

United Republic of Tanzania

Tanzania Electricity Supply Company Limited

(TANESCO)

United Republic of Tanzania
The Project for Capacity
Development of Efficient Distribution
and Transmission Systems
(Distribution/ Substation)

Work Completion Report

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Abbreviation

Abbr.	Official Name
CP	Counterpart
JCC	Joint Coordination Committee
M&E	Monitoring and Evaluation
OJT	On-the-job Training
PTO	Principal Training Officer
TFM	Task Force Member
TOT	Training of Trainers
TTS	TANESCO Training school
TTTS	TANESCO Technical Training School

1. Project Summary

1.1 Project Background

Tanzania maintains its economic growth more than 6% per year (IMF) and corresponding power demand has been increasing more than 10% per year. However, due to drought in recent years, the amount of hydraulic power generating has been decreasing and TANESCO has been buying the electrical power more and more from Independent Power Producer (IPP) to cover the demand and offset a shortage due to decrease in hydraulic power generation. As a result, as of 2011, back spread between electricity tariff (0.12 ¢ /kWh) and the electricity tariff from IPP (0.20 ¢ /kWh) was caused and TANESCO was put in the severe situation. Moreover, public aid from the government and donors became diminished due to the trial to privatize TANESCO from 1992 through 2006, investment in facilities and equipment, and manpower was reduced. This led facility deterioration and frequent power outage occurred (26.3 hours/ month) due to lack of maintenance etc. and in consequence, this constituted a serious obstacle to socioeconomic activity.

Under the above circumstances, Tanzania government requested Japan Technology Cooperation Project (hereinafter referred to as “This Project”) in order to improve human resource development system in TANESCO and to improve operation and maintenance practices in 2007.

The project purpose is “to improve and sustain the internal system of human resource development” and

- ① The training system for distribution and substation operation in TANESCO Training School (TTS) is developed,
- ② Each level of artisans, technicians and engineers working for distribution and substation operation is trained and certified through the training system at TTS,
- ③ Quality management (QM) activities are introduced to TANESCO and its activities are promoted continuously, and
- ④ Reflect the outcomes of training at TTS and Quality Management (QM) activities into technical activities related to distribution and substation operation

The above 4 outcomes are set as a goal and the corresponding activities were commenced in 2009.

1.2 Process of Project

As a result of evaluation at the time of the project completion in February, 2014, each outcome was almost achieved. However, it is still required to check quantitative effect about reduction in the number and the duration of outage in the pilot area etc. and expand the activities throughout Dar es Salaam in order to maximize the effect of this project and ensure the sustainability. Therefore, model quality management (QM) structure for operation and maintenance was set as a main activity in order to reflect into the training contents at TTS, extension of project duration up to 1.5 year was agreed with TANESCO and they signed Minutes of Meeting (M/ M).

1.3 Project Purpose

The project sets overall goal of “The improved operation and maintenance practices are implemented at distribution and substation facilities of TANESCO” and project purpose of “to

improve and sustain the internal system of human resource development”, and is intended to develop the following desired outcomes and achieve the project purpose by carrying out activities;

Outcome 1: The training system for distribution and substation facilities of TTS is developed,

Outcome 2: The artisans, technicians and engineers working for distribution and substation facilities are trained and certified through the training system at TTS,

Outcome 4: Models of maintenance practices for distribution and substation facilities to utilize knowledge and skills acquired through the technical training and Quality management (QC) activities are established, and

Outcome 5: Technical working procedures for operation and maintenance of distribution and substation facilities are standardized

2. Implemented Activity

2.1 Activities in relation to Outcome 1

2.1.1 Distribution

- a. Select granting tools, equipment and consumables (the equipment)

Consult with Counterpart (CP) and Long-Term Expert (LTE) about development of training facilities and equipment related to model practice in the pilot area, and select the equipment.

➤ Actual Activity Contents

Required equipment for OJT activity was selected after due consultation with CP of TANESCO and LTE. Model offices were selected at kick off meeting and the equipment was determined in quantity, handed over and delivered to the objective regions.

- b. Develop TTS Annual Training Plan

Check the training plan for each level of technicians, engineers and artisans in Distribution area and give advice.

➤ Actual Activity Contents

Actual training achievement and training plan in 2014 and 2015 were reviewed including specialized training with TTS PTO and confirmed that the trainings in 2014 and 2015 were implemented as planned. We gave them advice that it is important to keep implementing the training with the current contents as well as to appropriately revise the contents when new techniques are integrated or new issues are arisen etc.

- c. Develop training curriculum and text materials

Consult with CP about training curriculum and text materials required for development and determine the priority and contents to be developed in the project.

➤ Actual Activity Contents

A workshop in relation to the demarcation point between distribution and substation was held to clarify the demarcation point of operation at common facilities between distribution and substation, and to discuss any texts need to be revised TTS PTO. The current text materials were reviewed and confirmed that no revision is required so far.

- d. Prepare training curriculum and text materials

Supplement the training curriculum and text materials based on the contents consulted with TFM.

➤ Actual Activity Contents

The current text materials were reviewed with TTS PTO and confirmed that no revision is required so far.

- e. Train and certify trainers

Carry out TOT about supplement curriculum and text materials newly prepared.

➤ Actual Activity Contents

Since no revision was required, TOT was not conducted.

2.1.2 Substation

a. Select the equipment

Consult with CP and LTE about development of training facilities and the equipment related to model practice in the pilot area, select, and purchase the equipment.

➤ Actual Activity Contents

The equipment required for OJT activity and the quantity was determined through the consultation with CP of TANESCO and LTE, handed over to TANESCO in June, 2015 and delivered to zonal workshops accordingly.

b. Develop TTS Annual Training Plan

Check the training plan for each level of technicians, engineers and artisans in Substation and give advice.

➤ Actual Activity Contents

Actual training achievement and training plan in 2014 and 2015 were reviewed including specialized training with TTS PTO and confirmed that the trainings in 2014 and 2015 were implemented as planned. We gave them advice that it is important to keep implementing the training with the current contents as well as to appropriately revise the contents when new techniques are integrated or new issues are arisen etc.

c. Develop training curriculum and text materials

Consult with CP about training curriculum and text materials need to be developed and determine the priority and contents to be developed in the projects

➤ Actual Activity Contents

A workshop in relation to the common facility operation between distribution and substation was held with TFM of distribution and substation, TTS PTO and CP to clarify the demarcation point of operation at common facilities between distribution and substation, and to discuss any text materials need to be revised.

d. Prepare training curriculum and text materials

Supplement the training curriculum and text materials based on the contents consulted with TFM.

➤ Actual Activity Contents

Load management of common facility operation between distribution and substation was incorporated into the development plan of curriculum and text materials for substation plan, prepared and supplemented together with TFM.

e. Train and certify trainers

Conduct TOT about supplement curriculum and text materials newly prepared.

➤ Actual Activity Contents

TOT for 6 trainers was implemented about the curriculum and text materials for substation plan in which load management of common facility operation between distribution and

substation was incorporated in order to foster them.

2.2 Activities in relation to Outcome 2

2.2.1 Distribution

a. Check training contents

Check and consult with CP about the training contents for distribution at TTS and list up any additional training contents required.

➤ Actual Activity Contents

The consultation with TTS PTO and facilitators revealed that the manner of common facility operation between distribution and substation, load data collection at SS and those utilizing have partly problems but the countermeasures have been already incorporated into the text materials.

b. Conduct a training based on the training plan

Provide monitoring and advice whether the training contents are along with the review based on the annual training plan.

➤ Actual Activity Contents

Training contents was monitored and an advice was provided as needed, about especially the training contents (contents of text materials and the training procedure) which TANESCO had independently planned and been carrying out.

c. Conduct a final exam to the trainees

Check the current evaluation system at the time of training completion, evaluate it and consider the new structure.

➤ Actual Activity Contents

It was confirmed at the meeting with TTS PTO that TANESCO has been independently carrying out the final exam. The contents of final exam were explained and confirmed there were no problems. Since the assessment of skill level for actual site work shall be essential hereafter in order to secure the power quality, we suggested introducing a system to rank the skill level.

d. Check the training implementation status and its contents

Participate in M&E based on CP plan, check the status and give advice as needed.

➤ Actual Activity Contents

Schedule for M&E was arranged with TTS PTO and checked the implementation status based on M&E implementation plan of TANESCO, and we gave advice. It was found that it was securely implemented based on the annual implementation plan. We reviewed the implementation report and gave advice that necessary following-up shall be securely provided. Also, we gave advice that appropriate review shall be required if any issues on text materials and/ or time schedule of training etc. are arisen after actual performance.

2.2.2 Substation

a. Check training contents

Check and consult with CP about the training contents for substation at TTS and list up any additional training contents required.

Upon due verification of technical understanding by CP, especially about basic knowledge of substation facilities (interrupting capacity, phase adjustment equipment (shunt reactor and static capacitor), function of relay, protection coordination, and equipment grounding etc.) and substation plan (points of attention to substation new construction/ expansion, basic power flow analysis, compliance of transmission and substation capacity, transformer load, normal utilization ratio, ultimate overload utilization ratio, idea of number of transformers installed, transformer capacity and compliance of number of distribution line outgoing etc.), consider the necessity of training and list up any additional training contents required.

➤ Actual Activity Contents

The current training curriculum and text materials at TTS for substation were reviewed and training for substation plan was discussed with TFM. Consequently, it was determined to newly implement training for substation plan and the text materials were prepared. TOT was carried out with the prepared text materials and the training was implemented accordingly.

b. Conduct a training based on the training plan

Provide monitoring and advice whether the training contents are along with the review based on the annual training plan.

➤ Actual Activity Contents

Training contents were reviewed and advice was given as needed.

c. Conduct a final exam to the trainees

Check the current evaluation system at the time of training completion, evaluate it and consider the new structure.

➤ Actual Activity Contents

We provided advice on implementation of final assessment with evaluation sheet using for M&E after training and introduction of qualification test in relation to site activity. We also confirmed that TANESCO independently implemented the final exam and provided advice on the contents.

d. Check the training implementation status and its contents

Participate in M&E based on CP plan, check the status and give advice as needed.

➤ Actual Activity Contents

M&E schedule was arranged with TTS PTO, M&E implementation status in TANESCO was checked based on the plan and advice was given.

2.3 Activities in relation to Outcome 4

2.3.1 Distribution

a. Introduce Quality Management (5S, KAIZEN)

Check KAIZEN introduction status on site in distribution, pick up tasks on site and for introduction of KAIZEN, consult with CP about introduction plan for KAIZEN activities, and promote KAIZEN introduction on site through OJT.

- Check KAIZEN introduction status on site in Distribution

➤ Actual Activity Contents

Following-up was verified in relation to the improvement activity after the training for technicians and engineers. Due to bad report collection rate of improvement activity performance after training, advice to simplify the report was given in order to use and collect it more and as a result, reflect the result into the actual work.

- Pick up tasks for introduction of KAIZEN and establish introduction plan.

➤ Actual Activity Contents

Opinion was exchanged on issues of common facility operation between distribution and substation at the workshop of substation plan and OJT seminar. As we instructed to hold a joint coordination meeting between distribution and substation regularly to resolve the issues, the meeting has been regularly held (every other month) since April, 2015.

- Introduce KAIZEN activities through OJT

➤ Actual Activity Contents

Subjects to be addressed were determined at kickoff meeting and OJT seminar. It was determined to prepare HV distribution line diagram and pole sheet from the aspect of strengthening facility management, and documents to grasp the work progress and performance from the aspect of business operation.

b. Promote use of training outcome to the site activities

- Demonstrate maintenance and management of distribution facilities on sites.

➤ Actual Activity Contents

Specialized training for repair plan and OJT seminar were held regarding patrol plan upon the accident analysis at distribution line, how to establish the repair plan and progress control etc. in order to develop a better understanding of activity to decrease in the number of accidents at distribution line (OJT activity). Distribution and substation department discussed about work with no power which is one of the common activities of repair work as we had instructed to prevent repetitive power shut down for a work in the overlapped area, and consequently, the schedule for power shutdown was mutually arranged during OJT activity. Specialized training regarding how to identify decrease in the number of power shutdown and reduction in time of power outage was carried out in order to grasp the outcome of OJT activity.

- Check the status of model practice in the pilot area, arrange the further schedule and Actual Activity Contents, and provide advice about the establishment of pilot area.
 - Actual Activity Contents

It was revealed that a series of activity was postponed since the end of July, 2014 in K' North so it was determined to implement OJT activity together with other 3 pilot areas newly selected.

- In order to share the outcome of model practices in the pilot area, discuss and determine the additional pilot area in Dar es Salaam with CP.
 - Actual Activity Contents

Distribution department and TTS discussed to select pilot areas, and 4 areas were picked up and determined as a pilot area at kickoff meeting.

- Discuss and fix the work schedule to grasp the current condition of distribution network in the additional pilot area with CP.
 - Actual Activity Contents

Patrol plan and repair work plan were established according to the priority based on the results of analysis after collection of accident records at the pilot areas. Patrol has been carried out since January, 2015 and repair work has been executed since February, 2015.

- Provide advice about the activity to grasp the current condition and progress in the additional pilot area to CP.
 - Actual Activity Contents

In order to figure out the facility condition, patrol implementation contents, the consolidated manners of malfunctions, preparation status of facility management documents were checked to the regions while visiting, and provide advice and training for patrol to enhance the accuracy of figuring out the condition. In order to verify the progress on a monthly basis, Monthly Progress Report was prepared, rules to monthly report to executives were set and the operation was commenced.

- Discuss and determine the maintenance plan at distribution network in the additional pilot area with CP.
 - Actual Activity Contents

As regional engineers were consulted and provided advice about the idea of repair plan, repair plan was established. While visiting at each region, it was checked whether appropriate review was provided according to the progress and corresponding follow-up was provided. In the beginning, due to lack of materials and equipment as well as vehicles, the progress was delayed in whole, but after advice to share the available materials and equipment as well as the vehicles among zones and regions to the managers, improvement was gradually obtained. Advice was provided that OJT coordinator and CP shall arrange the share of materials equipment on zone basis.

- Provide advice about the model maintenance practices at distribution network in the additional pilot area to CP.
- Actual Activity Contents

It was confirmed that repair work was commenced under the repair plan. Progress management was monitored, advice was given, and sampling test at completed part of the repair work and instruction in failure work was provided.
- Grasp the quantitative effect about reduction in number and duration of power outage in the pilot area.
- Actual Activity Contents

Data was collected and the effect was estimated. Each region did not manage the load at distribution line, so the amount of power was calculated under the amount of power sales.
- Summarize quantitative effect and calculate the effect of improvement of TANESCO's earnings.
- Actual Activity Contents

Potential income currently losing was estimated based on the electricity unit rate derived from the number of power outage, time duration of power outage and the amount of power sales revealed.

2.3.2 Substation

a. Introduce Quality Management (5S, KAIZEN)

Check KAIZEN introduction status on site in substation, pick up tasks on site and for introduction of KAIZEN, consult with CP about introduction plan for KAIZEN activities, and promote KAIZEN introduction on site through OJT.

- Check KAIZEN introduction status on site of Substation.
- Actual Activity Contents

Following-up action of improvement activity after training for technicians and engineers was reviewed. Improvement activity report after training suffered from low response rate, so the report was simplified to increase the rate and reflect the outcome into the actual work accordingly.
- Pick up tasks of KAIZEN introduction and establish introduction plan.
- Actual Activity Contents

Opinion was exchanged on issues of common facility operation between distribution and substation at the workshop of substation plan and OJT seminar. As we instructed to hold a joint coordination meeting between distribution and substation regularly to resolve the issues, the meeting has been regularly held (every other month) since April, 2015.

- Introduce KAIZEN activities through OJT

➤ Actual Activity Contents

In order to figure out the conditions at the time of visual and periodic inspection, malfunction detection, and implementation of repair, and the failure facility condition in order to secure the maintenance budget to avoid accident from occurring, management by “Malfunction Report” and “Monthly Report” etc. which record the malfunction condition revealed through the inspections, judgment of urgency, repair manner and the result, was introduced. During OJT activity, the following instruction and advice were provided;

- Carry out a work with power shutdown by distribution and substation at the same time in order to reduce the time duration of power shutdown
- Control spare parts inventory in order to properly procure materials and equipment for repair work
- Improve inspection and repair work, such as insulator cleaning work to maintain insulation, and contact cleaning work and lubrication of movable part of equipment

b. Promote use of training outcome to the site activities

Demonstrate maintenance and management of substation facilities on sites.

➤ Actual Activity Contents

25 distribution substations in DAR were intended for activity and we accompanied on visual inspection (once every other month), periodic inspection (once a year) and repair work and provided instruction and advice.

a) Implementation status of visual inspection and periodic inspection

- Visual inspection: 109 times (25 substations)
- Periodic inspection: 25 times (25 substations)

b) The number of malfunction detected and repair

- Total number of malfunction detected: 177
- The number of malfunction repaired: 72

The major malfunction which may lead an accident was preferentially repaired.

c) Seminar for promotion of understanding of preventive maintenance

The following seminars were held in order to promote further understanding of preventive maintenance;

- “Understand of purpose and manner of preventive maintenance and work implementation according to the guideline” (interpretation of workflow which supplements the guideline)
- The advantage of early detection of malfunction using “the advantage of preventive maintenance compared to breakdown maintenance”

d) Outcome of OJT activity

Through OJT activity, “skill level of maintenance work” and “the advantage of implementation of preventive maintenance” were assessed. As a result, the following outcome could be obtained;

- Maintenance work skill was dramatically improved compared to before-after OJT

activity.

- Big results in cost evaluation (loss avoidance of facility repair expense and the amount of power outage in case of accident) were obtained by repairing “major malfunction may lead accidents.”

2.4 Activities in relation to Outcome 5

2.4.1 Distribution

a. Promote use of training outcome to the site activities.

- Check the contents of working guideline and manual for maintenance of distribution facilities and O&M management.

➤ Actual Activity Contents

Distribution department in TANESCO prepared the construction manual and submitted it to the executives, but they instructed to revise it by voltage and simplify it so the distribution department reviewed it. The revised construction manual was verified and advice was given. The revised one shall be submitted to the next Technical Examination Committee.

OJT manual covering implementation items for each step (the manner of accident analysis at distribution lines, idea of priority, patrol viewpoint, the way to detect malfunction, record management, inspection after work completion, judgment of construction effect etc.), and attention to the repair plan establishment through the model office activity in 2014 was prepared together with TANESCO. The OJT activity was carried out according to the manual.

- Review the working guideline and manual of the consistency between working guideline and manual on site, and training contents at TTS

➤ Actual Activity Contents

It was confirmed that a part of construction manual has already been incorporated into the practical training for artisans at TTS. OJT activity according to the manual has been carried out and no issue to review are found so far.

2.4.2 Substation

a. Promote use of training outcome to the site activities.

