ANNEX3

Monitoring Sheet

To CR of JICA PNG Office

Project Monitoring Sheet

Project Title : PROJECT FOR THE IMPROVEMENT OF PLANNING AND OPERATION OF POWER SYSTEM

Version of the Sheet: Ver.1 (July. 2022)

Name: Obed Batia
Title:Project Director

Name: Seiji Ueoka
Title:Chief Advisor / System Planning

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Monitoring Sheet (1)

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I. Summary

1. Progress

1-1.Progress of Input

The contract of this Technical Cooperation Project was concluded between JICA and Kansai TD, Newjec and SeED Okinawa on 14th January 2022 and the Project activities have started as three years project until Jan, 2025.

In March 2022, a kick-off meeting was held on the Web with Papua New Guinea (hereinafter referred to as "PNG") to facilitate the implementation of the project, and basic matters such as the project implementation structure and implementation methods were confirmed.

（First Dispatch）

In March 2022, meetings were held with the project manager of the PNG side and the leaders of each working group (hereinafter referred to as "WG"), and the request for the notification of the WG members and materials required for future WG activities were collected.

（Second Dispatch）

At the second dispatch in May 2022, PNG side nominated members of each WG and the WG was formally inaugurated, and the project activities began.

In formulating the training curriculum for the second and third years, baseline surveys were conducted through questionnaires and interview surveys to grasp the initial state of individual abilities, experiences, etc. of each counterpart individual.

Based on these results, each WG considered syllabus and curriculum proposals for the steady implementation of technology transfer, and these results were compiled as a capacity assessment report (draft version).

On May 27, 2022, the first Joint Coordination Committee meeting was held to explain the work plan and to discuss the WG members. Both sides confirmed the plan.

Original allocation plan of the Expert Team and its performance are shown in Fig1-1-1.

