for Sustainable Development. In the following year it published a book on “Culture of Maintenance for Sustainable Development in Tanzania,” and currently TechMa is conducting a pilot project on “Building a Culture of Maintenance for Schools in Dar es Salaam.