- Check the contents of working guideline and manual (Preventive Maintenance Work Procedure and Working Procedure) for maintenance of substation facility and O&M management. Note that the contents of working guideline should include inspection result till maintenance (fault detection, maintenance plan (including prioritizing), maintenance work)

➤ Actual Activity Contents

The contents of guideline and manual prepared in phase I was verified and supplement of contents, such as inspection classification, inspection result, repair plan and repair work. Guideline and manual for inspection and O&M were prepared. After that, workflow including inspection result and repair work etc. to supplement the guideline was prepared and training was provided at the seminar of promotion of understanding.

- Review the working guideline and manual to ensure the compliance between working guideline and manual on site, and training contents at TTS.
- Actual Activity Contents
The consistency between training contents at TTS and the guideline and manual was confirmed.

3. Challenges, Applied Methods and Lesson in the Project Implementation

3.1 Challenges and creative effort

Regarding outcome 1

- The necessary materials were not prepared at the right moment.
In case of any project to mainly implement actual work like this time, delay in material preparation is concerned about contributing stagnation in activity. During this project, OJT objective regions borrowed minimum equipment and tools out of the equipment previously handed over to TANESCO, regions were mutually borrowing and lending the equipment etc. actively and OJT activity could be implemented as planned. (DIS)
- There is no rule to set when and who review the training curriculum and text materials as well as when and who prepare the training curriculum and text materials when new technique, construction manner and equipment are introduced. (DIS and SS)
- Training for new system TANESCO independently developed was monitored and it was revealed that the training focus on only how to use the system, not on how to utilize the data from the system. (DIS)

Regarding outcome 2

- Training evaluation system was introduced. (DIS and SS)
A system should identify and/ or verify the necessity of training, the contents and location etc. It is anticipated that the system cannot be an as-needed training if the current training implementation manner is applied.
- Well-stocked materials, equipment, tools and measuring instruments etc. at each site (DIS and SS)
Even though proper construction manner with adequate skills, techniques and knowledge are provided through the training, due to lack of materials, equipment, tools and measuring instruments, the trained ability cannot be demonstrated. It is urgently necessary to prepare the materials, equipment, tools and measuring instruments required for the site work.

Regarding outcome 4

- A structure for work improvement was introduced. (DIS)
Even though the accuracy of data required for OJT activity was further promoted in order to enhance understanding of improvement activity and the logbook and monthly progress report in MS Excel were prepared and shared in order to minimize the activity, TANESCO members did not recognize the above mentioned activities are to encourage the deepening of improvement activity. It is necessary to take an approach to pick up tasks as a starter of KAIZEN approach, to enhance awareness of KAIZEN and change in the way of thinking by TANESCO members.
- Supply reliability was improved by discussion among departments.
Joint coordination meeting between distribution and substation departments was introduced and established in TANESCO. It is necessary to reduce power shutdown for works (planned power shutdown/ power outage by accident) with close coordination among departments on site basis and

to work on investigating into the cause of accidents and we suggested that joint coordination meeting is required to hold on mainly zone, region and workshop level basis. In OJT activity, zone managers held joint coordination meeting between distribution and substation department once every three month and its effect, such as reduction in overlapped power shutdown in relation to work and/ or inspection for distribution and substation etc. was seen. The development to other regions is hereafter expected. (DIS and SS)

- Even though various improvement activities were implemented such as preparation of records like Monthly Report etc. and work procedure etc., the member of TANESCO did not yet understand this is the way to improve. It was suggested that the member of TANESCO have a resistance to change from the old habit and if this goes on, it is concerned to change nothing and fall into a decline. An activity dedicated to improvement is expected. (SS)
- In the beginning, managers who can be a center of regions, such as regional managers and/ or principal engineers etc. were not really involved, and we realized that they did not find OJT activity important to do as a part of routine work. Therefore, their consciousness was encouraged by, consultation with regions while visiting, close opinion exchange among zone managers and managers at distribution department and updating OJT activity status and current issues. Consequently, a certain effect could be achieved, such as to discuss and take a countermeasure against lack of vehicles and/ or equipment on their own. (DIS)
- Even though repair work is basically required for power shutdown, it is too large to shut down the whole area of repair work, so it is necessary to consider the system structure enable to narrow the area of power shutdown. (DIS)
- OJT activity contributed to preparing diagram of distribution network and pole sheet which are the basis for facility management. Hereafter, it is essential to set a rule to keep updating the facility data. (DIS)
- As the contents of work instruction are unclear and not described precisely, workers do not exactly understand the work and the quantity of materials and equipment required for maintenance were not clear and these fell into lacking. In order to clarify the work contents, it is necessary to develop shop drawing and figure out them. Shop drawing helps facility management documents updating. (DIS)
- Although OJT activity focused on facility maintenance, approach from facility plan and inspection after work completion is vital in order to enhance further accident reduction at distribution line. It is necessary for TANESCO head office to implement KAIZEN in business operation. (DIS)
- The top cause of accident at distribution lines is unknown. This is because the same accident was recorded by several regions redundantly so recording manner should be reviewed. (DIS)
- Maintenance work as a part of OJT activity was developed according to the guideline. As a result of assessment, organization level of skill and technique was dramatically improved. However, assessment by organization level means that there is an expert, at least, in the organization for a certain activity and it does not mean all the members in the organization reach that skill level so it is significant to raise the skill level of all the members in the organization with activity centering on the expert. (SS)

Regarding outcome 5

- Construction manual is subject to review once any new technique, construction method or equipment shall be introduced and after review and approval, it is necessary to keep everyone informed on site.

Distribution department in TANESCO has a standard of “Engineering Instruction” but it has not been reviewed since 2008 so immediate review is required. (DIS)

- It is necessary for TANESCO internally to set a rule for updating standard documentation and document management structure (systematic management and supervisory structure including who revise the standard documentation, make a corresponding arrangement and take charge of the standard documentation.) (SS)
- Structure shall be able to regularly check whether standard documentations need to be reviewed or revised etc. (DIS and SS)

3.2 Lesson

Organize the lesson regarding “securing of resources” and “change in the way of thinking” which have become issues since the original period, as well as “quantitative grasp of the project outcome” which was set in this phase.

【securing of resources】

Delay in activity became issues due to lack of materials, equipment and vehicles as well as manpower. Therefore, during OJT activity in this period, issue resolution by borrowing and lending materials, equipment and vehicles among the objective regions and information exchange were strongly suggested and information was closely exchanged in order to enhance the involvement of regional managers for issue resolution.

【change in the way of thinking】

Preventive maintenance which is the basic idea of OJT activity, contributed to improving the facility reliability. Consequently, a certain result, such as reduction in compliments of power outage by accident at distribution lines and emergency service was achieved and OJT team found the activity effective. However, teams other than OJT team realized the effect so they did not become fully consciousness to reduce accidents at distribution lines and have still been carrying out a non-standard work. It is essential for TANESCO to recognize to share the activity to other teams in order to understand OJT activity is required to be carried out as a routine work.

【quantitative grasp of the project outcome】

Quantitative grasp of outcome was hard for TANESCO because they did not collect and analyze the data, such as the time and number of power outage/ shutdown, but generally speaking, it is expected that quantitative grasp of project outcome may contribute to encouraging the initiative of counterpart and the objective organization. That is why its preparation is required in the beginning of the project.

3.3 Issues related to other activities

According to the experience through this project, OJT activity was often postponed while STE were out of Tanzania so during this extension period, the visit schedule of STE was arranged to minimize the period of their absence as much as possible. However, the activity was still suspended during the period of absence. Therefore, it is necessary to consider how to check and follow up the activity during the period of absence.

Information, such as idea of relevant activities and progress etc. is vital to perform the activity, and close coordination with the relevant activities and establishment of a course of action and its implementation enable to carry out activity more effectively as well as JCC and session of working group. It is considered that related parties shall share the information closely.

4. Accomplishment of project object

Outcome 1 was accomplished as follows;

- TTS achieved the competency in establishment of annual plan and implement general and specialized training for distribution and substation as planned including selection of objective persons.

Outcome 2 was accomplished as follows;

- Artisans, technicians and engineers for both distribution and substation were trained according to the annual plan and approved by final exam which TANESCO developed.

Outcome 4 was almost accomplished as follows;

- Distribution department shared the data by intranet with departments, regions and relevant parties in order to define the reporting route by results from Accident Report at Distribution Lines (Logbook) and Monthly Progress Report through OJT activity, progress management and preparation of workflow. However, TANESCO did not find those activities are a part of KAIZEN activities.

Substation department shared the information of malfunction detection and repair progress together with workshop and substation department of head office by Monthly Progress Report. The status of equipment is respectively managed by Malfunction Report including determination of urgency, repair manner and after-repair report when a malfunction is detected.

- OJT activity for distribution, such as prioritizing from establishment of repair work plan through work implementation and repair area setting etc. was implemented on the basis of voluntarism of OJT implemented regions so STE provided advice as needed when they visited. Consequently, it promoted regions' independence and they did the repair work by themselves with their creativity. Maintenance work became enriched in OJT implemented regions. Number of accident at distribution lines and time duration of power outage were decreased.

After holding OJT seminar of "understanding purpose and manner of preventive maintenance and conduct work along with the guideline", everybody in the substation department was on the same page and work development (inspection plan ~ inspection ~ repair plan ~ repair ~ facility management) according to the guideline was carried out. Also maintenance skill was dramatically improved through OJT activity. Furthermore, "malfunctions detected by OJT activity" were treated, so accident was prevented from occurring and significant result in cost (cost for facility repair in case of accident occurred and avoidance of supply loss during power outage) could be achieved. Effect was showed by OJT seminar of "cost advantage of early repair" and it is expected that further approach according to the guideline and utilization as an evidence of internal budget request for repair.

Outcome 5 was almost accomplished as follows;

- For distribution, draft construction manual was prepared and currently under approval in order to standardize it in TANESCO. OJT work procedure is supposed to be reviewed by TANESCO after OJT activity for standardizing.

For substation, substation maintenance guideline is supposed to be approved and after approval, documents used in 2 OJT seminars, "understand of purpose and manner of preventive maintenance

and work implementation according to the guideline” and “cost advantage of early repair” which have already held shall be incorporated into this guideline as a reference.

5. Suggestion for accomplishment of overall goal

It is vital to maintain the idea and manner in this project and improve by PDCA repeatedly in order to achieve overall goal. At that time, the process to improve, involvement of executives, improvement of manner suitable for each region and information sharing among department are significant.

It is important for executives to be aware of the fact that operation and maintenance of facility greatly contributes to the business of TANESCO as well as the work improvement of each relevant department, such as facility plan, procurement and human resource department etc. In order to keep facilities in good condition, various things, such as personnel, vehicles, equipment, tools and materials etc. are essential and approach is necessary with mutual awareness among department as one.

OJT activity for distribution during this project period was held at a relatively short cable length line so it is required for the area has longer cable length line to change in approach appropriately. Also, there were some people for substation whose skill was dramatically improved in inspection, repair, maintenance technique and management. An expert needs to help others not only in the OJT implemented workshop but also in other workshop of TANESCO for enhancing technique. It is considered to bring a certain effect to repeatedly try PDCA.

Synergetic effect in improvement activity is considered to be brought by sharing information among departments. In case of failure at a facility, there is a cause. It is expected to prevent a facility accident from occurring by sharing the result of investigating the cause. Also, sharing information by the inspection after work completion leads to interfere with a failure work from occurring by enhancement of inspection accuracy. During this project period, joint coordination meeting between distribution and substation department was positively held in order to share the information among departments and it is required to recognize the importance of the information obtained from the meeting and to closely coordinate and contact with departments.

6. Appendix

6.1 OJT Implementation Structure in Extension Period

6.2 Project Design Matrix

6.3 Expert Dispatch Record (Personnel Planning)

6.4 Documentation for handing over of Granting tools and equipment

6.5 Minutes of Meeting of JCC etc

6.6 Cost-effectiveness trial calculation documents

【Distribution】

【Substation】

6.7 The other (documents for continued use after project implementation)

【Distribution】

- Workflow
- Log Book
- Monthly Progress Report

【Substation】

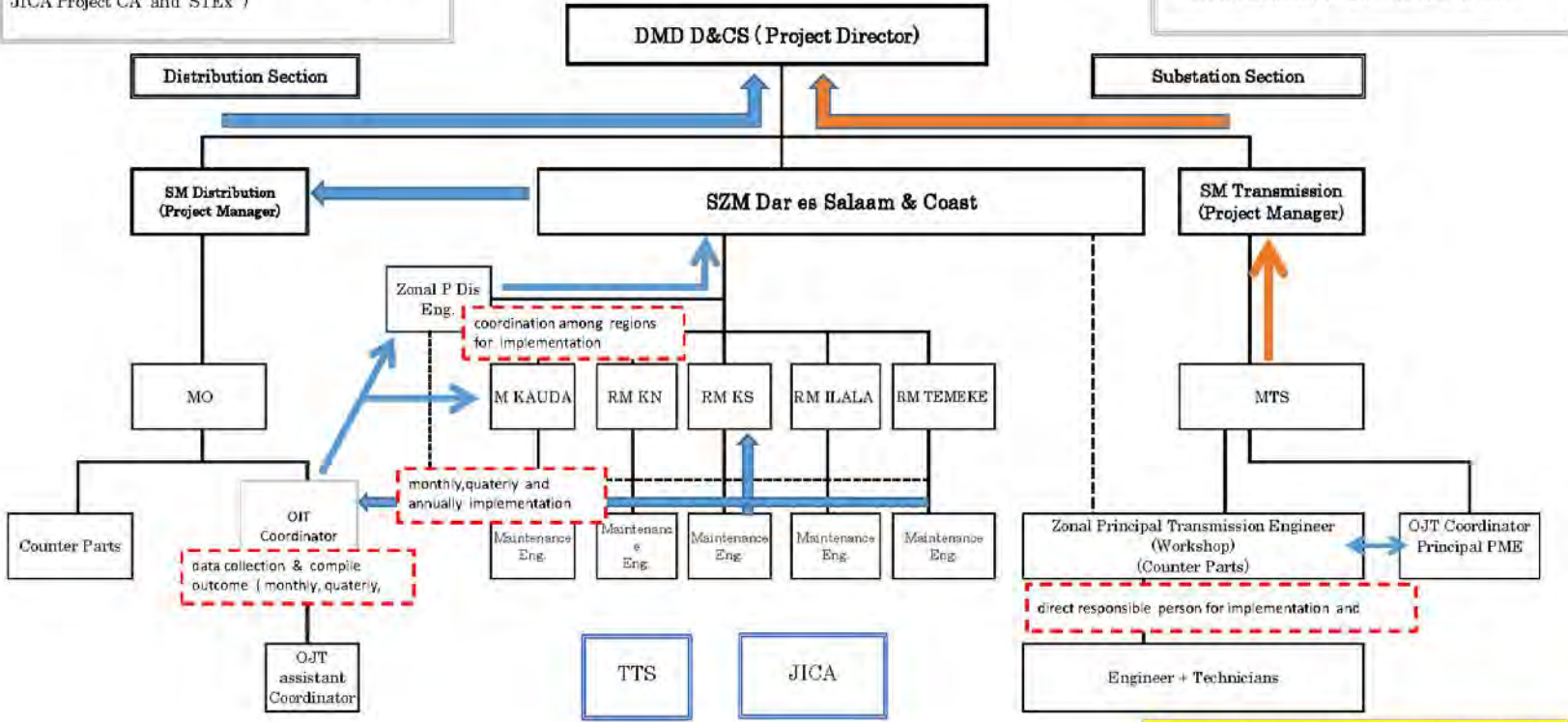
- Workflow
- Malfunction Report
- Monthly Report
- Improvement assessment of technique and skill by OJT activity

6.1 OJT Implementation Structure in Extension Period

Report flow for Distribution
 ① Main Eng. in Region to OJT Coordinator
 ② OJT Coordinator to Zonal P Dis Eng. & AHM
 ③ Zonal P Dis Eng. to SZM DSM&Coast
 ④ SZM to SMD (Project Manager)
 ⑤ SMD to DMDD&CS (CC : JICA Tanzania and JICA Project CA and STEx)

OJT Implementation Structure in Extension Period (Draft)
 THE PROJECT FOR CAPACITY DEVELOPMENT OF EFFICIENT DISTRIBUTION AND TRANSMISSION SYSTEMS

Report flow for Substation
 ① Zonal PE (OJT Coordinator) to MTS
 ② MTS to SMT (Project Manager)
 ③ SMT to DMDD&CS (CC : SZM DSM&Coast JICA Tanzania , Project CA and STEx)

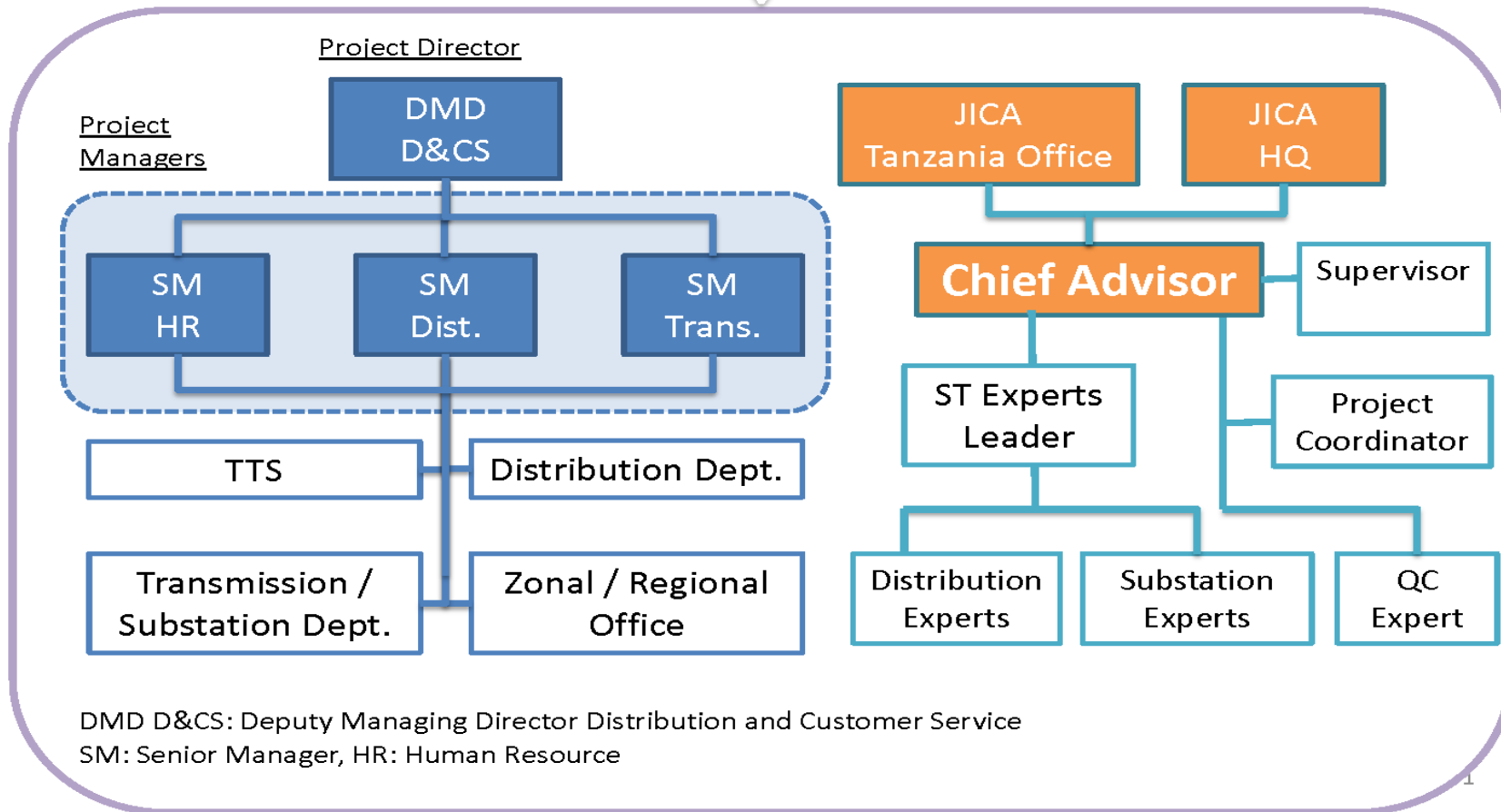


- ◆ OJT Target area
 1. Distribution : 4 Regions in Dar es Salaam
 2. Substation : 33/11 kV Substations in Dar es Salaam
- ◆ JICA Experts with TTS give necessary Training / Instruction to responsible people before the work start and during the work
- ◆ JICA Experts also request the adhoc "Joint meeting" to exchange and share common information for the effective and efficient implementation
- ◆ JICA expects TANESCO will adapt this manner of work to upcountry after the Project.