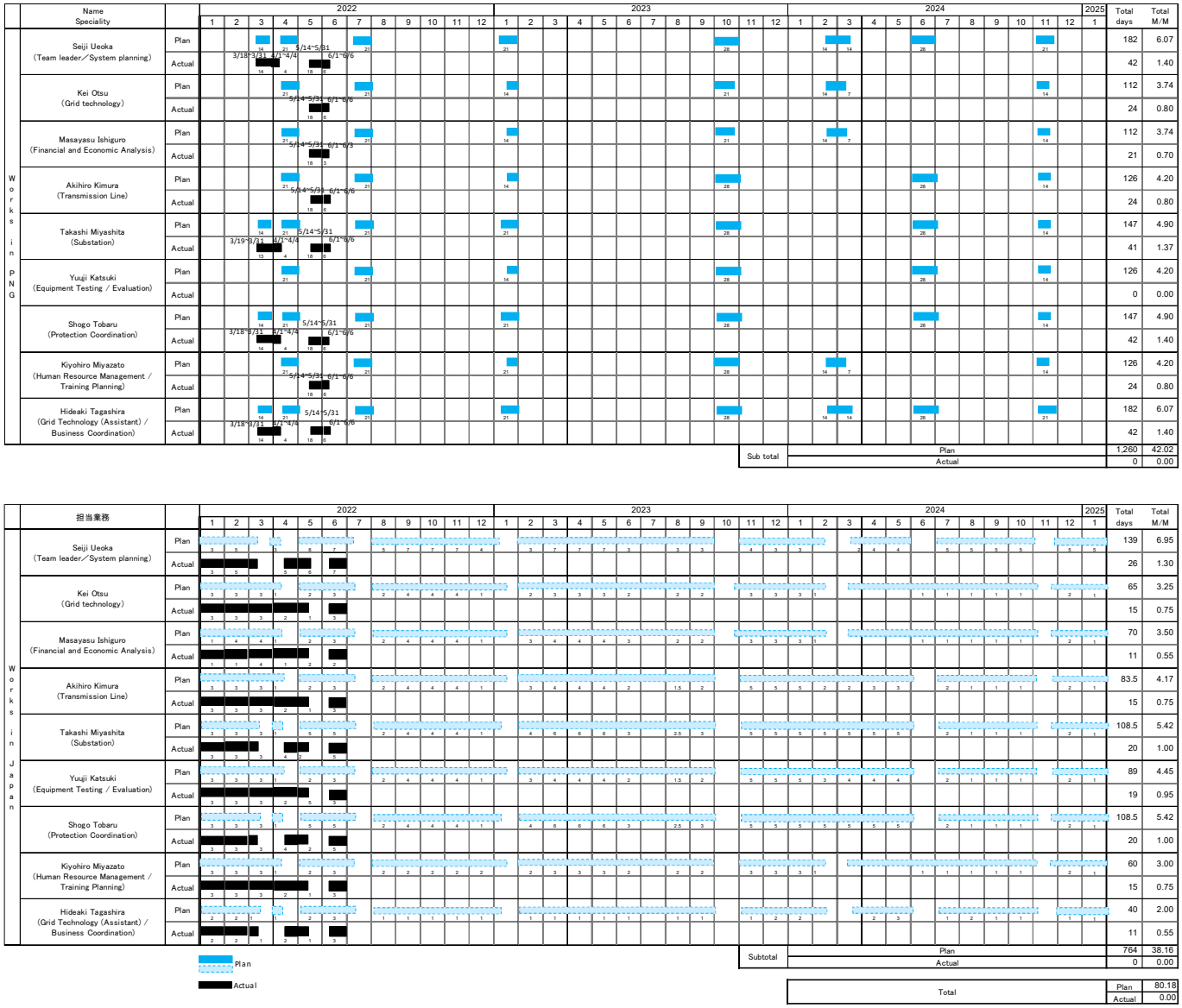


Fig.1-1-1 Original allocation plan of the Expert Team and performance

1-2. Progress of Activities

（1） Work Plan

As for the work plan, the expert team prepared the draft Work Plan before the second dispatch and explained the contents of technology transfer, the method, the schedule, etc. to each WG members.

And after exchange opinions with them, Work Plan was finalized.

At the first Joint Coordinating Committee held on 27th May 2022, Work Plan was explained by the Expert team and confirmed between JICA and PNG side.

（2） Baseline Survey

This project is a technical cooperation project aimed at enhancing the technical capacity of PNG Power Limited (hereinafter referred to as "PPL") staff, in order to improve their ability to formulate system planning and operate related statistics.

Therefore, because it is necessary to measure the degree of technical capacity enhancement of C/P, a baseline survey was conducted with the aim of grasping technical capabilities of C/P at the beginning of the project.

Baseline surveys were conducted through questionnaire and interview for each WG C/P.

In addition, the interview was conducted with three or more experts from the expert team, including team leaders,

and members of the Human Resource Development/Training Team, in order to avoid bias in the evaluation.
A baseline survey was implemented through questionnaire and interview survey to the members of the Working Group. And interview survey was conducted mainly by the expert related to the field of Working Group and other two experts such as team leader, Human Resource Management/Training Planning Expert for fair evaluation.
As for the detailed contents, method and results of the baseline survey, please refer to the Capacity Assessment Report submitted in July 2022.

Regarding the effectiveness of the technology-transfer, the Expert team plan to carry out the monitoring evaluation by the same method (questionnaire and interview survey) as baseline survey at the end of the technology transfer, and to compare the difference between before and after the technology transfer.

（３） Activities for WG

（３） －１． System Planning WG

① Result of activity to apprehend the current situation

i. Status of POM grid

- Centered on the POM urban area, the Rouna hydroelectric power plants owned by PPL are located to the east and the LNG-fired power plants owned by IPPs are located to the west. While the trend is similar in PNG in general, the POM grid has been experiencing insufficient supply relative to demand, and IPPs have been called upon to develop power sources.
- As of May 2022, three IPPs, Exxon Mobile, Niu Power, and Dirio, have generation facilities connected to PPL's POM grid. The first IPP grid connection to the POM grid was when Exxon Mobile installed an LNG-fired power generation facility on the west side of the POM grid.
- Although rehabilitation of the Rouna hydropower plants and other efforts are underway, the capacity of PPL's hydropower plants is small, and Niu Power is responsible for about half of the supply to the POM grid.

ii. Exxson Mobile's grid connection

- Exxon Mobile owns an LNG plant along the coast about 20 km northwest of POM, and the thermal power plant is located adjacent to this LNG plant.
- In order to connect Exxson Mobile's thermal power plant to the POM system, a single 66 kV transmission line L545/1 was built from the west side of the POM system to Kanudi from Exxson Mobile on the southern route. This is not suitable for the N-1 requirement set forth in the PNG Grid Code.
- From the start of Niu Power's grid connection to the start of Dirio's grid connection, Exxon Mobile was connected to Niu Power via 66kV single circuit, L545/2. This connection to the POM grid via NiuPower temporarily connected Exxon Mobile to the POM grid via two routes.
- Exxon Mobile's thermal power plant has been shut down after Dirio's thermal power plant, which was interconnected later, went into operation.

iii. Niu Power's grid connection

- After Exxson Mobile, Niu Power connected an LNG-fired power plant to the POM grid as an IPP.
- Niu Power's thermal power plant is located adjacent to Exxon Mobile's LNG plant. The reason this installation location was chosen is thought to facilitate the procurement of LNG, the fuel.
- In order to connect Niu Power's thermal power plant to the POM grid, a single 66 kV transmission

line L546 was being built from the west side of the POM grid on the northern route from Niu Power to Moitaka.

- Niu Power is also connected to Exxon Mobile by L545/1 and L545/2, but is released by a switchgear on the Exxon Mobile power plant premises. Therefore, it is not configured to be connected to Kanudi via Exxon Mobile. As a result, Niu Power is not suitable for the N-1 requirements set forth in the Grid Code.
- Since Niu Power is responsible for about half of the POM grid's supply capacity, a single line accident has the potential to black out the entire POM grid. For this reason, a new single transmission line to Niu Power and Dirio is being considered with the support of DFAT.

iv. Dirio's grid connection

- Dirio was the third IPP to connect an LNG-fired power plant to the POM grid.
- Dirio's thermal power plant is also located adjacent to Exxon Mobile's LNG plant. As in the case of Niu Power, it is assumed that the reason this installation location was chosen was to facilitate the procurement of LNG as fuel.
- The grid connection of Dirio's thermal power plant does not involve the construction of a new large-scale transmission line to the POM urban area. Dirio's thermal power plant is connected by a T-branch to a 66 kV transmission line that connects Exxon Mobile's thermal power plant to Niu Power's thermal power plant. Dirio is connected to Niu Power's 66 kV bus bar via L545/2 and finally to Moitaka at L546 as well as Niu Power.
- Dirio is connected to the POM system by a single L546 transmission line. This is not suitable for the N-1 requirement set forth in the PNG Grid Code.
- L545/1 from Exxson Mobile to Kanudi is not utilized because the line capacity is small and limits the generating capacity of the thermal power plants. To simplify grid protection, L545/1 is opened at a switchgear on the Exxson Mobile power plant premises.

v. Future grid connection

- The Edevu and Naoro Brown hydroelectric power plants are planned in the northeast direction of the POM. In the near term, the company is about to start grid impact studies for the grid connection of the Edevu hydroelectric power plant.
- At this time, the most likely plan is to construct a 132 kV single circuit from the Edevu hydroelectric power plant to Moitaka to start the grid connection, and then convert to double circuits at a later time. The towers are being considered to be capable of supporting double circuits so that the second circuit can be efficiently connected at a later time.

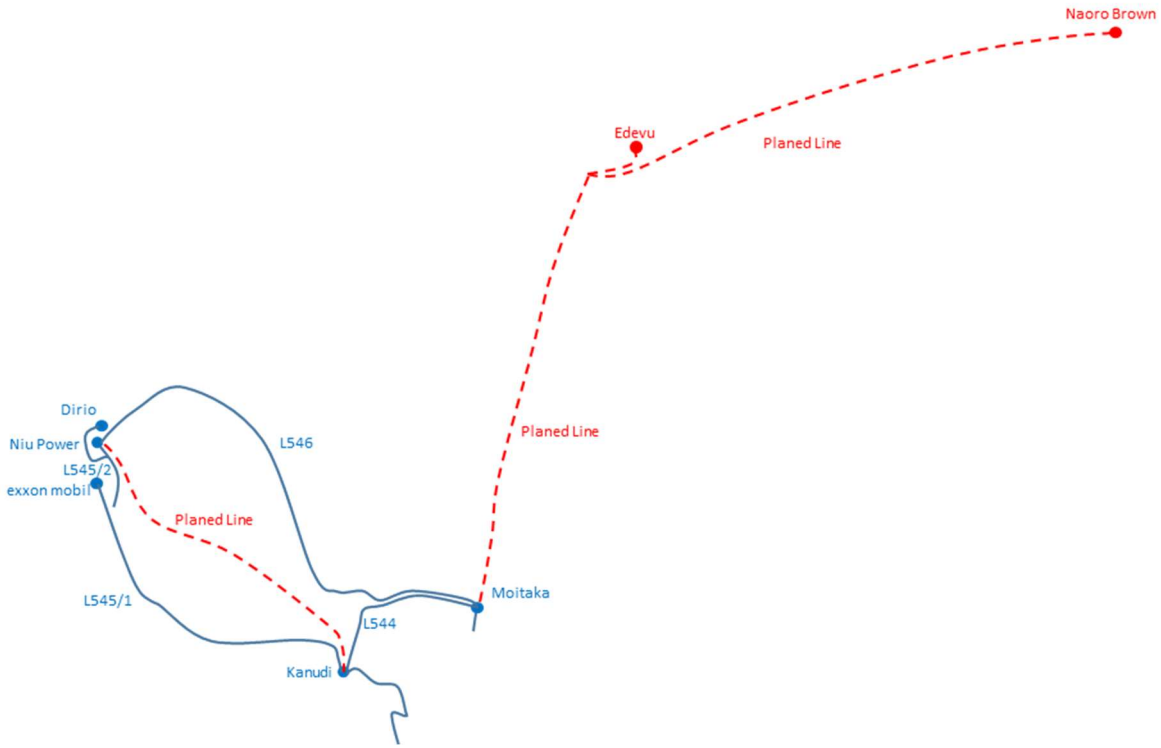


Fig1-2-1: Transmission line reinforcement plan for grid interconnection in the POM grid

Fig1-2-2: IPPs connected to POM system

vi. Actual condition of grid impact study

- Practical manuals for grid impact studies are not formulated within PPL.
- The grid impact study of Exxson Mobile and Niu Power was outsourced by PPL to an outside consulting firm. Dirio's technical review was conducted by PPL itself, but the personnel who were in charge have already moved on and their skills have not been inherited.
- Due to the small number of applications for grid interconnection from IPPs, the department in charge of gird impact studies within PPL has not accumulated sufficient skills required. Current personnel were given the skills necessary to simulate the system using Power Factory, with assistance from DFAT.
- PPL had two licenses of Power Factory. With support from DFAT, it acquired five additional new licenses and now has seven. PPL have enough licenses.