◆ update by the talk between Ag.SMT&MTS and JICA CA
 ◆ the new scheme will be finalized at end of 2014

Joint Coordinating Committee

(chaired by MD of TANESCO)



6.2 Project Design Matrix

1. Project Title: The Project for Capacity Development of Efficient Distribution and Transmission systems

2. Project Period: 6 years and 8 months (August 2009 – March 2016)

3. Implementing Organization: Tanzania Electric Supply Company LTD. (TANESCO)

4. Project Location: Tanzania

5. Target Group: Artisans, Technicians, Engineers and Administrators of TANESCO

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
<p>Super Goal Reliability of power system of TANESCO is improved.</p>	<p>a. The number of disconnection faults of distribution lines is decreased; b. The number of failures of substation equipment is decreased.</p>	<p>a. Records of disconnection faults of distribution lines by each regional office; b. Records of failures of substation equipment by each substation.</p>	
<p>Overall Goal The improved operation and maintenance practices are implemented at distribution and substation facilities of TANESCO</p>	<p>a. The standardized practices of maintenance for the distribution facilities introduced by the Project are implemented in Dar es Salaam Regions by 2018. b. The standardized practices of maintenance for substation facilities introduced by the Project are implemented at all the substations in Dar es Salaam Regions by 2018. c. Standardized working guidelines and manuals for improved operation and maintenance of the distribution and substation facilities are practiced throughout TANESCO by 2018. d. The performance of the distribution network in the Dar es Salaam regions:* is improved: ➤ No. of outage by causes ➤ Duration of outage by causes *Baseline data (2013-2014) should be collected.</p>	<p>a. &b. Records and data of operation and maintenance of distribution facilities and substations in Dar es Salaam regions c. Records and data to check compliance of the working guidelines and manuals developed by the Project in all the regions. d. Records and data to verify the performance</p>	<p>- Budget for replacement and rehabilitation of power facilities is secured. - Operation and maintenance of power stations and transmission lines are properly carried out. -Sufficient power generation and transmission capacity are installed.</p>
<p>Project Purpose The internal system for human resource development is improved and sustained.</p>	<p>a. The mid-term plan for TTS is prepared and approved by the TANESCO management by 1Q 2013 b. Training Plan for TTS is integrated in the TANESCO Corporate Business Plan by the end of the Project. c. OJTs based on the model maintenance practices and the working guidelines and manuals for distribution and substation facilities are introduced in TANESCO by the end of the Project.</p>	<p>a. The mid-term plan; b. TANESCO Corporate Business Plan c. Monitoring and evaluation report for Artisan, Technician and Engineer; d. Monitoring and evaluation report on QC activity.</p>	<p>- Sufficient budget and human resources will be continuously secured for human resource development of TANESCO. - Sufficient budget for procurement of necessary equipment and tools for operation and maintenance of distribution facilities and substation will be continuously secured. - Incentive system for internal qualification and certification will be established and applied. - Trained and TANESCO certified trainers continue to work for training at TTS with good</p>

	d. The monitoring and evaluation system confirms the QC activities at the work places by the end of the Project.		incentives. - Trained facilitators continue to work for QC activities with good incentives.
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<p>Output 01</p> <p>The training system for distribution and substation facilities of TANESCO Training Schools (TTS) is developed.</p>	<ul style="list-style-type: none"> a. Trainings at TTS are incorporated in the approved training policy of TANESCO by January, 2009. b. Training curriculums and text materials for Artisans are developed in May 2011, and for Technicians and Engineers are developed in July 2012; c. Manager, 10 technical staff and 16 administrative staff members for TTS are assigned by the end of the Project. d. The certification systems for artisans, technicians and engineers are established by July, 2012. e. 31 of TANESCO trainers are trained by Oct. 2012. f. Necessary and adequate training facilities, tools, equipment and consumables are developed or procured by the end of project. g. Monitoring and evaluation system for trainings at TTS is established by Feb.2013. h. h Specialized course(s) are designed by the initiative of the Business Unit by the end of the Project. 	<ul style="list-style-type: none"> a. TANESCO Human resources Training Policy; b. Curriculum and text materials c. Organizational chart of TTS; d. Certificates e. Organization chart of TTS; f. Purchased equipment list (Japanese side and TANESCO side) g. Monitoring and evaluation report; h. Established Curriculums 	
<p>Output 02</p> <p>The artisans, technicians and engineers working for distribution and substation facilities are trained and certified through the training system at TTS.</p>	<ul style="list-style-type: none"> a. Annual training plan is prepared after 2012. b. TTS training is monitored and evaluated and improved. c. General training courses at TTS are conducted. <ul style="list-style-type: none"> i .558 of artisans are trained by the end of the Project. ii. Technicians are trained by the end of the Project. <ul style="list-style-type: none"> - Distribution : 294 - Substation: 82 iii. Engineers are trained by the end of the Project. <ul style="list-style-type: none"> - Distribution: 157 - Substation: 49 ** The target figures are as of November, 2012. b. Specialized course(s) are conducted since 2013. <ul style="list-style-type: none"> 453Technicians and Engineers are trained by the end of project. 	<ul style="list-style-type: none"> a. Annual training plan; b. TTS annual report, c. Records of training and certification and examination; <ul style="list-style-type: none"> i. certification and examination; ii. certification and task iii. certification and task d. TTS annual report, 	

<p>Output 03</p> <p>Quality Control (QC) activities are introduced TOTANESCO and its activities are promoted continuously.</p>	<ul style="list-style-type: none"> a. Curriculum of 5S training is developed by September, 2012. b. 20 facilitators for 5S activities are trained by December 2013. c. Strategic plan to introduce 5S activities TOTANESCO is developed and approved by the TANESCO management by March, 2012. d. Workshops for promotion of QC (5S and KAIZEN) activities are implemented 25 times by the end of project. e. KAIZEN approach is introduced Technical training. f. The monitoring and evaluation system is established by the end of the Project. 	<ul style="list-style-type: none"> a. Training curriculum; b. TOT and one week training, c. Approved Strategic plan; d. Record of QC workshop for promotion; e. training curriculum, f. Annual "M&E" report 	
<p>Output 04</p> <p>Models of maintenance practices for distribution and substation facilities to utilize knowledge and skills acquired through the technical trainings and QC activities are established.</p>	<ul style="list-style-type: none"> a. A procedure manual for model maintenance practices for distribution facilities in pilot site(s) is drafted by December, 2013. b. A procedure manual for model preventive maintenance practice for substation facilities is drafted by December 2013. c. On the Job Trainings (OJT) based on the procedure manual for maintenance of the distribution facilities in pilot site(s) in Dar es Salaam are implemented by the end of the Project. d. On the Job Trainings (OJT) based on the procedure manual for preventive maintenance at the pilot substations in Dar es Salaam are implemented by the end of the Project. e. Effects of the model maintenance practices for distribution facilities are verified by the end of the Project f. Effects of the model preventive maintenance practices for substation facilities are verified by the end of the Project. 	<ul style="list-style-type: none"> a. Drafts of model maintenance practices for distribution and substation facilities b. Records of OJTs in the pilot sites. c. Operational data collected by the model activities d. Operational data collected by the model activities e. Data on "Effects of model maintenance practice" f. Data on "Effects of model maintenance practice" 	
<p>Output 05</p> <p>Technical working procedures for operation and maintenance of distribution and substation facilities are standardized.</p>	<ul style="list-style-type: none"> a. Working guidelines and manuals for operation and maintenance of distribution facilities are prepared by the end of the Project. b. Working guidelines and manuals for operation and maintenance of substation facilities are prepared by the end of the Project. c. The working guidelines and manuals for 	<ul style="list-style-type: none"> a. working guidelines and manuals b. working guidelines and manuals c. revise text materials to reflect working guidelines and manuals 	

	<p>operation and maintenance of distribution and substation facilities are incorporated in the technical training courses at TTS.</p> <p>d. A check and supervision system for practice of the working guidelines and manuals is established.</p>	<p>d. document for check and supervision system for practice of the working guidelines and manuals</p>	
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Activities	Inputs	
<p>1. The training system for distribution and substation facilities of TANESCO Training Schools (TTS) is developed.</p> <p>1-1. Preparing Internal Training Policy;</p> <p>1-2. Carrying out Training Needs Assessment (TNA);</p> <p>1-3. Developing training facilities and procuring tools, equipment and consumables necessary for the training;</p> <p>1-4. Preparing curriculums and text materials; for training artisans, technicians and engineers;</p> <p>1-5. Preparing training plans for the artisans, technicians and engineers, respectively;</p> <p>1-6. Carrying out trainers' training and certify trainers;</p> <p>1-7. Preparing internal certification standard for the artisans, technicians and engineers, respectively;</p> <p>1-8. Establishing monitoring and evaluation system to review the technical trainings at TTS;</p> <p>1-9. Improving the training based on the results of the monitoring and evaluation;</p> <p>1-10. Developing the administration and management system for TTS;</p> <p>1-11. Designing specialized training course(s) by Business Units' initiatives;</p> <p>2. The artisans, technicians and engineers working for distribution and substation facilities are trained and certified through the training system at TTS.</p> <p>2-1. Carrying out general training courses for the artisans, technicians and engineers respectively;</p> <p>2-2. Carrying out certification examination, and certifying the successful artisans, technicians and engineers based on the internal certification standard.</p>	<p><Japanese Side></p> <p>A. Experts</p> <p>1. Long-term (Resident) Experts</p> <ul style="list-style-type: none"> - Chief advisor - Coordinator / Power Utility Training Program <p>2. Short-term (Visiting) Experts</p> <p>Short-term experts will be assigned in the following specialized fields:</p> <ul style="list-style-type: none"> - Operation and Maintenance of Distribution Facilities - Distribution Planning - Operation and Maintenance of distribution and grid Substations - Quality Management. <p>Short –term experts in other specialized fields will be assigned depending on the requirement for effective implementation of the Project.</p> <p>B. Training in Japan</p> <ul style="list-style-type: none"> - Counterpart Training (tailor-made courses and/or existing group training courses) - Third country training if necessary <p>C. Equipment etc.</p> <p>The equipment and tools will be provided depending on the necessity for effective implementation of the Project. The following areas of activities are provisionally selected:</p> <ul style="list-style-type: none"> - Training for distribution, substation - Distribution and substation maintenance works <p>D. <u>Local Cost:</u></p> <p><Tanzanian Side></p> <p>A. Counterpart Personnel</p> <ul style="list-style-type: none"> - Project Director: Deputy Managing Director of Distribution and Customer Services - Project Managers: Senior Manager Human Resources, Senior Manager Distribution, Senior Manager Transmission - Working Group members: Manager Training and Manpower Development, Human Resources Department, Manager TANESCO Training Schools, Manager Operations in Distribution Department, Manager Transmission Substation in Transmission Department, Principal Training Officer (Technical) TANESCO Training Schools - Task members: Managers and officers of the relevant Business Units, and TTS staff 	<p>- Trained and certified trainers continue to be assigned as trainers at TTS during the project implementation.</p>

<p>2-3. Carrying out specialized training courses for technicians and engineers, respectively;</p> <p>2-4. Preparing TTS annual reports;</p> <p>2-5. Planning and implementing a final workshop share the outcomes of the Project.</p> <p>3. Quality Control (QC) activities are introduced TOTANESCO and its activities are promoted continuously.</p> <p>3-1. Creating management awareness;</p> <p>3-2. Preparing strategic plan for 5S and KAIZEN promotion;</p> <p>3-3. Training facilitators for 5S and KAIZEN;</p> <p>3-4. Developing curriculum and materials for 5S and KAIZEN training;</p> <p>3-5. Carrying out 5S workshops at HR and the Regional Offices of TANESCO;</p> <p>3-6. Building the mechanism of monitoring and evaluation for 5S and KAIZEN activities;</p> <p>3-7. Monitoring 5S and KAIZEN activities;</p> <p>4. Models of maintenance practices for distribution and substation facilities to integrate technical training and QC activities are established.</p> <p>4-1. Designing models of improved maintenance practices for distribution and substation facilities</p> <p>4-2. Planning On the Job Training (OJT) based on models of maintenance practices for distribution and substation facilities.</p> <p>4-3. Implementing On the Job Training (OJT) at the pilot sites of distribution and substation facilities in Dar es Salaam;</p> <p>4-4. Collecting performance data of the distribution network in the pilot sites for OJTs, such as the number of outage by cause, duration of outage, etc.</p> <p>4-5. Assessing effects of technical</p>	<p>- 5S facilitators</p> <p>The membership will be flexible for accommodating changing requirement for the Joint Coordinating Committee and Working Group functions.</p> <p>B. Land, Buildings and others: Training facilities of TTS</p> <p>C. Office space and necessary facilities for Japanese experts</p> <p>D. Operational expenses;</p>	
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<p>trainings at work places of distribution and substation facilities</p> <p>5. Technical working procedures for improved operation and maintenance of distribution and substation facilities based are standardized.</p> <p>5-1. Identifying the current issues for operation and maintenance of distribution and substation facilities;</p> <p>5-2. Drafting working guidelines and manuals for operation and maintenance practices of distribution and substation facilities reflecting OJTs of the models of improved maintenance practices;</p> <p>5-3. Establishing a check and supervision system for practice of the working guidelines and manuals.</p> <p>5-4. Feeding back the contents of the working guidelines and manuals the contents of technical training courses at TTS</p>		<p style="text-align: center;">Pre-Conditions</p> <ul style="list-style-type: none"> - TANESCO has willingness to improve and sustain the training system. - Necessary budget, office space and facilities for the Project are allocated.
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6.3 Expert Dispatch Record (Personnel Planning)

Personnel Plan/ Expert Dispatch Record

Project: The United Republic of Tanzania

The Project for Capacity Development of Efficient Distribution and Transmission Systems (Distribution/ Substation)

1. Site Activity

Name (in charge)	Rating		No. of Travel	2014					2015												2016			Total No. of days	Total man month
				8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3		
Masaki Haruna (Leader)	2	Plan	4		█ (7 days)	█ (6 days)											█ (6 days)			█ (6 days)			25	0.83	
		Result	2		█ 9/7~9/13(7 days)	█ 11/2~11/8(7 days)	█ 7 days)										█ 9/6~9/12(7 days)			█ 2/10~2/13(4 days)			25	0.83	
Yasuhiro Tamura (Distribution Plan)	3	Plan	6		█ (20 days)	█ (30 days)			█ (30 days)		█ (30 days)					█ (30 days)				█ (26 days)			166	5.53	
		Result	5		█ 9/2~9/21(20 days)	█ 10/22~11/22(32 days)	█ 32 days)		█ 1/10~2/8(30 days)		█ 4/25~5/24(30 days)					█ 8/26~9/27(33 days)	█ 11/10~12/13(34 days)			█ 1/17~2/14(29 days)			208	6.93	
Yasunori Nishi (Distribution technique)	3	Plan	6		█ (20 days)	█ (30 days)			█ (30 days)		█ (30 days)					█ (30 days)				█ (26 days)			166	5.53	
		Result	3			█ 10/22~11/22(32 days)	█ 32 days)		█ 1/31~3/1(30 days)		█ 5/20~6/25(37 days)										█ 1/17~2/14(29 days)			128	4.27
Takafumi Nakada (Substation Plan)	3	Plan	6		█ (20 days)	█ (30 days)			█ (30 days)		█ (30 days)					█ (30 days)				█ (26 days)			166	5.53	
		Result	5		█ 9/2~9/21(20 days)	█ 10/22~11/21(31 days)	█ 31 days)		█ 1/10~2/8(30 days)		█ 5/2~5/31(30 days)										█ 1/23~2/14(23 days)			164	5.47
Katsuhisa Yamamoto (Substation Technique)	3	Plan	6		█ (20 days)	█ (30 days)			█ (30 days)		█ (30 days)					█ (30 days)	█ 8/29~9/27(30 days)				█ (26 days)			166	5.53
		Result	4		█ 9/2~9/21(20 days)	█ 10/22~11/21(31 days)	█ 31 days)		█ 1/31~3/1(30 days)		█ 5/23~6/21(30 days)									█ 11/14~12/13(30 days)		█ 1/23~2/14(23 days)			164
Katsuo Chiba (Interpreter)	4	Plan	6		█ (20 days)	█ (32 days)			█ (30 days)			█ (44 days)					█ (44 days)				█ (29 days)			199	6.63
		Result	4		█ 9/2~9/21(20 days)	█ 10/22~11/22(32 days)	█ 32 days)		█ 1/31~3/1(30 days)		█ 5/20~6/25(37 days)									█ 11/10~12/13(34 days)		█ 1/17~2/14(29 days)			182
Akiko Suzuki (Interpreter)	4	Plan	6		█ (20 days)	█ (32 days)			█ (30 days)			█ (44 days)					█ (44 days)				█ (23 days)			193	5.53
		Result	4		█ 9/2~9/21(20 days)	█ 10/22~11/21(31 days)	█ 31 days)		█ 1/10~2/8(30 days)		█ 4/25~5/31(37 days)						█ 8/26~9/27(33 days)				█ 1/23~2/14(23 days)			174	5.80
Site Activity																					Plan	1081	35.11		
Subtotal																					Result	1045	34.84		

6.4 Documentation for handing over of Granting tools and equipment



Date: 30/03/2015

Eng. Sophia S. Mgonja

Ag. Deputy Managing Director Distribution and Customer Services. (Project Director)

TANESCO

Dar Es Salaam

Re: HANDING OVER OF EQUIPMENT & TOOLS FOR THE PROJECT OF
CAPACITY DEVELOPMENT OF EFFICIENT DISTRIBUTION AND TRANSMISSION
SYSTEMS

The Project has been implemented through the partnership between TANESCO and JICA during the period of August 2009 to August 2014 in accordance with the Record of Discussion signed on 14th August 2008 and also extended up to March 2016 with Minutes of Meeting signed on 7th February 2014.