- Discussions on unifying the system simulation software used by each department, supported by USAID, have not reached a conclusion. Currently, each department continues to use the software it has been using to date.

② Problems

i. Grid impact study

- In the past, PPL may not have been able to confirm the need for the formation of facilities for the N-1 requirement in the grid impact study after the application for grid connection from IPPs, or it may have understood the need but for some reason did not consider the formation of facilities required at the start of grid connection.
- It is possible that PPL had the intention of forming facilities that meet the N-1 requirement after the fact, with priority on securing supply capacity, but the current unreliable grid that does not meet PNG's Grid Code is realistically causing blackouts caused by weak points.

ii. System planning

- Even if a grid impact study on grid connection determines that it is necessary, the plan may not reflect that determination in the grid plan, or the plan may not address the appropriate timing.

iii. Grid connection Procedure

- PNG's Grid Code requires that procedures be established between IPPs and PPL, but we have not been able to identify any documents established by PPL.
- PNG's Grid Code requires that the format of documents exchanged between IPPs and PPL, etc., be defined, but we have not been able to confirm that it is in place.
- here is no workflow that defines the internal operations from the acceptance of the grid connection to the completion of the connection.

iv. Software for gird impact study

- Any future updates to the Power Factory system simulation software will require acquisition of software-specific practical skills and maintenance costs for software updates.

③ Future activity plan

The WG will work to resolve the above issues while making efforts to collect further detailed information. Specific activities will be conducted in the form of lectures, including discussions, with the aim of improving the capabilities of PPL personnel participating in the WG.


Fig1-2-3: Lecture Scene of System Planning WG

（３）－２　Financial and Economic Analysis WG

①　Result of activity to apprehend the current situation

As a startup WG activity, we had an orientation for the WG members. The orientation provided guidance about what economic and financial analyses are as well as the abstract of the project, the work schedule, and composition of the WG.

Meanwhile, we received PPL financial statements for fiscal years 2018 - 2021, as part of data collection.

②　Problems

In the second mission, we could not start the actual training (in the form of lecture), due to time constraints.

As regards the schedule after the second mission, we decided not to set up an online meeting for the first training session, but instead commence a face-to-face meeting in the third mission. This is partly because an intensive time input is needed for each training theme, and partly because four of the members have little knowledge of economic and financial analyses.

With respect to the PPL financial statements, there are unclear descriptions.

The audited financial statements for fiscal 2018 are in conformance with ordinally accounting rules. However, those for other years are inconsistent in description and also incomplete. For example, except for the financial statements for fiscal 2018 and 2019, depreciation is excluded from operating cost. This treatment deviates from ordinary rules.

③　Future activity plan

Actual face-to-face training (lectures) will start in the third mission. Through this training, the WG members will be equipped with basic knowledge and prepared for the online training in the next stage.

（３）－３　Transmission　Line WG

①　Result of activity to apprehend the current situation

The expert team collected the following information about current situation during first baseline survey and plans to carry out an additional baseline survey on the next local activity (Second baseline survey). Therefore, there is a possibility that this information will be updated after second baseline survey.

i.　Patrol and inspection of transmission facilities

- There is no classification of patrol and inspection in PPL maintenance work. Visual inspection is conducted and it covers the contents of patrol and inspection. The method of visual inspection is both on the ground and climbing the tower.
- The period of visual inspection is approx. once a month in urban areas without the restriction of access. On the other hand, it is approx. once a year in mountainous areas.
- WG members understand the basic knowledge of structure and features of transmission facilities such as tower, insulator, conductor, foundation.
- The check sheets for inspection don’t exist in PPL. The accuracy of inspection depends on the ability and experience of inspection workers.
- The criteria for judging damage or malfunction of transmission facilities also don’t exist. The accuracy of it also depends on the ability and experience of inspection workers. Therefore, there are many cases where some facilities damaged or malfunctioning with a severe condition that it is necessary to replace promptly

are discovered.

ii. Repair of transmission facilities

- Almost all repair works are conducted by PPL maintenance team. One of those reasons is there are few contractors to be able to repair in PNG.
- The resource of maintenance work which includes workers and equipment isn't enough in PPL. Therefore, there are some cases where light - damaged or malfunctioning transmission facilities have been left without managing the progression for a long time.
- The repair works for severely damaged or malfunctioning transmission facilities such as collapse of tower are consigned to overseas contractors. However, it takes much time to procure the required materials and workers.

iii. Asset management of transmission facilities

- The database management system for transmission facilities is being developed by PPL asset management team currently. This system was provided by the Australian software company and PPL asset management team has been proceeding with data registration regarding transmission, substation, and distribution facilities into this system.
- Approx.75% of data registration regarding distribution facilities has been completed. However, that regarding transmission and substation hasn't been proceeded yet.
- Required data to manage the condition of transmission facilities has been considered.

iv. Records of fault accident on transmission line

- The reason why the fault accident causing an unplanned power outage on the transmission line mainly accounts for trees under the transmission line. For examples;
- Growing Trees under transmission line approach to the energized conductor and cause a ground fault
- When land owner under the transmission line cut trees. they crash the conductor and some towers collapse.
- Precaution against above fault accident hasn't been functioned adequately due to resource shortage of maintenance teams.
- ROW (Right of way) under transmission line exists in PNG. However, it isn't specified in national law or company documents. As a result, it doesn't function adequately to secure power supply reliability.
- There is little lightning in PNG and the fault accidents due to lightning are also few.

v. Training for transmission maintenance workers

- There are no training facilities for transmission line in PPL. Therefore, transmission workers are trained and accumulate experience through maintenance works on actual transmission facilities.
- Maintenance teams conduct line works with planned power outage conditions by themselves. They feel afraid of climbing the tower with energized condition due to lack of training and experience. As a result, simultaneously planned power outage of double circuits is implemented even if the range of line works is only one circuit.
- When maintenance teams conduct line works with planned power outage conditions, they don't use grounding rods for transmission line. PPL operates grounding for transmission line only at both substations. Therefore, there is a risk that the voltage induced by another HV transmission line remains on the

transmission line partially even under power outage conditions.

vi. Tools and measuring equipment for transmission maintenance works

- Some of the energized checkers owned by maintenance teams are out of order.
- As described above, maintenance teams don't own grounding rods for transmission line.
- The items that inspection workers always take are camera, field glass, and compact type thermography.
- Maintenance teams don't own measuring equipment for transmission line such as the megger one for insulator units and the ground resistance one. Test teams own this measuring equipment.
- Asset management teams promote new transmission line construction projects and test teams carry out commissioning test with required measuring equipment. Therefore, there is no opportunity that maintenance teams use any measuring equipment.

vii. Collected data

Collected data during first baseline survey is as follows;

Title	Summerly
Inspection plan by asset management team	Yearly inspection plan for POM, Ramu and Gazzel
Inspection report by maintenance team	By POM O&M center
Main maintenance work report	The report of replacement insulator unit or cutting tree
Procedure for power outage work by maintenance team	Procedure to conduct planned power outage work
Transmission maintenance record	For insulator unit replacement work
Work flow of maintenance team	Work flow for new project and maintenance work
Supplier Contact List	Transmission material
Training Needs Form	Request for own training in near 3 years
Transmission Maintenance_ Line Details-2022	Detailed information of transmission line in POM grid

② Problems

Problems based on the result of grasping the current situation in PPL are described below. JICA expert team plans to carry out an additional baseline survey on the next local activity (Second baseline survey). Therefore, there is a possibility that this information will be updated after second baseline survey.

i. Patrol and inspection of transmission facilities

- PPL maintenance teams have carried out a visual inspection of transmission facilities. However, internal rules and manuals regarding the method, period, and viewpoint of visual inspection don't exist in PPL.
- The check sheet for visual inspection and criteria for judging damage or malfunction of transmission facilities don't also exist in PPL.
- Therefore, the accuracy and scope of visual inspection depends on the ability and experience of the inspection workers, and insufficient inspection is conducted occasionally.

ii. Asset management (including repair works)

- Systematic database management of transmission facilities hasn't been implemented.

- Accumulating the records of damaged or malfunctioning transmission facilities discovered in the past and devising appropriate repair plans haven't been also implemented.

iii. Countermeasure against fault accidents on transmission line

- The period of visual inspection hasn't been kept appropriately due to resource shortages, especially in Ramu grid where it has many mountainous areas.
- As a result, fault accident due to trees under transmission line occurs.

iv. Lack of the opportunity of training for transmission workers

- There are no manuals and facilities to train transmission workers in PPL
(The distribution training facilities are in the training center, however, transmission and substation training facilities aren't.)
- When maintenance teams conduct line works with planned power outage conditions, simultaneously planned power outage of double circuits is implemented even if the range of line works is only one circuit. As a result, the power supply reliability may decline.

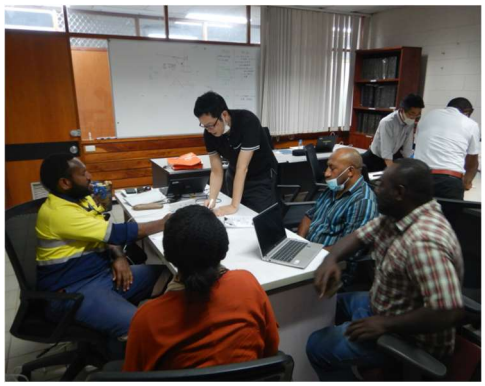
v. Lack of tools and measuring equipment for transmission maintenance works

- The required tools for maintenance works such as energized checkers and grounding rods are lacking. Therefore, it is necessary to list and provide them in this project from the viewpoint of safety and regular management.

③ Future activity plan

JICA expert team will analyze the above collected data and information, Furthermore, consider how to improve the above problems.

It will carry out additional data collection on the next local activity (second baseline survey) to proceed preparation of required rules and manuals. After second baseline survey, online training for PPL members will be started to improve their knowledge regarding maintenance and asset management works.



<Photo of WG2-1 activity>

（３）－４ Substation WG

① Result of activity to apprehend the current situation

i. Patrol and inspection, maintenance

- Criteria for maintenance work to maintain substation facilities is insufficient.