We have received your request letter Ref. SMD/MO/DISTRIBUTION dated on 27th March 2015 to purchase equipment and tools for the smooth implementation of OJT Maintenance works as an important part of the Project. After consideration and consultation with JICA Tanzania, the Project has agreed to provide those equipment and tools to TANESCO related Business unites directly. The hand over equipment and tools are as attached documents.

We emphasize you that you will use them to enhance the outcome of the training at TTS for improving your quality of the work. And also we concern your proper maintain of the said equipment and tools.

We would be grateful if you would send us an acknowledgement letter on this matter.

Best regards

長坂 = 部

Jiro Nagasaka

Chief Advisor

Head Office
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Morogoro Rd.
Ubungu, DSM,

Main Project Office
TANESCO Training School
Railway St/Mnyampal St, DSM
Tel +255 (0) 22 2119943

Project Office Masak
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Tel +255 (0) 22 2600078



The Project for the Capacity Development for Efficient Distribution and Transmission
Systems

CC: JICA Tanzania Office

CC: Senior Zonal Manager in DSM & Coast

CC: Ag. Senior Manager Transmission

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TANESCO Technical Training school
Tosama Ganga St, Masaki, DSM
Tel +255 (0) 22 2600078

Provision (Hand-over) of Equipment and tools

Project for Capacity Development of Efficient Distribution and Transmission Systems
(TANESCO-JICA PROJECT)

S/No	Description of Item	Unit	Requested quantity	Provision (hand over) quantity
1	Hydraulic compression tools (Manual Type) EP-410A	Ea	18	18
2	Dies for compression tools EP-410A 'UT2 (U-0)	Ea	18	18
3	Dies for compression tools EP-410A 'UT3 (U-D3)	Ea	18	18
4	Dies for compression tools EP-410A 'UT4 (U-D)	Ea	18	18
5	Dies for compression tools EP-410A 'Cu150-29	Ea	18	18
6	Check meter for compression tools EP-410A (check pressure) III Type	Ea	6	6
7	Short Circuit Ground Device	Ea	12	12
8	Insulation Operation Rod	Ea	12	12
9	Safety belt	Ea	18	18
10	Wire Grip 20-4K	Ea	18	18
11	Cable Cutter 600mm	Ea	18	18
12	Work bench on a pole 01 - Pole Platform (900mm) K-3	Ea	18	18
13	Work bench on a pole 02 - Pole Platform (11,00mm) K-4	Ea	18	18
14	Work bench on a pole 03 - Pole Platform (thick pole type) Polestart PS-2	Ea	18	18
15	Pole Climber - Spikes FG-1	Pair	18	18
16	Tool bag	Ea	25	25
17	Tool bag Size: Φ 300 * D 400mm	Ea	25	25
18	Brush for aluminium wire U type	Ea	60	60
19	Interval Measurement Rod (12m) FS-12	Ea	6	6
20	Engine chain saw MEA 5000G Red	Ea	11	11

21	Engine chain saw MEA3600M Red	Ea	6	6
22	Infrared Camera Ti90	Ea	3	3
23	AC & DC Clamp Meter DCM-400AD	Ea	3	3
24	SF Gas Leak Detector 3-033-R02	Ea	3	3
25	Digital Multi Meter 83-5	Ea	3	3
26	Waveform Observation Device Power Quality Analyser PW3198	Ea	2	2
27	Waveform Observation Device Clamp on Sensor 9694	Ea	4	4
28	Waveform Observation Device Portable case C1001	Ea	2	2

"Tunayaangaza Maisha Yako"



"We light Up Your Life"

**SHIRIKA LA UMEME TANZANIA
TANZANIA ELECTRIC SUPPLY COMPANY LIMITED**

Ubungo Head Office, "Umeme Park", P.O. Box 9024, Dar Es Salaam, Tanzania, Tel: +255 22 2451130/9. Fax: +255 22 2452026

Our Ref:

Date:

SMD/MO/DISTRIBUTION

17th June, 2015

Chief Advisor,

Capacity Development for Efficient Transmission
and Distribution Systems (TANESCO - JICA Project)

DAR ES SALAAM

Dear Sir,

RE: RECEIPT OF TOOLS & EQUIPMENT FOR MAINTENANCE WORKS

Please refer to your letter dated 30th March, 2015 regarding handing over of tools and equipment for maintenance of distribution and transmission systems.

We confirm receipt of twenty one (21) types of tools and equipment for maintenance of distribution network and seven (7) types of tools and equipment for maintenance of substation and transmission network from JICA. The list and quantities of items received is appended to this letter.


TANESCO and JICA representatives made a joint inspection of the equipment and tools on 11th and 12th May, 2015 and found all the tools and equipment are in good order. KAUDA and regions in Dar es Salaam and Coast zone collected the equipment and tools on 13th May, 2015.

TANESCO once again appreciate JICA assistance in providing tools and equipment for maintenance works. We have received the tools and equipment at the time when their use is of paramount importance towards maintenance of our Distribution and Transmission networks. We commit ourselves to take care of the provided tools by using the tools & equipment efficiently and during storage.

We once again thank you and JICA for your continuous cooperation and assistance.

Yours faithfully,

For: TANZANIA ELECTRIC SUPPLY COMPANY LIMITED



Eng. Sophia S. Mgonja (Ms)

For. MANAGING DIRECTOR

SSM/SKM/he

c. c. CHIEF REPRESENTATIVE,
JICA TANZANIA OFFICE
P. O. BOX 9450, DAR ES SALAAM

6.5 Minutes of Meeting of JCC etc

TANZANIA ELECTRIC SUPPLY COMPANY LIMITED



2015 THIRD QUARTER MEETING BETWEEN TRANSMISSION & DISTRIBUTION DEPARTMENTS

Venue : Office of Manager Distribution

Date: 29th September, 2015

Participants:	Eng. Kahitwa Bishajja	Member
	Eng. Theodory Bayona	Member
	Eng. Simon Kihyo	Chairman
	Eng. Moshah Izahaki	Secretary
	Mr. Zakaria Magalama	Member

Agenda:

1. Opening of Meeting
2. Adoption of the agenda
3. Confirmation of the previous minutes
4. Matters arising
5. Performance on the maintenance of distribution networks
6. Status of feeder tripping statistics
7. Connection of new customer at Mlandizi Substation (Kiluwa Steel)
8. AOB

S/N	Issue	Action	Responsible Person	Date of feedback
1	Opening and Introduction	The chairman opened the meeting and welcome at 9:30 hours	Eng Kihyo	
2	Adoption of the Agenda	Members adopted the agenda.	All	
3	Confirmation of the previous minutes of meeting.	Members reviewed the previous minutes of the meeting. Minor editions were made.	All	
4	Matters arising from the previous meeting: A. JICA Project of DSM:	<ul style="list-style-type: none"> • It was reported that the progress on Civil works is good. Ilala substation was estimated at 49% while 38% is for all substations. • Preparation for design and installation of tall gantries at Songas and Ubungo 132kV substation to avoid obstruction of fly over along Mandela highway. • It was reported that the process to secure ownership of land for all sites was going on well. The meeting proposed involvement of Senior Zonal Manager to accelerate process to get <i>title deed</i> for Ilala and other sites 	Eng. Bayona	
	B. Kigamboni Substation	It was reported that, the process to secure ownership of land was going on well and that follow up is being made by the RM Temeke. The meeting proposed involvement of Senior Zonal Manager in these matters to accelerate the process of getting necessary documents..	Eng. Bayona	

	<p>C. Luguruni Substation</p>	<ul style="list-style-type: none"> • It was reported that there are two possible sites for this substation one is being followed up by RM Kinondoni South while the second one is being chased up by the Head Office Surveyors. • While efforts are continuing to secure land and necessary documents, conceptual design for the substation shall be finalized and submitted for deliberation. • The meeting proposed site visit by Transmission and Distribution Team on 2nd October. 	<p>Eng. Bayona</p> <p>Mr. Mgalama</p>	
	<p>A. Upgrading of lines to 132 kV and introduction of 132/33 kV Substations:</p>	<p>As discussed in the previous meeting TANESCO should consider establishment of 132 and 220kV ring connections to transmit large amount of power and maintain system reliability. This will go together with construction of 220 and 132kV substations. In other areas 33kV 33kV distribution network should be established to replace 11kV system in order to improve supply reliability and reduce system loss. Specific proposals include:-</p> <ul style="list-style-type: none"> • Double circuit 132kV lines Bagamoyo - Tegeta substation and Tegeta - Makumbusho. • 220kV Kibaha – Bagamoyo line that is expected under North East Grid extension Project. Follow up necessary to discuss possibility of three winding transformer (220/132/33kV) at Bagamoyo. • 220kV line between Kinyerezi and Mbagala. in order to strengthen city center's distribution network. • Expansion/upgrading of substation such as Tandale to maintain N-1 Philosophy.. • It was reported that procurement process is going on for transmission line material Mtwara – Lindi 132kV project. 	<p>Mgalama/ Mosha/ Bayona</p>	

	<p>B. Progress on the procurement/maintenance of breakers for the substations.</p>	<p>It was pointed out that, parallel efforts have been going on in order to repair and/or replace all defective circuit breakers such as:-</p> <ul style="list-style-type: none">• Procurement of ABB circuit breakers for replacing defective ones at City Center. The breakers have been supplied and installed.• Procurement of ABB circuit breakers for replacing defective ones at Kunduchi is in progress• Major overhaul of ABB Circuit breakers in Grid substations is in progress.• Replacement of defective circuit breakers at Same, Kiyungi, Nyumaba Ya Mungu and Korogwe is in good progress, the project is near completion.• 33kV reactor breakers were successfully revived at Shinyanga, Mwanza and Singida• New 220kV reactor was successfully installed on 20MVAR reactor at Singida.• It was agreed to meet with Eng. Manirabona in order to know the status of TEDAP project at Oysterbay and FZ2 substations. Foundations for temporary installation of ex. City Centre CB's are being constructed at Oysterbay to ensure reliable supply while waiting for TEDAP project to be completed.• It was also advised that, 15MVA, 33/11 kV Transformer to be added at M/City substation in order to accommodate the University Load but however it was noted that we should first follow up on the status of the ownership of the substation.	<p>Eng. Masha</p>	
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	a. Progress of the construction of 132 kV Mtwara – Lindi Line and upgrading of 33/11 kV substation	<ul style="list-style-type: none"> • It was mentioned that, procurement of line materials is in progress and the specifications for upgrading of 33/11 kV Mtwara substation have already been sent to the PMU for further processing. • It was further noted that, Ex-T5 Transformer to be transported from Ubungo to Mtwara for the same purpose of upgrading the substation. • It was pointed out that, Eng Kihyo to communicate with RM Mtwara for the reinforcement of distribution network 	Eng Bayona/ Mosha	
	b. 33/11kV unmanned substations switching	<ul style="list-style-type: none"> • It was reported that the training on distribution staff who are responsible for switching of unmanned substations has not started yet. Eng Kihyo to follow up and report 	Eng Kihyo	
5	Performance on the maintenance of distribution networks	<ul style="list-style-type: none"> • It was pointed out that the current On Job Training which is being conducted in Dar es Salaam region under JICA through TTS is progressing well and it has brought substantial improvement to the system. Data to be used to show the extent of the improvement and best was to move ahead. 	Eng Kihyo	
6	Status of feeder tripping statistics	<p>Data for feeder tripping were discussed. It was agreed to carry out further detailed analysis to the data to identify critical cases as well as recorded trend.</p> <p>The signs of improvement esp. in Dar have to be proved by data.</p> <p>Submission of findings and recommendations in the next meeting.</p>	Mr. Timothy Mgaya	
7	Connection of new customer at Mlandizi Substation (Kiluwa Steel)	<p>It was reported that the investor will install power transformer at Mlandizi substation and a 33kV line to the proposed factory.</p> <p>Technical proposal including line- in line –out configuration on 132kV busbar was given to the Investor. The Investor has supplied transformer to site.</p>		

		<p>It was discussed and agreed to carry out the following:-</p> <ul style="list-style-type: none"> i. Verification of transformer rating by obtaining data from manufacturer ii. Arrangement for MoU (similar to that of Hong Yu Steel) between TANESCO and the Investor to establish modality to pay back the investment through electricity bills 	<p>Mr. Zakaria Mgalama</p> <p>Mosha/Kihiyo</p>	
8	A.O.B	<ul style="list-style-type: none"> • Timetable for future meetings shall be put in place • Each assignment shall have specific person to make follow up and report. <p>NEXT MEETING: 27TH NOVEMBER, 2015</p>		

Signed:

Name:

.....

.....

Chairman

.....

Secretary

6.6 Cost-effectiveness trial calculation documents

【Distribution】

Summary of OJT Activity

Distribution Plan STE : Yasuhiro Tamura

Distribution Technique STE : Yasunori Nishi

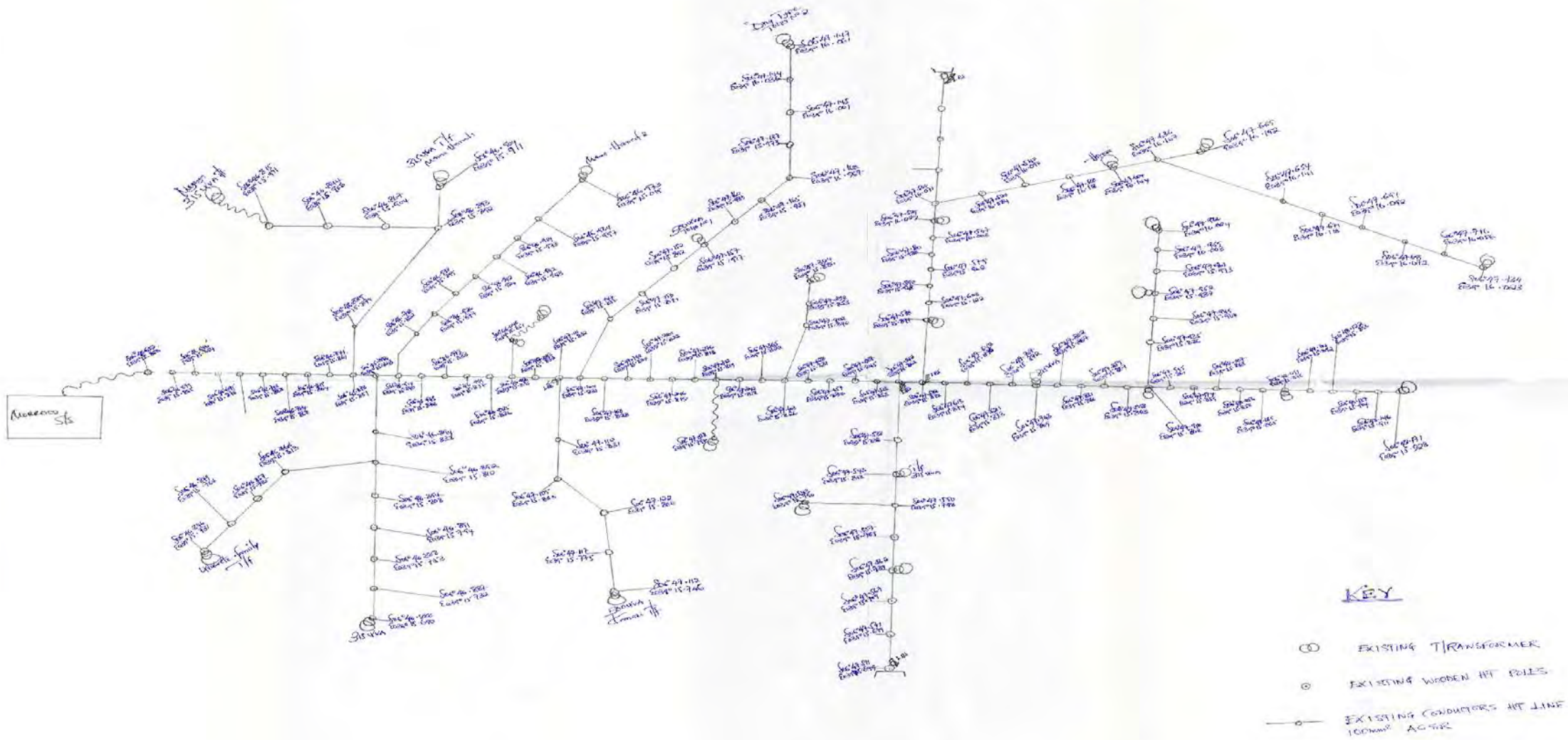
6. Evaluation

(1) Qualitative assessment

- ① Almost completed distribution line diagram • pole sheet which become the base for facility management documents.
- ② Malfunction items which each region addresses and priority of distribution lines, except Jumper and tree which were addressed together, were determined and initiated of their own initiative.
- ③ Each region assembled a team for OJT activity promotion and mainly maintenance engineer with the regional manager at the head of team addressed how to proceed the activity energetically. In case of delay, they addressed to review the material procurement manner • construction area and move up the schedule of patrol etc of their own initiative and originality. I found them motivated to enthusiastically promote the repair plan which they planned.
- ④ Joint coordination meeting is regularly held to share the information and solve the mutual problems between substation and distribution.
- ⑤ Modified holistic maintenance programme was introduced in Dar es Salaam, Coast Zone
[Definition of management policy and standard]
- ⑥ The simplification of data input and accuracy improvement are attempted by utilizing Excel instead of Logbooks (Records of accidents at distribution lines by handwriting). Also, the labor-saving business and information-sharing are attempted through to conduct business processing of monthly progress report by utilizing TANESCO Intranet.

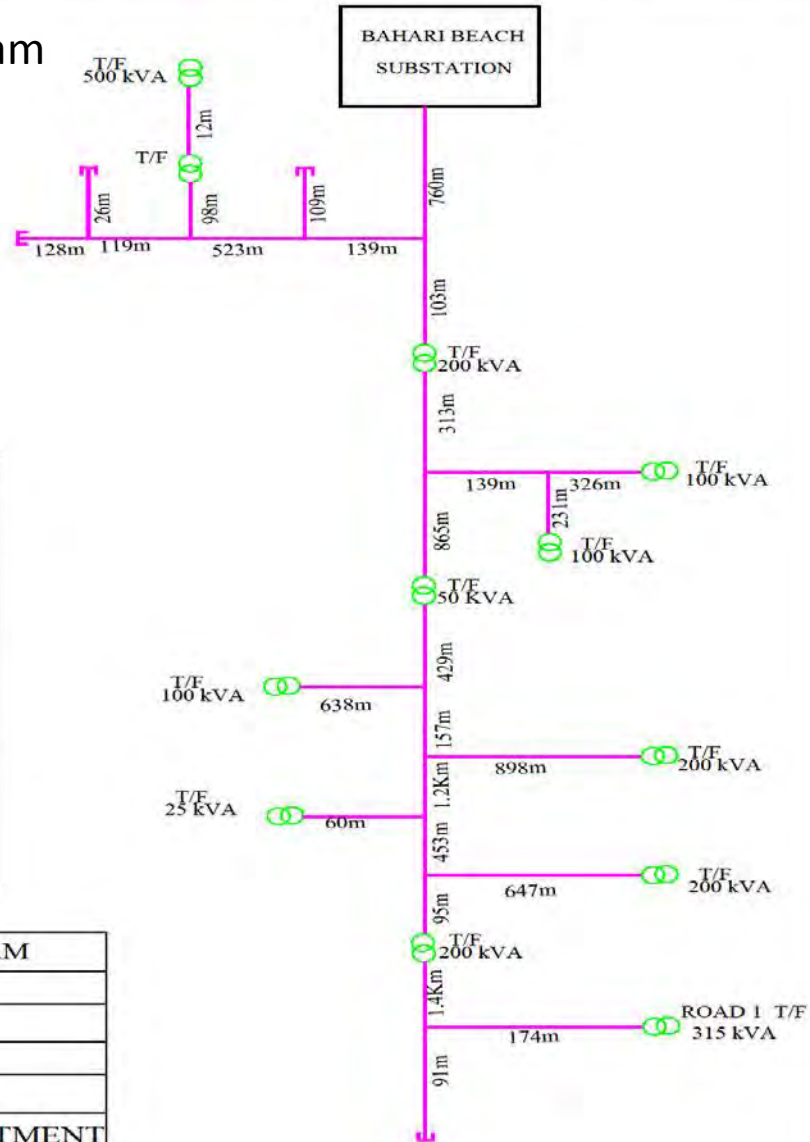
distribution line diagram

DIAGRAM OF 0-4 FEEDER
11 KVA LINE



SINGLE LINE DIAGRAM LINE FOR BAHARI BEACH 1 FEEDER

distribution line diagram



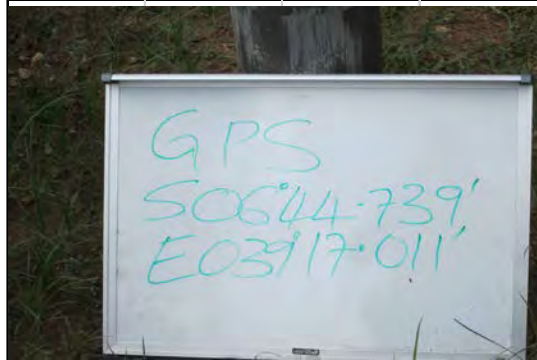
LEGEND

- DISTRIBUTION TRANSFORMER
- LBS LOAD BREAK SWITCH (LBS) NORMALY CLOSED
- LBS LOAD BREAK SWITCH (LBS) NORMALY OPEN
- METERING UNIT
- UNDER GROUND CABLE
- 11 kV LINE
- not to scale

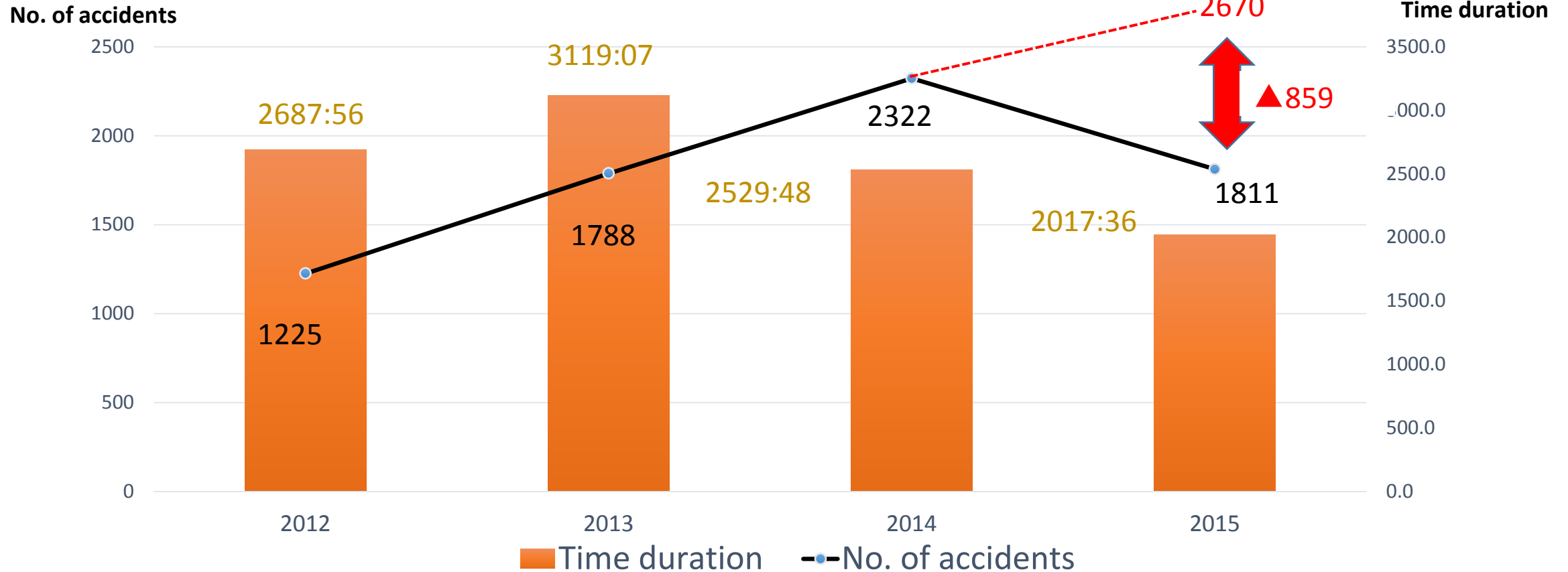
MAK 3& 4 SINGLE LINE DIAGRAM	
Drawing By:	Romana Mrosso
Checked By:	Elisa Kirimbo
Approved By:	Fadhili Kalissa
Date:	June 2014
PLANNING & DESIGN DEPARTMENT	
(MAPPING SECTION)	

Distribution Pole Data Card

Pole NO	S06° 44·739 E039° 117·011		
Pole Material	Wooden Pole	Steel Pole	
Voltage Type	High Voltage Pole	Low Voltage Pole	
Year of Pole Erection			
Length of Pole	M		
Soil Condition	Hard Soil (Rock ,etc)	Normal	Soft
Pole Depth	M	M	M
Kicking Blok/Brace blok	Laid	Not Laid	
Remark			



Transition of accident occurrence at distribution lines



- ① From 2012 to 2014, due to increase in load (demand increase), about 500 accidents were increased. Unless maintenance is provided, No. of accidents in 2015 will be increased about 2670. (About 20 accidents/ feeder/ year were occurred in 2014)
- ② Time duration of power outage per accident was somehow shortened from 2012 to 2014. (Further analysis is required.)

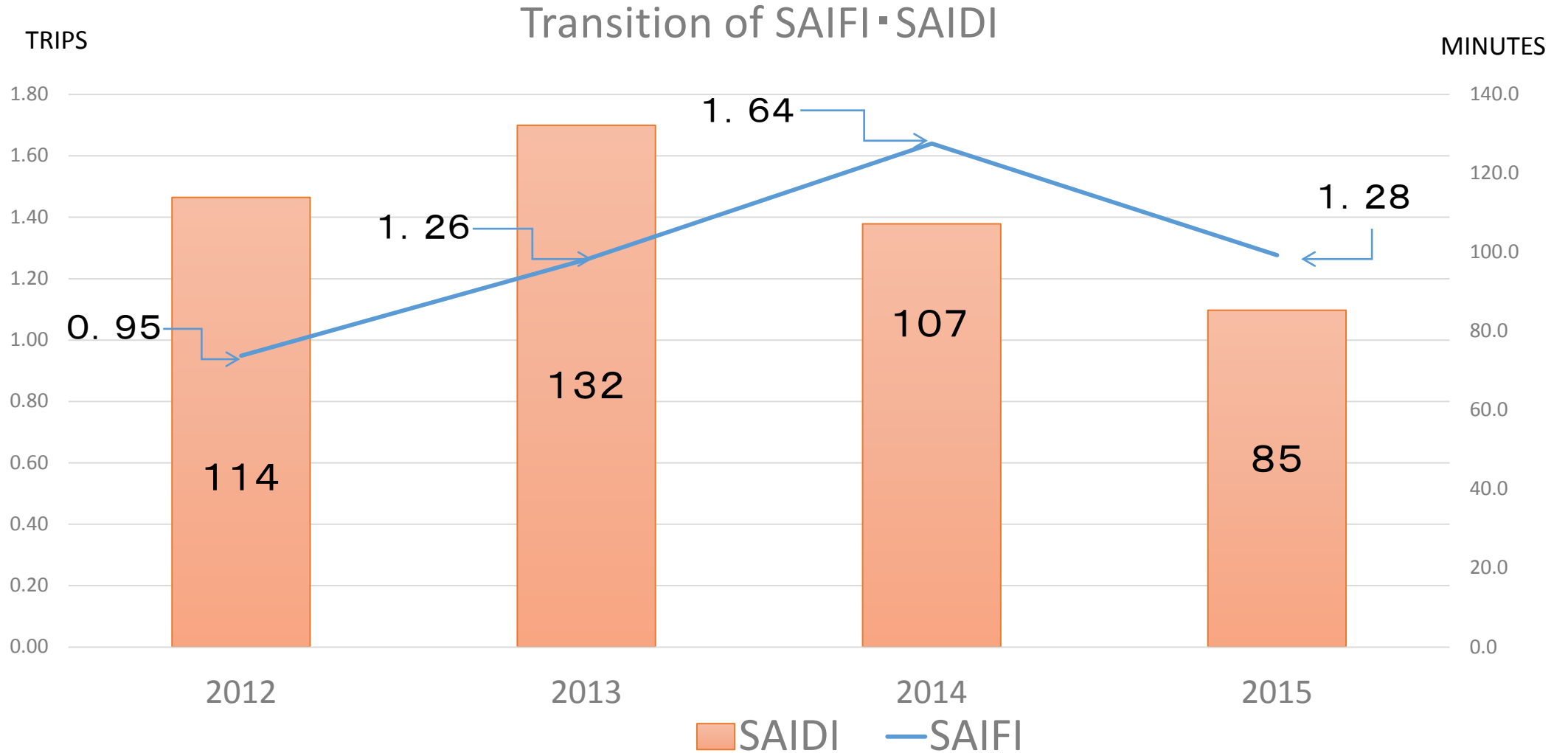
(2) Quantitative assessment

- ① Estimate the volume of power sales per distribution line upon the total power sales and number of distribution lines.
The volume per distribution line 3400KW
- ② Investigate the decrease in the number of accident at distribution line by the effect of repair work according to the estimated number of accident at distribution line in 2015 and accident record at distribution line.
As of the end of Dec 859 accidents
- ③ Calculate the unit rate per unit KWH from total power sales and electricity cost received.
1KWH 315Tsh
- ④ Calculate the growth in power sales upon the reduction number of accidents at distribution lines by repair work and the volume of power sales per distribution line.
Average time duration of power outage per distribution line: 70 minutes
859 accidents 3,400KW/ distribution line ($859 \times 3,400 \times (70/60) \doteq 3,407,000\text{KWH}$)
- ⑤ Calculate the growth in revenue upon the growth in power sales and KWH unit rate.
 $3,407,000\text{KWH} \times 315\text{Tsh} = 1,073,205,000\text{Tsh}$

It can be said approx. 1,073,205,000 Tsh was gain as cost effectiveness by the reduction in accident at distribution lines by this OJT activities.

(3) Transition of Improve Quality of Services (SAIFI • SAIDI)

- SAIFI : System Average Interruption Frequency Index
- SAIDI : System Average Interruption Duration Index



7. Suggestion to TANESCO

(1) Continuous implementation of OJT activity

- ① Carry it out until all the distribution lines are complete.
- ② After the completion, collect and analyze the accident record in 2015, establish the repair plan, prioritize the items (repair contents and distribution lines etc) and continuously carry out the repair work.
- ③ Manage the repair work progress and accident occurrence situation and work together with head office, zones and regions.

[Strict delivery management]

(2) Approach to solving problems found out through OJT activity

- ① **Difficult to shut down the power for work** → ▪ coordination of distribution lines to minimize the area of power shutdown and implementation of Autorecloser, Disconnectorswitch installation.

[Load management at distribution lines and consideration of remaining power]

- ② **Enhance the approach not to occur new non-standard work.**
→ ▪ Provide not only maintenance department, but also other departments, such as construction and emergency department etc thorough instruction in the standard work and enhance inspection department.
- ③ **Establish the maintenance system of facility management documents**
→ ▪ prepare and carry out the work flow which shows how to upgrade the facility management documents. ▪ Prepare the shop drawing and promote the use
- ④ **Lack of materials** → ▪ Improve the accuracy of the required material take off by using shop drawing prepared in order to purchase the materials smoothly.

- ⑤ **Too many unknown cause** → ▪ Investigate malfunctions at distribution lines by insulation resistance tester, install LBS, such as auto recloser etc, and improve the accuracy of patrol at the time of accident.
- ⑥ **Data vary** → ▪ Provide thorough instruction in data collection, such as "What is accident at distribution line?", "What is time duration of power outage?", and "How to handle an accident occurred at 2 distribution lines at once" etc to avoid variance.
 (How to count the feeder's accident number crossing the boundary between two regions is unified but there are small variations on how to count the cause..
 How to count the duration time of outage is unified, but there is unrealistic data showing very short time of duration.)
- ⑦ **Data examination** → ▪ Examine the data and consider the review in accordance with "What data is required?", "What data is not required?", "Do any data need to be subdivided?" and "Are definitions of all data defined?" etc
 [EX in Japan: Accident at a distribution line ▪ Power cut off at a section of HV line by recloser at distribution line ▪ Automatically restoring power to the line after a momentary fault ▪ Accident affected by the facility owned by the customer etc]
 [Automatically restoring power to the line after a momentary fault: after momentary fault was caused at a distribution line, power can be restored at one time]
- ⑧ **Define the restoration manner at interconnecting lines ▪ SS for distribution (33/ 11kV)**
 → Define the accident investigation manner at SS ▪ Distribution in the event of unknown cause.

⑨ Currently, head office holds Joint Coordination Meeting between substation and distribution. From now on, each zone or site shall hold joint coordination meeting to discuss and arrange the site power shutdown plan or work arrangement etc in order to solve the problems and promote the efficient operation.

(Cost zone is implementing this meeting every three month)

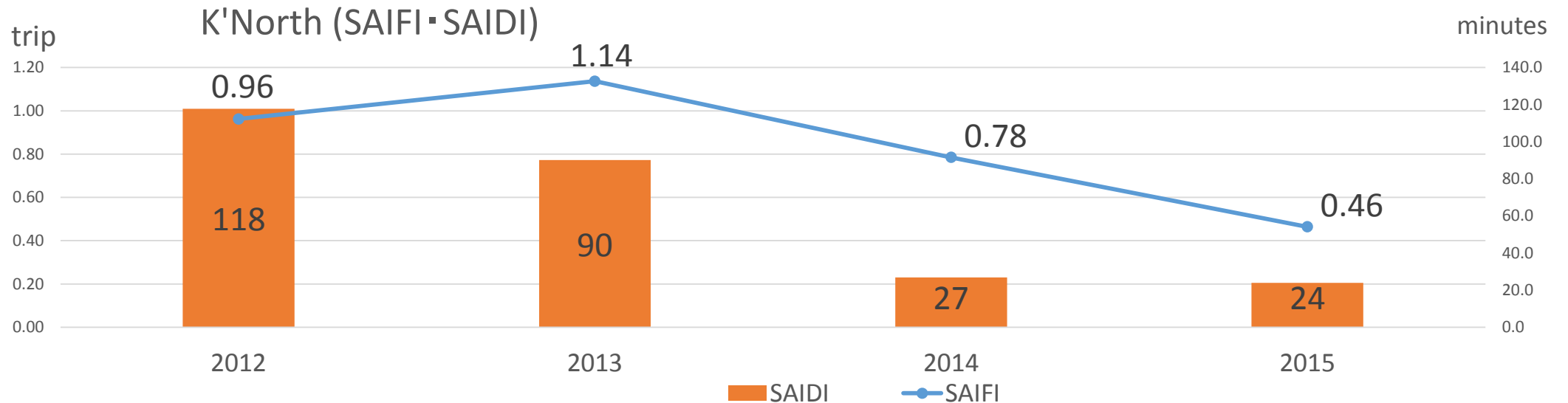
⑩ **Inspect facilities surrounding repair work.** → ▪ Provide repair to any malfunction such as insulator cracks or conductor disconnection etc which leads accident at distribution line. To prevent accident at distribution line.

8. Reference

▪ Predicted effect in 2016 by OJT activity

Precondition

- ① Complete all the repair work at distribution lines (No increase in the number of distribution lines)
- ② Carry out works in standard manner for new construction work and emergency work.
(compression ▪ bush clearing etc)
- ③ 10% of OJT repair missing and non-conforming work (compression malfunction etc) shall be considered.



▪ SAIFI at K'North which handled as a pilot model marked about 0.5 in the record of 2015, accident at distribution line can be reduced to 600.