- Testing equipment, manpower and spare parts are insufficient.
- Because of frequent troubles of the equipment, the repair cycle is short, and it keeps PPL busy.
- There is no standard check sheet such as a patrol chart, and it relies on individual experience.The preparation of clear rules is necessary.

ii. Asset management
- PPL is currently developing an asset management data system.
- Poor storage of equipment adversely affects the life of it.

iii. Response to accidents and failures
- In cases of serious power outages, factor analyses are performed using Fish Bone Diagram.
- Regarding factor analysis in the event of power outages, and there is no maintenance information management system in PPL .

iv. Working with power outage
- Because the capacity of the equipment is inadequate, it is difficult to stop operation as scheduled.

v. Outline and rule in PPL
- Technical documents related to substation O&M don't exist in PPL because their technical documents have not been properly handed over from the predecessor company. In the field of distribution, their technical documents have been prepared by an Australian consultant.

vi. Measuring instruments situation
- Most of measuring instruments are only one, and in the case of the test, only one maintenance team of POM go to each substation, so it seems inefficient.
- The most of measuring instruments are large and high functionality, so it is expected that PPL is able to improve their work efficiency by reducing size and weight of measuring instruments and their cost performance by equipping measuring instruments considered of usage and frequency in use.

vii. Collection data list

Title	Summary
PPL structure	Described about T&D business unit structure
PNG Power Distribution Manuals	PPL designed manual about distribution

② Problems
- The environment for the maintenance is not sufficiently prepared due to the shortage of materials,manpower, and the management system, and consequently, troubles of the equipment occur frequently.
- There is no redundancy of the facilities, and scheduled power outage adjustment is difficult, and the management system in accidents is considered to be insufficient.
- The storage status of technical data differs depending on the substation, so it is insufficient to hear only at the head office, it is necessary to go to other substations and maintenance bases for site survey in the future.
- It is considered necessary to develop manuals in the future, but manufacturers may not comply with PPL's requests to provide technical documents.

③ Future activity plan
- 2022.07~2022.09：Organizing information and preparing about baseline survey

- To hold online working
- Preparation for procurement of measuring instruments

➢ 2022.10~2022.11：Third trip (baseline survey)

- Baseline survey and analysis of the current situation during the third trip

➢ 2022.12~2023.03：Capacity assessment and planning training

- Implementation of capacity assessment
- Preparation and implementation of on-line training
- Selection of maintenance skills to be imparted to PPL
- Preparation of manuals

（3）－5 Protection Coordination WG

① Result of activity to apprehend the current situation

Through the WG activities, the following items were discussed, and the current situation was identified.

➢ Protection Scheme (Distance relay, Differential relay)
➢ Power outage case studies
➢ Simulation software (ETAP)
➢ Work process

The following table shows the materials collected.

Title	Summary
Organizational chart	National System Operation Management Team
Protection System Reviews (POM, RAMU)	Protection setting reviews are done by Voltex in 2019 and Entura in 2012.
PNG Grid Code	A comprehensive set of conditions that covers a wide set of rules must comply with assets connected to a power system.
List of protection relays	List of relays on POM, RAMU and GAZELLE
Relay setting manuals: Specification sheet	Manufacuturer's specification sheets
Diagram of Konedobu Substation	Including relay with CT connections
system outage brief	Power system outage report on 13th April

② Problems

Regarding the simulation software (ETAP) that PPL's protection team plans to utilize, POM and Gazelle grids are currently under modeling, and the progress of this project may be affected depending on the status of the modeling. Regarding the protective coordination study, it is necessary to discuss measures with CP while conducting the survey in the future, such as creating a protective coordination diagram and substituting it or prioritizing the study of Ramu system for which a model already exists. Since it was not possible to investigate

the contents of ETAP during the second trip due to the absence of the supervisor who holds the license, prior arrangements will be made so that the actual equipment can be investigated during the third trip.

③ Future activity plan

We will conduct online training as part of capacity assessment and continue to work on understanding the skills of PPLs. In addition, we will organize the items to be surveyed during the third trip.

（3）－6 Human Resource Development WG

① Result of activity to apprehend the current situation

Through the WG activities, the following issues were discussed, and the current situation was identified.

- Employee training and evaluation systems
- Employee's motivation and ambition
- Condition of training facilities

The following table shows the materials collected.

Title	Summary
PPL Technical Training Qualification	Outline of training offered by PPL
Technical Training: Modules Outline Summary	List of courses in PPL Training College
Introducing PPL Training College	Overview of PPL Training College
Performance Management and Improvement Policy& Administration Guideline	A guideline about how to manage employees' performance
Recruitment & Appointment Policy and Administration Guidelines	A guideline about management and administration of all recruitment and appointment practice
Staff Training and Development Policy & Administration Guideline	A guideline about policy and administration for staff training and development
Performance Review Form -Contract Officers 2019	Contents of contract for individuals (Performance evaluation, development plan, etc)
Position Categories	List of the members of PPL
Job Description (Senior Protection Engineer)	Job Description of Senior Protection Engineer

② Problems

Since WG4 requests materials from a wide range of departments, there is a concern that the process of permitting the provision of such materials within PPL will take time, and it may take longer to receive the materials. In order to ensure that the necessary materials are provided, we will make requests as far in advance as possible.