Estimated accident value in 2015: 2670 2670-600=2070

- Calculate the growth in power sales upon reduction number of accidents at distribution lines by repair work and the volume of power sales per distribution line.

$$2070 \text{ accident/ distribution line } 3,400\text{KW}$$

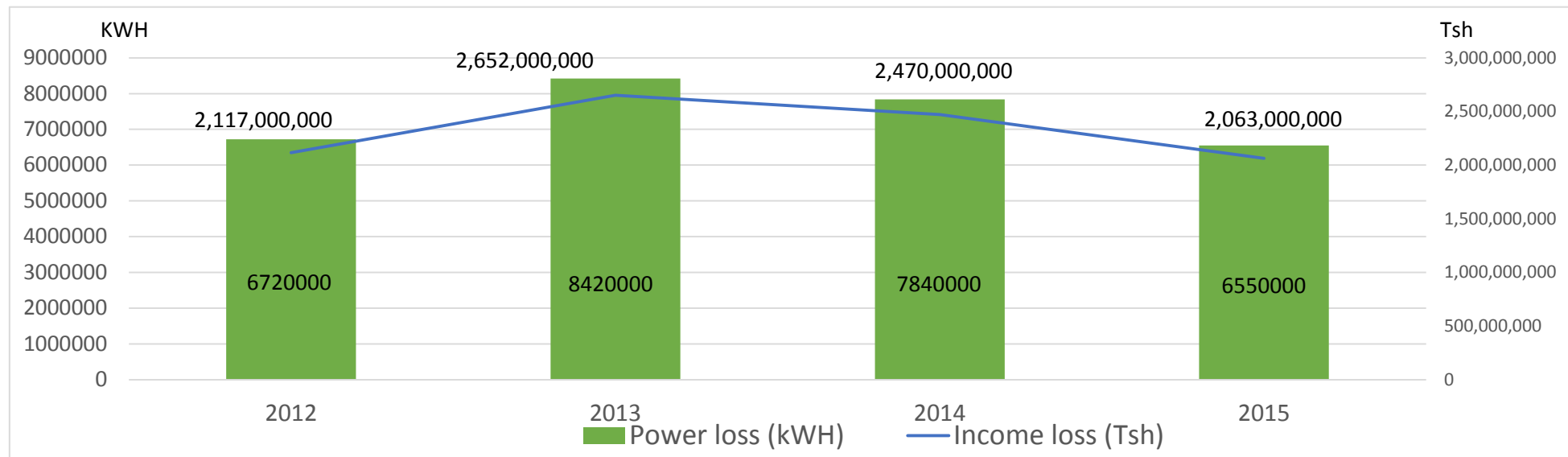
$$(2070 \times 3,400 \times (70/60) \doteq 8,211,000\text{KWH})$$

- Calculate income loss

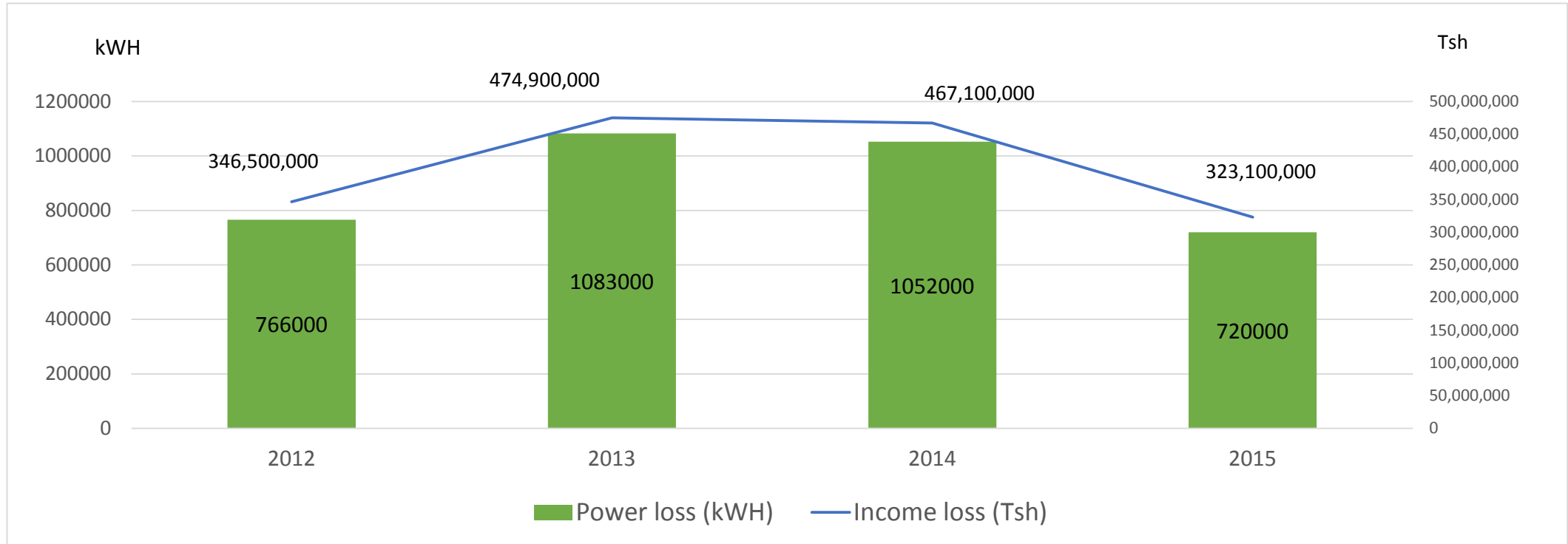
$$8,211,000 \times 315 = 2,586,465,000\text{Tsh}$$

Approx. 2,586,465,000Tsh of cost effectiveness can be anticipated.

Loss due to accidents at distribution lines



Loss due to accident by unknown cause



- Great income are lost every year due to accidents at distribution lines.
- Loss due to accident by unknown cause becomes too large to ignore.

【Substation】



Part.2

SS OJT and SS Plan

<JICA>

III. Holding a seminar to promote understanding by JICA

1. Understanding PM

- A seminar was held to share the common understanding among whole SS sections, taking the occasion of split-off of DSM workshop into 2 groups, to understand the purpose and manner of PM and carry out the operation in accordance with the Maintenance Guideline.

<Held in May, 2015> <Participants: 19 persons>

2. The advantage of early repair of malfunction

(malfunctions detected by Site Visit & Periodic Inspection)

(Theme: “The cost advantage of PM compared to BM” in item IV)

- The cost advantage of early repair compared to the cost after accident/ failure.
- It was valuable for explanation of internal budget request for repair

<Held in Dec, 2015> <Participants: 11 persons>



[Seminar in Dec, 2015]

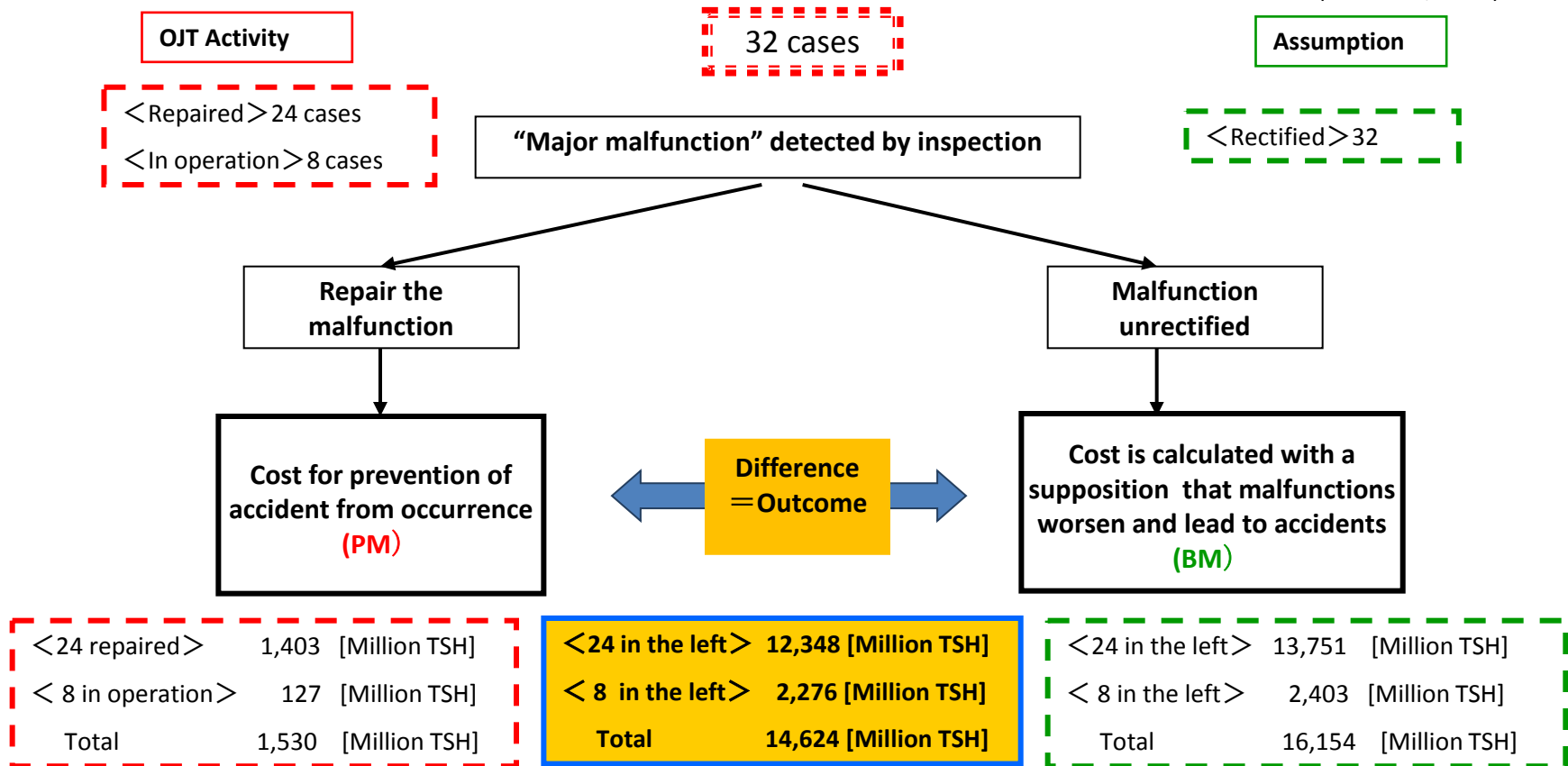
IV. Outcome of SS OJT Activity (COST)

1. The cost advantage of PM (Preventive Maintenance) compared to BM(Breakdown Maintenance)

Manner

During this activity implementation period, malfunctions were detected by Site-Visit and Periodic Inspection and accidents were prevented by “repairing major malfunctions.”

(As of Dec, 2015)



IV. Outcome of SS OJT Activity (COST)

2. Malfunctions detected by Site-Visit and Periodic Inspection and repair

Number of defected malfunction and repair (cases)

Total malfunctions detected	177 (By Site Visit : 161, Periodic Ins : 16)	
Minor malfunctions detected	145 (By Site Visit : 137, Periodic Ins : 8)	→ Repaired: 48 (Repair ratio 33 %)
Major malfunctions detected	32 (By Site Visit : 24, Periodic Ins : 8)	→ Repaired: 24 (Repair ratio 75 %)

(Malfunction found from Dec, 2014 to Jun 2015, Malfunction repaired till Dec, 2015)

Minor malfunctions and major malfunctions leading to accident

- All the malfunctions detected by the inspections were divided into “minor malfunction” and “major malfunction leading to accidents”. However, it is difficult to define the classification of the two. Thus, here major malfunction leading to accidents defines that “any malfunction which is leading to an accident in a short time if unrectified and judged as “Emergency”.
- In this assessment, “minor malfunction” is not covered, however, repair is necessary as unrectified malfunctions would effect the deterioration of equipment and its life time of operation.
Any minor malfunction may lead to accidents in the mid and long term.

No. of major malfunctions repaired was totally 24 out of 32 and the repair ratio was 75%.

Compared to the malfunction required urgent treatment, it is not high in performance, however, there are many individual repairs during the repair implementation period. Therefore, their effort could be seen.

IV. Outcome of SS OJT Activity (COST)

3. Estimation of cost advantage

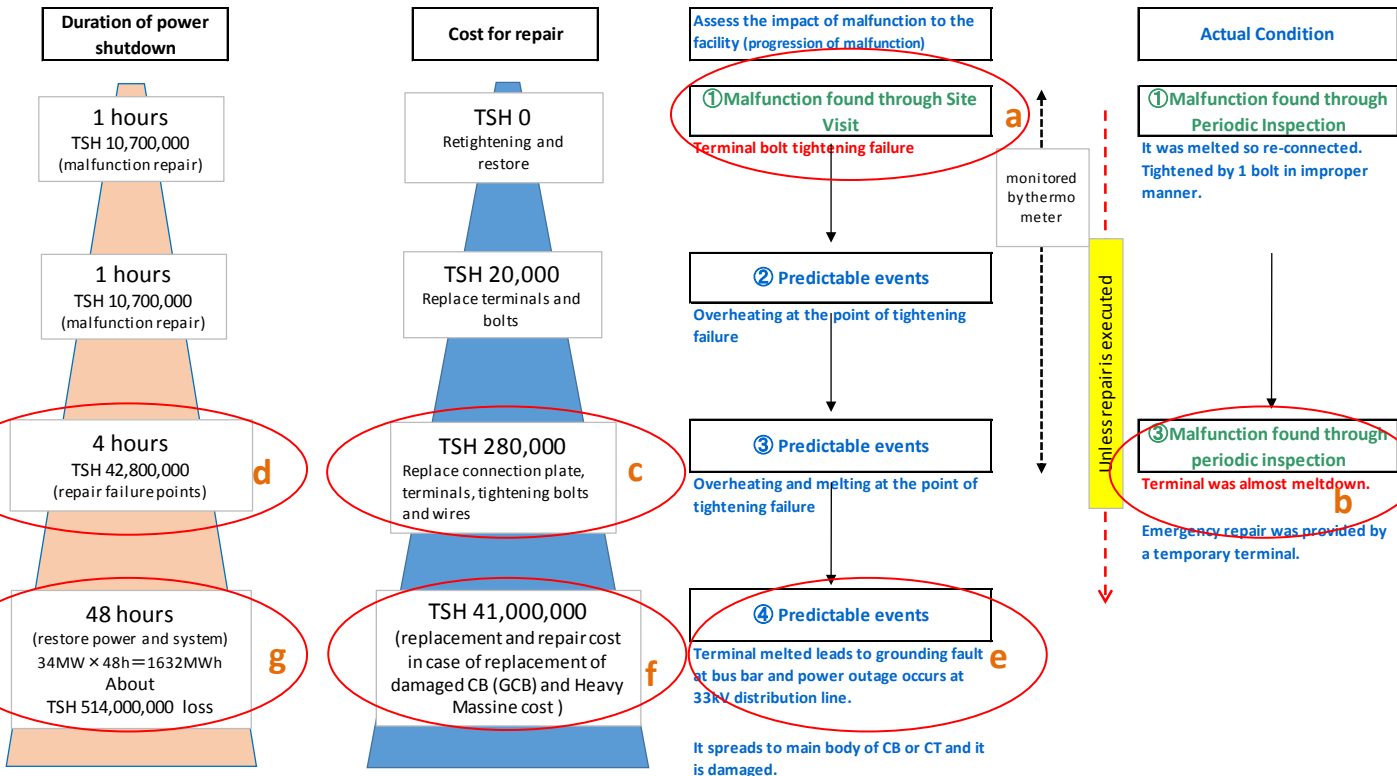
The financial impact that 32 major malfunctions might cause accidents was calculated based on “timing of repair implementation and visualization of financial effect.” Note this assumption is based on the condition that necessary materials are available. Labor cost is not included.

(1) Timing of repair implementation and visualization of financial effect

"Maintenance Response Against Cost" — Lack of tightening of GCB terminal at KURASINI SS

Here is the result of study about terminal bad connection of bus bar between GCB and CT found through Site Visit and Preventive Maintenance(Periodic Inspection).

Examination of Maintenance Implementation



Here is a sample of “Timing of repair implementation and visualization of investment effect” indicating malfunction progress, repair cost and time duration of power outage/ shutdown. The column in the right hand side indicates the timing of malfunction detected in this inspection and the status. Minor malfunction requires small repair cost but if it is abandoned, the malfunction becomes worse and requires much more cost.

This figure helps to understand the importance of Maintenance (early detection by inspection and repair).

Result of Study

Early detection could provide emergency repair prior to accident occurrence. Site Visit and Preventive Maintenance (Periodic Inspection) contribute to avoiding the worst-case scenario. In the event of accident, **emergency response** wastefully requires about TSH 41,000,000 for repair and about 48 hours(TSH 514,000,000) power outage. Hereafter, repair work for permanent restoration can be executed with TSH 280,000 for equipment and 4 hours for repair of failure points **in planned manner**.

IV. Outcome of SS OJT Activity (COST)

Explanation of KURASINI SS 「Improprore of tightening of GCB terminal」

Inspection result (situation of malfunction)

- a : Improper tightening of terminal was detected by visual inspection (stage ①)
- b : It was checked at the time of periodic inspection. At that time, the terminal was already melted and those could lead to an accident. (stage ③)

Repair cost currently required (Stage ③)

- ← Excluding labor cost. Materials (equipment and parts) are assumed to be available.
- c : Repair cost required for stage ③ (materials)

TSH 280,000 Replace connection plate, terminals, tightening bolts and wires

- d : Time duration of power shutdown and electricity rate to repair stage ③

4 hours TSH 42,800,000 (repair failure points)

Calculation formula : SS load (as of Nov, 2015) × Time duration of power shutdown × Electricity rate (TSH/kWh)
= 34 MW × 4 h × 315 TSH = 42,800,000 TSH

- e : In case the malfunction is unrectified , disconnection accident can occure . (stage ④)

Construction cost to recover from accident and restore power (stage ④)

- ← Excluding labor cost. Assume materials (equipment or parts) are available.
- f : Repair cost for stage ④ (material)

TSH 41,000,000 Replacement of damaged CB (GCB) and Heavy Massine cost

- g : Time duration of power shutdown and electricity rate for repair of stage ④

48 hours (restore power and system) About TSH 514,000,000

Calculation formula : Load at SS (investigated in Nov, 2015) × Time duration × Electricity rate (TSH/kWh)
= 34 MW × 48 h × 315 TSH = 514,000,000 TSH

IV. Outcome of SS OJT Activity (COST)

(2) Repair cost for major malfunction

Repair cost of PM and BM for 32 “major malfunctions” are calculated by "Timing of repair implementation and visualization of financial effect.

Trial Calculation of effect on Inspection at 25 SS for distribution in DAS

(1) Compare the trial calculation of "immediately repair (Preventive Maintenance (PM))" and "malfunction abandoned without repair (Breakdown Maintenance (BM))" in case a serious malfunction is detected by SS inspection.

Conditions for examination

- a) Repair cost includes only main material cost and excludes labor fee.
- b) Time duration of power shutdown means the required time for restoration of the relevant equipment and excludes the time of power restoration.
- c) Required materials for repair work is considered to be procured so the time required for material procurement shall not be included.
- d) Time cost shall be calculated based on the electricity rate of TSH 315/ kW.

As for NO 3, 4, and 5, there is only one examination documents so it is divided into Malfunction Reports.