③ Future activity plan

We will continue to gather information through online meetings and draft the ability requirements. During the

third trip, we will use the draft to refine the ability requirements so that they meet the needs of PPL.

（４） The first Joint Coordinating Committee（2022.5.27）

On 27th May 2022, the first Joint Coordinating Committee was held with the attendance of Mr. Yokota, Senior Representative of JICA PNG Office.

The Minutes of Understandings of the first Joint Coordinating Committee is attached the end of this Monitoring Sheets.

Main points of the discussion in the meeting are as follows.

１）Explanation of Work Plan

２）Confirmation of the members of the Working Group

1-3. Achievement of Output

（１） As for the Output 1, "Capacity of system planning for the transmission line is improved", we are investigating the identification and role of related departments in formulating grid plans, and are currently organizing the current situation.

（２） As for the Output 2, “Capacity of maintenance for transmission line and substation is improved”, the survey was carried out on the O&M ability of transmission lines and substations of PPL and grasping the present situation for the activity plan formulation was carried out. In the second trip, we comprehended information about O&M in PPL. This information will be supplemented by delving into it in the future baseline survey. Then, based on the results of the baseline survey, the effective maintenance skill and asset management skill will be identified for PPL, and the detailed activity plan will be formulated and evaluation indices will be established to improve those skills.

（３） As for the Output 3, “Capacity of protection coordination is improved”, utilizing the established WG, we are gathering information and sorting out the current issues that PPL is facing. The problems raised in (3)-5(2) will be addressed by the third trip, and will be addressed in coordination with the PPL so that it will not affect the progress of the project in the future.

1-4. Achievement of Project Purpose

As for the Project Purpose, when we achieve the Output 1~3 as described in 1-3, the Project Purpose “PPL can properly implement system planning for the transmission line and maintenance for transmission line and substations on its own .” will be achieved.

But now we have just started the project activities and it is concentrated on project activities related to baseline surveys of PPL staff and understanding of the mechanism of PPL's work and the current status of equipment. It is still a situation in which it takes time to achieve the targets.

1-5. Changes of Risks and Actions for Mitigation

Following factors are considered to become obstacles for the smooth implementation of the Project.

(1) Inadequate assignment of C/P

If the adequate C/P will not be assigned at the proper time and necessary numbers, activities of the technology transfer could not be carried out on schedule.

(2) Inadequacy of working environment and necessary equipment

Proper working environment and equipment will be indispensable for implementing the Project on schedule.

Lack of proper working environment and equipment would be obstacles for the smooth implementation of the Project.

(3) Shortage of budgetary allocation

In order to carry out the Project on schedule, necessary budget should be prepared in adequate time. If the necessary budget would not be allocated on time, we cannot expect the Project running smoothly.

If some risks occurred in these factors, Project will face a serious problem.

Therefore the expert team has exchanged views with C/P of PNG frequently and has confirmed the important issues by the Minutes of Understandings in order to avoid misunderstanding with each other and has tried to minimize the risks of above mentioned factors.

Assumed risks and countermeasures for minimizing risks are shown in Table 1-5-1.

Fortunately there occur no problems so far now.

Table 1-5-1. Risk items

	Risk Factor	Countermeasures for Mitigation	Results
1	Assignment of C/P	The expert team requested to establish the WGs and to assign the C/P for the technology transfer at the Kickoff meeting in March 2022.and confirmed it in the Minutes of Understanding of the first JCC held on 27th May 2022.	No problems occurred in C/P allocation. Actual number of C/Ps are more than the original Plan.
2	Assignment of Japanese Expert	As for the contents and method of technology transfer were discussed and confirmed in the Work Plan in May 2022. And this Work Plan was agreed between JICA and PNG side in the first JCC held on 27th May 2022. Base on the schedule in the Work Plan, the expert team was dispatched	No problems occurred so far now
3	Management of Scheduling and Implementation	The expert team and Project Manager exchange views frequently mainly about the schedule of the technology transfer.	No problems occurred so far now
4	Share of Information	Regarding the daily job management, the expert team discuss with the Project Manager and the progress of the project is reported in the JCC and shared among the related people.	No problems occurred so far now
5	Office Space and Working Environment	The expert team requested the office space to PNG side in the kickoff meeting in MArch 2022. PNG side provided the office space with air condition to the expert team.	No problems occurred so far now

1-6. Progress of Actions undertaken by JICA

(1) To make a contract with Kansai T&D, Newjec and SeED Okinawa and start the Technical Cooperation Project in January 2022

(2) To Convene a consultant for the PEP meeting

(3) To Participate in the 1st JCC (27th May 2022)

1-7. Progress of Actions undertaken by Gov. of PNG

(1) To provide the expert team office space with necessary equipment

(2) To assign the C/P as the member of the Working Group for the technical transfer
Assignment of the C/P is shown in Table 1-7-1.