NO	Malfunction	Malfunction Report No	Load of target equipment (MW)	Immediately Repair (PM)				Malfunction Abandoned without Repair (BM)				Total difference (TSH) ((c)+[d]) - ([a]+[b])	
				Cost of repair (TSH) - [a]	Power Shutdown for repair (h)	Price conversion from the time (TSH) - [b]	Current repair total [a]+[b] (TSH)	Responden Repaired: ○ Temporary Repaired: △	Cost for repair (TSH) - [c]	Power Shutdown for repair (h)	Price conversion from the time (TSH) - [d]		Total malfunction repair (c)+[d] (TSH)
1	BAHARI BEACH SS AC,DC malfunction	BB 4	12	30,000	2	7,560,000	7,590,000	△	500,000,000	168	635,040,000	1,135,040,000	1,127,450,000
2	BAHARI BEACH SS High in oil level of TR	BB 5	12		0	30,240,000	30,240,000	△	40,000,000	24	90,720,000	130,720,000	100,480,000
3	BUGURUNI (FZ1) SS DS close failure	FZ1 2	7.35	7,000,000	4	9,261,000	16,261,000	○	30,000,000	10	23,152,500	53,152,500	36,891,500
4	BUGURUNI (FZ1) SS DS close failure	FZ1 3	7.35		0	4,630,500	4,630,500	○	30,000,000	10	23,152,500	53,152,500	48,522,000
5	BUGURUNI (FZ1) SS DS close failure	FZ1 10	7.35	7,000,000	4	9,261,000	16,261,000	○	30,000,000	10	23,152,500	53,152,500	36,891,500
6	BUGURUNI (FZ1) SS T2 11kV neutral grounding failure	FZ1 11	7.35	100,000	1	2,315,250	2,415,250	○	1,000,000,000	168	388,962,000	1,388,962,000	1,386,546,750
7	CITY-CENTER SS OCB oil leaking (oil blowout—no oil level)	CC 1	20		0	31,500,000	31,500,000	△	41,000,000	48	302,400,000	343,400,000	311,900,000
8	EPZA SS GCB SF6 decrease in Gas pressure	EPZA 2	6	6,000,000	0		6,000,000	○	500,000,000	144	272,160,000	772,160,000	766,160,000
9	G'MBOTO (FZ II) SS DS Bus bar connection Lapping joint	FZ2 5	18.5	1,320,000	4	23,310,000	24,630,000		1,320,000	4	23,310,000	24,630,000	0
10	KARIAKOO SS 11kV Cub Bus Bar Carbonised	KA 3	10		0	15,750,000	15,750,000	○	400,000,000	72	226,800,000	626,800,000	611,050,000
11	KIGAMBONI SS Line Jumper Lapping joint	KG 6	3	60,000	2	1,890,000	1,950,000		840,000	4	3,780,000	4,620,000	2,670,000
12	KIGAMBONI SS Structure grounding failure (No grounding wire. Stolen)	KG 10	3	40,000	1	945,000	985,000		900,000,000	144	136,080,000	1,036,080,000	1,035,095,000
13	KIGAMBONI SS Bus bar connection Lapping joint	KG 9	3	60,000	2	1,890,000	1,950,000		840,000	4	3,780,000	4,620,000	2,670,000
14	KURASHINI SS Disabled protection relay at secondary of main TR	KR 11	12	200,000	2	7,560,000	7,760,000	○	500,000,000	168	635,040,000	1,135,040,000	1,127,280,000
15	KURASINI SS DS Weld failure of connection terminal	KR 14	33.86	280,000	4	42,663,600	42,943,600	○	41,000,000	48	511,963,200	552,963,200	510,019,600
16	KURASINI SS GCB Improper tightening of terminals	KR 2	33.86	280,000	4	42,663,600	42,943,600	○	41,000,000	48	511,963,200	552,963,200	510,019,600
17	KURASINI SS Line Wire Lapping joint	KR 1	33.86	60,000	2	21,331,800	21,391,800		1,440,000	24	255,981,600	257,421,600	236,029,800
18	MBEZI SS 11kV SG leak noise	MBE 11	17		0	26,775,000	26,775,000	○	125,000,000	72	385,560,000	510,560,000	483,785,000
19	MBEZI SS Burnout of terminal block at protection relay	MBE 9	17	40,000	2	10,710,000	10,750,000	△	10,000,000	4	21,420,000	31,420,000	20,670,000
20	MIKOCHENI SS 11kV Cub Insulation failure (Ozone small • Corona noise)	MK 12	9.5	6,000,000	48	143,640,000	149,640,000	○	1,000,000,000	168	502,740,000	1,502,740,000	1,353,100,000
21	MIKOCHENI SS Line LA Grounding failure	MK 9	9.5	20,000	2	5,985,000	6,005,000	○	500,000,000	168	502,740,000	1,002,740,000	996,735,000
22	MIKOCHENI SS MCT Crack	MK 16	9.5	20,000,000	5	14,962,500	34,962,500		100,000,000	48	143,640,000	243,640,000	208,677,500
23	MIKOCHENI SS OCB Failure in contact resistance	MK 18	9.5		0	23,940,000	23,940,000		50,000,000	48	143,640,000	193,640,000	169,700,000
24	MIKOCHENI SS bird damage	MK 11	19		0	5,985,000	5,985,000	○	30,000,000	10	59,850,000	89,850,000	83,865,000
25	MSASANI SS 11kV Cub Battery panel Small animal leaving	MS 8	10.5	400,000	5	16,537,500	16,937,500		400,000,000	72	238,140,000	638,140,000	621,202,500
26	MSASANI SS DS close failure	MS 3	10.5		0	6,615,000	6,615,000	○	30,000,000	10	33,075,000	63,075,000	56,460,000
27	MSASANI SS Incorrect operation in TR valve	MS 10	10.5		0	3,307,500	3,307,500	○	500,000,000	168	555,660,000	1,055,660,000	1,052,352,500
28	OYSTERBAY SS 11kV SG Damage and aging	OB 1	11	400,000,000	144	498,960,000	898,960,000	○	400,000,000	144	498,960,000	898,960,000	0
29	OYSTERBAY SS Line wire Lapping joint	OB 2	11	60,000	2	6,930,000	6,990,000	○	840,000	4	13,860,000	14,700,000	7,710,000
30	RAILWAY SS 33kV SG Hissing sounds	RW 1	13		5	20,475,000	20,475,000	○	150,000,000	168	687,960,000	837,960,000	817,485,000
31	RAILWAY SS SG Room Small animal living	RW 2	13	400,000	5	20,475,000	20,875,000	△	150,000,000	168	687,960,000	837,960,000	817,085,000
32	TANDIKA SS High in oil level of TR	TDK 7	9		0	22,680,000	22,680,000	△	40,000,000	24	68,040,000	108,040,000	85,360,000
Subtotal				449,350,000	295	1,080,749,250	1,530,099,250	24	7,543,280,000	2,374	8,610,682,500	16,153,962,500	14,623,863,250
Average (subtotal/ 32)				14,042,188	9	33,773,414	47,815,602	75%	235,727,500	74	269,083,828	504,811,328	456,995,727
Repaired or treatment provided: 24 total				427,410,000	266	975,942,450	1,403,352,450		6,088,840,000	2,026	7,662,330,900	13,751,170,900	12,347,818,450
Not yet repaired 8 total				21,940,000	29	104,806,800	126,746,800		1,454,440,000	348	948,351,600	2,402,791,600	2,276,044,800

IV. Outcome of SS OJT Activity (COST)

(3) The negative impact in case a detected malfunction is unrectified

The following table is made from [activity of understanding “Timing of repair implementation and visualization of financial effect”] in article 3 (1) and [repair cost for major malfunction] in article 3 (2).

Total repair cost of major malfunctions (32 cases)

<Million TSH>

	PM (OJT activity)				BM (after accident occurrence)				Advantage of PM
	Repair cost	Time duration of power shutdown (h)	Conversion into hourly rate equivalent	Total cost of repair {A}	Repair cost	Time duration of power shutdown (h)	Conversion into hourly rate equivalent	Total cost required after accident occurrence {B}	Difference {B-A}
Repaired 24	427	(266)	976	1,403	6,089	(2,026)	7,662	13,751	12,348
Not repaired yet 8	22	(29)	105	127	1,454	(348)	948	2,403	2,276
Total 32	449	(295)	1,081	1,530	7,543	(2,374)	8,611	16,154	14,624

(4) The cost advantage by OJT Activity

The cost advantage by 24 repairs through this OJT;

▪ 12,348 Million TSH

(Total repair cost after accident at 24 cases — Total repair cost at current situation at 24 cases)

IV. Outcome of SS OJT Activity (COST)

[Reference] Accident ratio (In the case of same preventive maintenance status of Japan)

The number of major malfunction leading to an actual accident out of total major malfunction

(The ratio of actual accident occurrence)

According to the survey in Japan, “22% of malfunction shall lead to an actual accident”

(Refer to Questionnaire survey about electrical accident in 2011 Kanto Tohoku Industrial Safety and Inspection Department)

In case accident ratio is considered, the outcome in cost by 24 repairs through this OJT shall be calculated;

- **1,622 Million TSH (22% of 13,751 Million TSH — 1,403 Million TSH)**

4. Recommendation to TANESCO

- a) Calculate the cost advantage of PM (Preventive Maintenance) compared to BM(Breakdown Maintenance) to acquire budget in TANESCO .**
- b) Promote to rectify malfunctions (prioritize the repair and carry out the work Don't leave malfunctions as they are.)**
Prioritize the malfunctions detected in consideration of its urgency and impact.
- c) Continuous execution of maintenance (according to the management cycle in the maintenance workflow). It is important to detect malfunctions by Visual and Regular Inspection and to continuously repair them properly.**
- d) Obtain records (documentation) and its complete management (prepare and manage the records to use.)**
Accident record is the most important record to grasp the cause, provide treatment, take a measure, such as sharing information etc.

V. Introduction of SS Plan Training at TTS

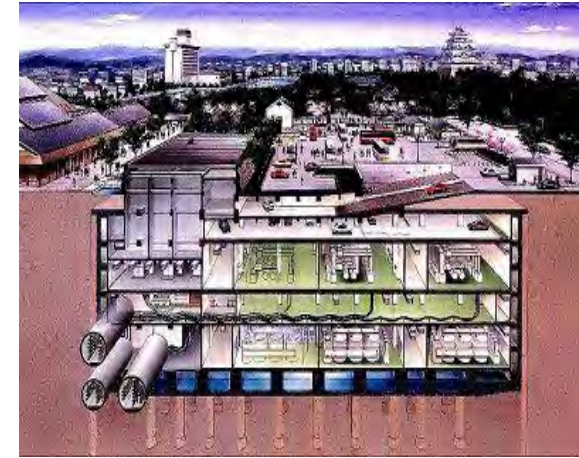
1. Purpose

Its very important to avoid over load of Substation Equipment to prevent accident, in addition to the OJT Activity for Preventive Maintenance.

Therefore, JICA has established "SS Plan Training" to Prevent Accident and Make efficient Power System through study "How to plan SS" and "How to calculate Power flow".

2. Activity status <Time of implementation: Sep, 2014~ Sep, 2015>

- ① Set task force by TANESCO and JICA <Sep, 2014>
(Member from TANESCO: 2 persons from DIS, SS and system control)
- ② Checked existing training contents for SS at TTS by task force and picked up any contents lacking in terms of SS plan <from Oct to Nov, 2014>
- ③ Prepared texts by task force <from Jan to Feb, 2015>
- ④ Carried out TOT to task force members by JICA because the members would be the trainer at TTS. <May, 2015>
- ⑤ Held TTS training in Sep, 2015 (4 days course x 2 times)
<Future schedule: Continuous implementation in TTS training after 2016.>



[May, 2015: TOT]



[Sep, 2015: Introduction of TTS training]

3. Training contents

- Attention to new construction or expansion of SS
- Basic power flow analysis
- Consistency between transmission and substation capacity
- How to consider to install TR
- Consistency between TR capacity and number of outgoing of distribution line



VI. Holding Power Quality Seminar

1. Purpose

Decrease in power system quality by some customer demand for industrial use has become an issue as a task in the business of TANESCO.

Therefore, a seminar was held with waveform observation device which JICA granted in May, 2015 in order to solve the problem by measuring voltage flicker and harmonic etc.

V



2. Activity status

<Timing of seminar implementation>

- Sep, 2015 (Countermeasure to ensure power quality and practical training to use wave observation device : 5 days course x 2 times, participants: 1st ••• 6 persons, 2nd ••• 8 persons)
- Jan, 2016 (Power quality analysis by analysis software : 1 day, participants : 15 persons who attended the seminar in Sep, 2015)
- Feb, 2016 (Power Quality Seminar • trial (Preparation of TTS training introduction) : for 3 days, participants : 10 persons who will be the trainers of the seminar)

<Participants>

Relevant departments in TANESCO (Power Quality, Business Promotion, Distribution, Substation, Power System Operation and TTS)

3. Further schedule

According to what TANESCO learnt through this training, introduce TTS training in 2016 and enhance ensuring power quality. (5 days course in Apr and Jun, 2016 respectively)

[Lecture in Sep, 2015]

[Practical training at SS in Sep, 2015]

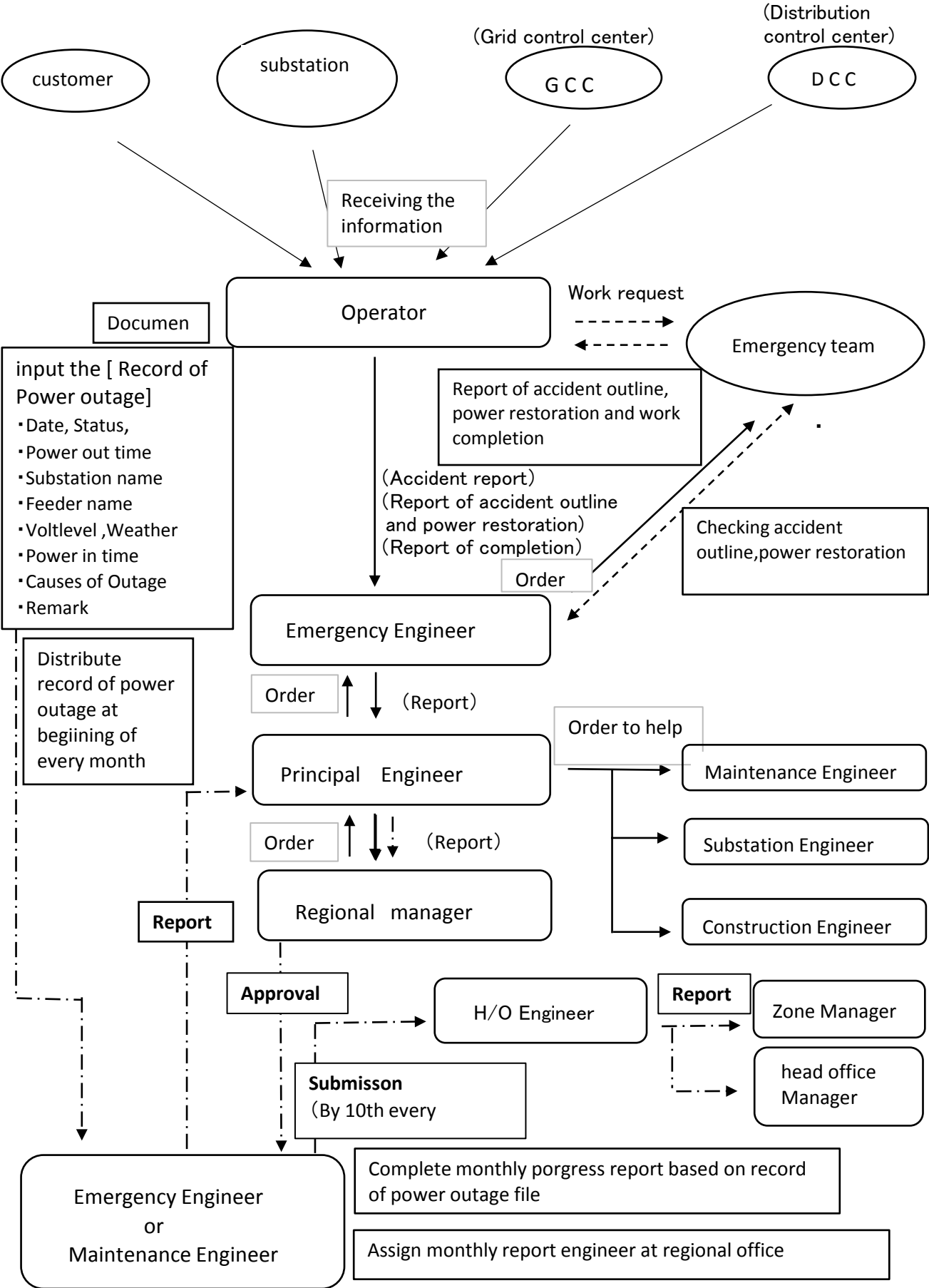


6.7 The other (documents for continued use after project implementation)

【Distribution】

- Workflow
- Log Book
- Monthly Progress Report

Work flow of feeder outage monthly report



Record of Power outage

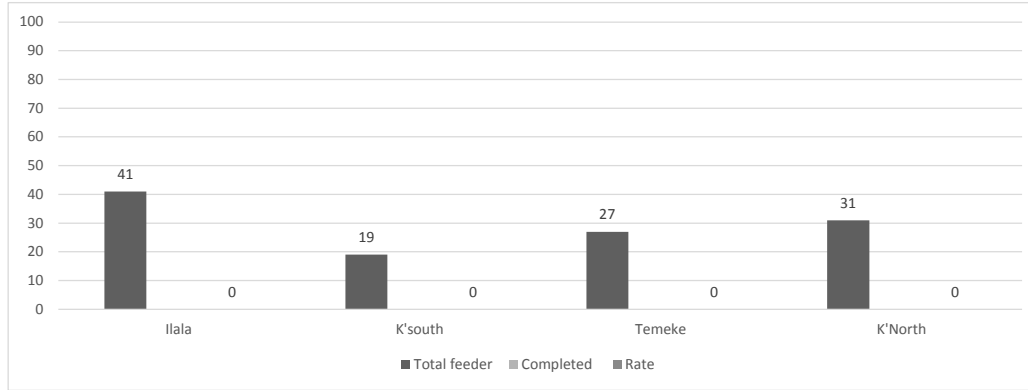
No	Date		Status	Time		Hour (In-Out)	Substation Name	Feeder Name	Volt Level	Weather	Remarks	Causes of Outag	
	Out	In		Out	In								
1													
2													
3													
4													
5													
6													
7													
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50													
Total						0:00							

OJT Progress Report (Monthly)

No.1

① Submit report by 7th of every month

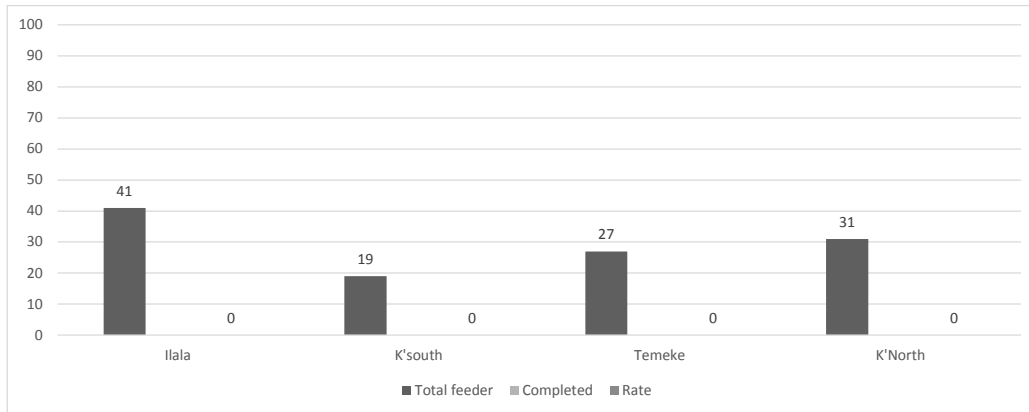
1. Feeder Patrol [Progress rate%(((Patrolled feeder/Total feeder)*100)]



Regional	Total feeder	Completed	Rate
Ilala	41		0
K'south	19		0
Temeke	27		0
K'North	31		0

Reason of progress delay

2. Repair work [Progress rate%(((Completed feeder/Total feeder)*100)]



Regional	Total feeder	Completed	Rate
Ilala	41		0
K'south	19		0
Temeke	27		0
K'North	31		0

Reason of progress delay

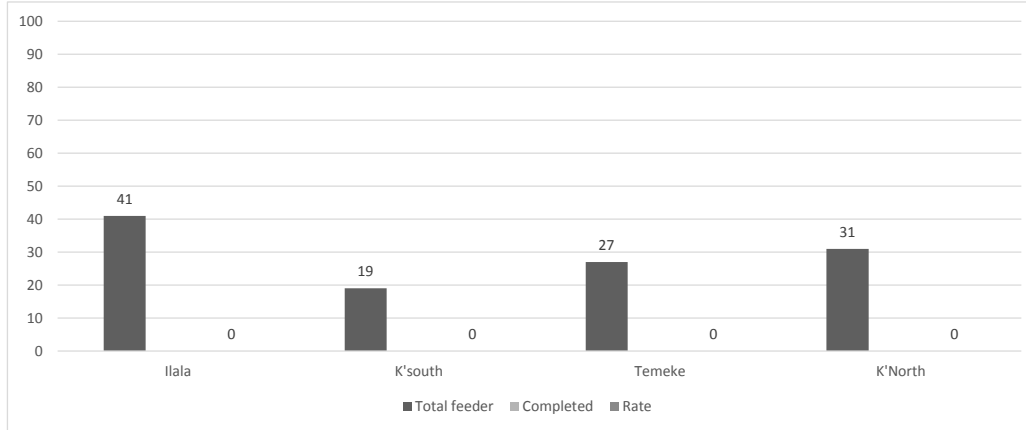
OJT Progress Report (Monthly)

(Documentation of Facility Control)

No.2

① Submit report by 7th of every month

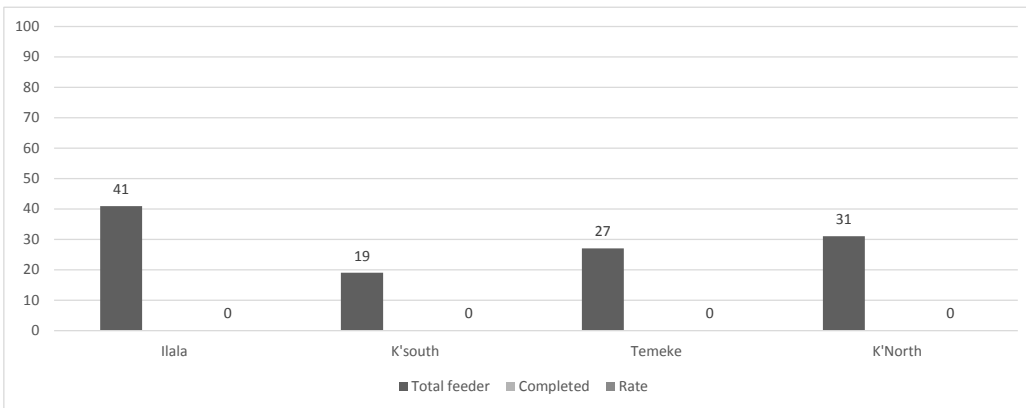
1. Pole Data Card [Progress rate%(((Completed repair work feeder/Total feeder) * 100)]



Regional	Total feeder	Completed	Rate
Ilala	41		0
K'south	19		0
Temeke	27		0
K'North	31		0

Reason of progress delay

2. Feeder Drawing [Progress rate%(((Completed repair work feeder/Total feeder) * 100)]



Regional	Total feeder	Completed	Rate
Ilala	41		0
K'south	19		0
Temeke	27		0
K'North	31		0

Reason of progress delay

【Substation】

- Workflow
- Malfunction Report
- Monthly Report
- Improvement assessment of technique and skill by OJT activity

Development by workflow

Workflow according to Guide line

Planning of Inspection

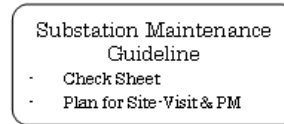
Implementation of Inspection (Finding Defective and Making Report)

Making Repair Plan (Prepare Device and Material)

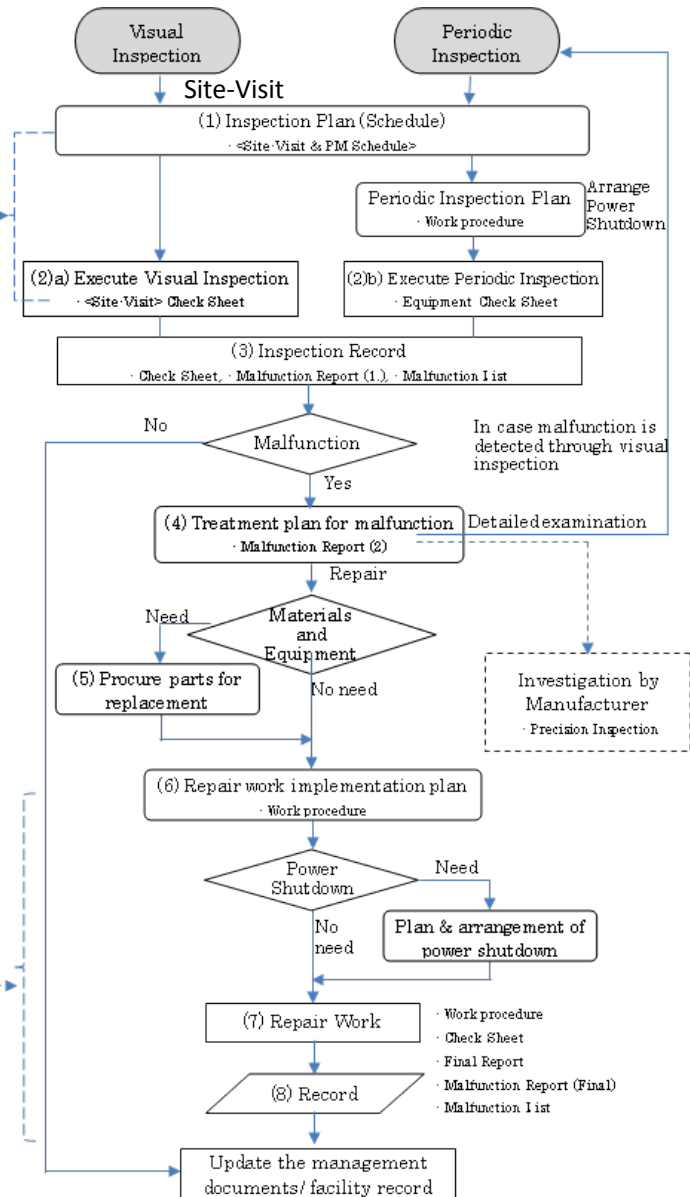
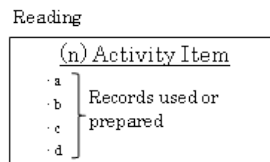
Implementation of Repair

Management of Device (Record , Management → Inspection Plan for Next)

Circle of Workflow



1. Demarcation of inspection and maintenance responsibilities.
2. Maintenance Activities
 - Substation patrol(SS supervisor)
 - Site Visit
 - Preventive maintenance
 - Specific maintenance
 - Corrective maintenance
 - Emergency maintenance
3. Planning for site visit and preventive maintenance.
4. Item and frequencies
5. Check sheet
6. Safety regulation.
7. Work Implementation
8. Keeping reports and records
9. Follow up of detected defects.



Malfunction report

“Malfunction Report” is a compiled sheet on “to report malfunction detected by inspection”, “to identify the urgency”, “repair manner”, and “record after repair” as a workflow.


Malfunction Report

Found at - Site Visit
 Preventive Maintenance

Sheet No. KR 2

Zonal	DSM & COAST	Equipment	KIGAMBONI FEEDER	Date	16-Dec-14
Substation	KURASINI	Device No.	33-KIG-0	Inspector	VERA BAITANI

1. Details of malfunction (by Inspector)

Photograph or sketch		Condition/remarks/comment
		Deformation of clamps connecting CB & CT which is probably due to faults and loose connections. some parts are connected by two bolts instead of four bolts
Implementation of measure		Present equipment status
<input checked="" type="checkbox"/> Not implemented <input type="checkbox"/> Emergency → ※Don't touch at Site Visit		<input checked="" type="checkbox"/> Using <input type="checkbox"/> Spare (stand-by) <input type="checkbox"/> Out of service (impossible to use)
To replace clamps		

2. Repair method (by Zonal w/s PE)

Time limit for repair	
<input type="checkbox"/> Emergency (Less than one month) <input type="checkbox"/> Early (Less than three month) <input checked="" type="checkbox"/> Next PM (One year)	
Shutdown work	Shutdown area
<input type="checkbox"/> Not necessary <input checked="" type="checkbox"/> Necessary →	All substation
Repair/implementation method	
The shutdown is to be planned and investigation on how to replace the clamps or fabricatiions should be done.	
Necessary parts and items for repair	
33kV CB, Kigamboni feeder	
Remarks/comment	

3. Repair results

Date	7-Jun-15	Repaired by	WS HC
Photograph or sketch			
			
Remarks/comment			
7 Jun 2015 PM & Repair Work Emergency rehabilitation was done by using aluminum terminal because the terminal was already melted. Permanent measurement will be done by using proper material recently.			

Sign 7-Jun Deo → → → →

Monthly Report

Monthly Report have been made to find Malfunction detection and Confirm Result of Repair Monthly.

OJT Progress Report (Monthly) About Dar 25 Distribution Substation

<DEC 2015>

NO.1

1.Site Visit(Number of Substation Each month) (Visual inspection)

			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
Plan			12	13	17	25	0	0	25	0	0	5	4	16	117
Result			12	9	17	25	0	0	25	0	0	5	4	12	109
Achievement Rate			100%	76%	100%	100%	0	0	100%	0	0	100%	100%	75%	93.2%
Reason of non Achievement	MAY 2015: Training Programs. However, there have been non joint inspections.														
NOTE	From July to December its was decided to visit the sites once in three months (NOV-2015)														

2.Periodic inspection(Number of Substation Each month)

			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
Plan			0	4	1	0	2	0	4	4	5	5	0	0	25
Result			2	1	1	0	6	5	3	2	5	0	0	0	25
Achievement Rate															100%
Reason of non Achievement	JUNE 2015: The two exercise was posponed by the respective region (Ilala)														

3.Malfunction Report Number of Issue (Each month)

			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
Site Visit			86	49	11	10	0	0	15	0	0	8	1	7	187
Periodic inspection			4	1	2	0	6	5	3	2	5	0	0	0	28
Total			90	50	13	10	6	5	18	2	5	8	1	7	215

4.Malfunction Report Number of Repair (Each month)

			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
Result			9	3	4	2	10	7	6	8	11	4	4	1	69

Improvement of technique and skill by OJT activity

Ranked how much maintenance skill and management level were improved through OJT activity by operation item and compared before-and-after activity.

1. Target, items and manner of assessment

a) Maintenance work was assessed per organization level.

(Top runner approach: A skilled person in an organization teaches the skill in the organization)

b) Item of the evaluations

Major item of the evaluation

1. Execution of inspection and repair ▪ ▪ ▪ <Site-Visit ,Periodic Inspection and Repair Work>

Making Annual Plan , outage arrangement with relative department, secure work safety/
making workflow , making repair plan and making Malfunction Report etc.

2. Maintenance technique ▪ ▪ ▪ <Substation> Knowledge of function, How to test(Test technique and
use of test equipment), Work skill(Contact cleaning, etc).

3. Management ▪ ▪ ▪ <Guideline> Difference between Breakdown Maintenance and Preventive
Maintenance, Understanding about Guideline and workflow

<Recording of Device> Making the Origin of Substation , Making trouble Record and Study preventive
measurement for the other etc.

c) assessment category and rating manner

Assessment category A, B or C

A: 80% or more // Excellent/ Very good

B: 50% or more ~ 80% or less // Good/ Fair

C: 50% or less // Poor

Assessment sheet

2. Assessment sheet and procedure

Assessed by “Maintenance work OJT assessment (per organization).” Assessment was done based on the record such as site activity status, progress of documentation and the performance of training etc including hearing to the workshop.

3. Manager		2. Maintenance		OJT evaluation for Maintenance Work (Organization Level) Sheet 1			
Item		Item		(Skill evaluation at an organization level—The work level practicable by persons in charge or managers) In case A is marked, a person acquired A rank shall be filled in "sheet 2."			
Standardization		Knowledge of Facilities		Evaluate on a scale of A to C A: 80% or more / Very well B: 50% or more, 80% or less / Moderately well C: 50% or less / Slightly well - Not at all well			
Administration knowledge		Measuring Technique		1. Execution of inspection and repair			
Budget Plan		Measuring Technique		Item	Ideal Situation	Original Period	Extension Period
Inspection equipment						Before	Before
						After	
				Inspection Plan	Be able to establish the Site-Visit plan effectively. Be able to develop the annual plan for periodic inspection. Be able to consult and arrange the power shutdown plan etc during periodic or extraordinary inspection with relevant parties. Be able to prepare Work Procedure for periodic or extraordinary inspection.		
				Implementation of Inspection	Be able to implement Site-Visit. Be able to conduct periodic or extraordinary inspection. Be able to inform about safety/ work procedure and the result at meetings before/ after work. Be able to conduct an inspection at the same level. (using each inspection check sheet)		
				Record Report	Be able to detect malfunctions. (a technique is acquired.) Be able to prepare/ secure the required equipment for inspection. Be able to determine the treatment manner for detected malfunction. Be able to record the periodic/ extraordinary inspection result. (PM Team Report, Final Report) Be able to record the detected malfunction. (Malfunction Report & List) Make check sheets and malfunction reports organized (filling etc) and available.		
				Implementation of Repair	Be able to report the inspection result to the executives. (Monthly Report) Fill the inspection record in the facility logbook. Be able to give malfunction quick treatment as a... Be able to consider and plan the repair... Be able to plan and create... Be able to...		

3. Assessment result

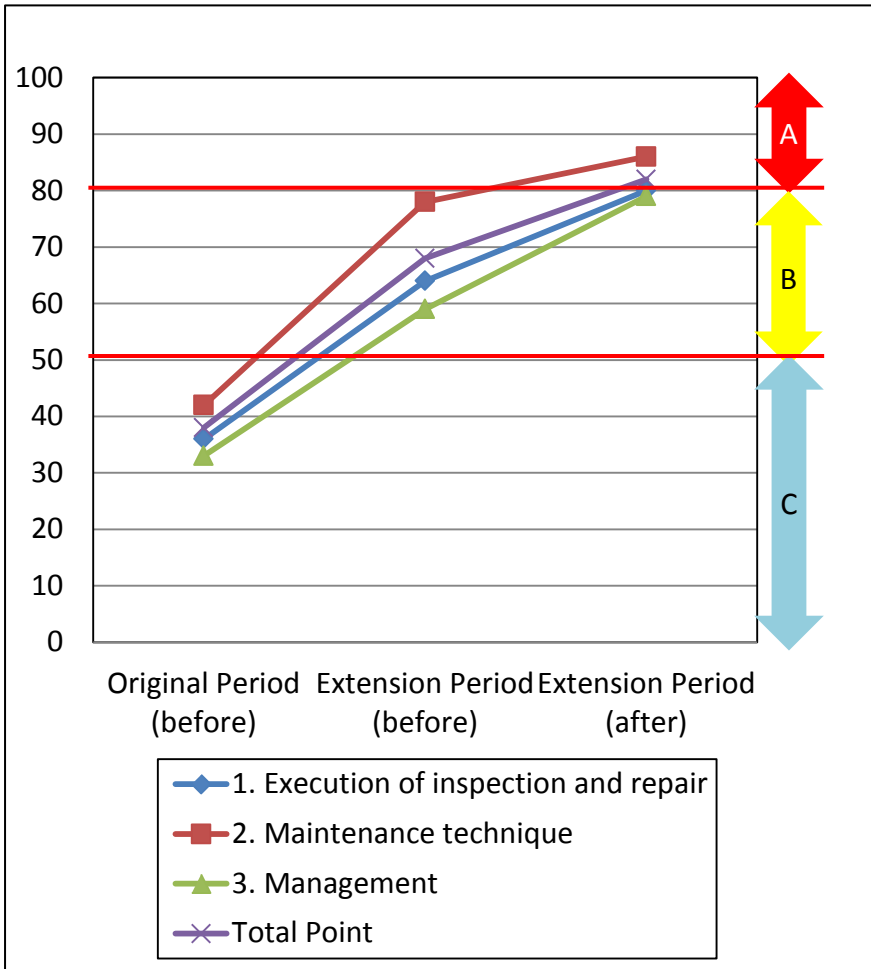
<rating/Assessment level>

Assessment item	Original Period	Extension Period	
	before (Jun-2012)	before (Jry-2014)	after (Jan-2016)
1.Execution of inspection and repair	36/C	64/B	80/A
2.Maintenance technique	42/C	78/B	86/A
3.Management	33/C	59/B	79/B
Total Point	38/C	68/B	82/A

a) In **“Implementation of inspection and repair”**, it was ranked on “C” at the beginning, then ranked on “B” before implementation of Extension Period and ranked on “A” after implementation. The reason why it has been improved from “C” to “A” is because the purpose of PM, implementation contents and the manner were standardized and have been widely become used by establishment of guideline, preparation of workflow and training (seminar).

b) In **“maintenance technique”**, it was ranked on “C” at the beginning, then ranked on “B but almost A” before implementation of Extension Period and ranked on the middle of “A” after implementation. Fulfillment of inspection equipment, implementation of specialized training and site OJT instruction can be named as a main reason of those improvements.

c) In **“management”**, it was ranked on “C” at the beginning, and then ranked on “B” before-and-after implementation of Extension Period, but after that, it was improved in almost “A.” Work systemization such as guideline, workflow and procedure etc, OJT along with the actual site work, and training (seminar) are the reason management level has been improved.

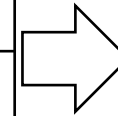


d) To sum up, before OJT, PM system was not structured, so organization level of maintenance work (assess whether there is a professional, not by individual skill or technique) was ranked on “C” but on-site training and guideline were developed so it was ranked on “B” and then workflow and procedure were widely used after implementation of Extension Period then it was ranked on “A”.

Compared to the situation before OJT implementation, organization level is dramatically improved.

Explanation : Organization level sample

	Person a	Person b	Person c	Person d	Person e
Technique and Skill (1)	<i>C</i>	<i>B</i>	<i>A</i>	<i>C</i>	<i>B</i>
Technique and Skill (2)	<i>C</i>	<i>B</i>	<i>B</i>	<i>B</i>	<i>A</i>
Technique and Skill (3)	<i>B</i>	<i>C</i>	<i>B</i>	<i>C</i>	<i>B</i>



Organization level
<i>A</i>
<i>A</i>
<i>B</i>

For Example
Even if
Organization
level is A class,
Member level
could be C,B
class.

4. Further Action.

Further development in view of assessment rank

Assessment was carried out to the “department level.” It implies that there are few individuals with high skills in the department, and not the entire staff in the department reached that level. Therefore, it is vital to carry on the activity mainly by the high skilled staff in the department to rise up the level of the rest.