(3) To supply the necessary data and information for technical transfer and analyze them with expert team

(4) To organize the first Joint Coordinating Committee (27th May 2022)

1-8. Progress of Environmental and Social Considerations (if Applicable)

No relevant matters

1-9. Progress of Considerations on Gender/Peace Building/Poverty Reduction (if applicable)

Five women are participating as WG members.

1-10. Other remarkable/considerable issues related/affect to the project (such as other JICA`s projects, activities of counterparts, other donors, private sectors, NGOs etc.)

As there are a lot of aid activities by various donors and agencies in the electric power sector in PNG. Projects by other donors which are expected to be considered to coordinate with are summarized as shown below.

Summary of Cooperation of Major Development Partners

Title	Funders	Description
Extend, expand and improve the electricity grid		
Extending HV/LV distribution lines into the Tsak Valley	New Zealand and Australia	Extending Ramu grid distribution in the Tsak Valley. Jointly funded by New Zealand and Australia, this PGK50 million project will extend the Ramu grid into the Tsak Valley, Wapenamanda District of Enga Province, and connect up to 5,500 rural households, schools, health centers, government offices and businesses within 500 meters of the main PNG Power Ltd (PPL) power lines.
Ramu grid transmission reinforcement	Japan	Upgrading existing 140km high voltage transmission line and construction of new substations.
Markham Valley solar plant	Australia	Constructing a solar power plant that will connect to the Ramu electricity grid through grant funding provided by the Australian infrastructure Financing Faci1ity for the Pacific (AIFFP).
Improved energy access for rural communities	Japan and New Zealand	Connecting households to the grid in West New Britain and Oro Provinces, and the Autonomous Region of Bougainville.
Refurbishment of the Ramu hydropower stations	Australia	Increasing capacity of the existing hydropower stations through refurbishment and repair work
Port Moresby grid upgrades	Australia	Installing new transmission lines and associated substations to increase the capacity and reduce generation costs of grids in the Port Moresby area.
Provincial grids improvement and upgrades	Australia	Improving, upgrading and restructuring six provincial grids in Finschhafen, Maprik, Daru, Kerema, Vanimo and Aitape.
Extension of the grid in Central Province	New Zealand	Extending the grid by 86km to villages in Central Province and connecting 5,600 households, schools and medical facilities. The project is due for completion in late 2021.
Strengthening PNG Power and connecting households	USA	Facilitating at least 130,000 new on-grid household electricity connections and strengthening PPL's financial viability and operational efficiency.
Ramu and Kimbe electrification project	Japan	Extending distribution lines to over 5,000 households mainly in rural areas of Ramu and some districts in Kimbe.
Build institutional capacity, strengthen policy and regulatory settings, and mobilise private investments		
Support to PPL on revenue protection	USA	Supporting the retail division of PPL on a revenue protection program focusing on its large commercial and industrial clients.
PPL capacity building and investment planning support	Australia and New Zealand	Working with PPL to strengthen its investment planning capabilities, as well as its corporate governance, and to develop policies and systems to improve project delivery, procurement, financial accountability and performance.

Enhance PNG's Energy Regulator Program	USA	Strengthening the capacity of the Government of PNG's energy regulatory authority to oversee technical regulations, and building PPL's capacity in competitive procurement.
Provide clean energy to rural and remote communities		
Pawarim Komuniti Off-Grid Electrification Program	Australia	Providing grants and technical support for innovative, Renewable, small-scale off-grid energy projects for remote communities.
EQUITV Project	Japan	Installation of solar products in remote schools. Solar panels, wind turbines, together with television sets and parabo a antennas installed in 315 elementary schools.
Facilitating off-grid household connections	USA	Facilitating at least 220,000 new off- grid household etectricity connections by developing viable off- grid electrification models.
Catalyse private sector engagement in electrification		
Catalyse Private Investment for Energy	USA	Leveraging USD200 million of financing including USD100 million of private financing to catalyse private investment in energy projects in PNG.
Facilitating private sector engagement, including in the power sector	Australia and New Zealand	Under the international Finance Corporation's PNG Partnership- Ⅱ with Australia and New Zealand(2018-2022), work is focusing on seven core areas including facilitating private sector investment in power infrastructure.

2. Delay of Work Schedule and/or Problems (if any)

2-1. Detail

About two months delay from the original schedule

2-2. Cause

In addition to security considerations from the PNG general election, training for staff selected from PNG public companies will be taken place in Australia in September 2022, and it was revealed that some C / Ps will participate in this training. Therefore it was decided to postpone the third dispatch period by about two months.

2-3. Action to be taken

This delay will be absorbed in the whole schedule in the first year of the Project.

2-4. Roles of Responsible Persons/Organization (JICA, Gov. of Myanmar, etc.)

No relevant matters

3. Modification of the Project Implementation Plan

3-1. PO

No change

3-2. Other modification on detailed implementation plan

No change

4. Preparation of Gov. of PNG toward after completion of the Project

Based on the manuals and training plans created in this project, the engineers trained in this project will continue to provide training.

II. Project Monitoring Sheet

1) Project Monitoring Sheet I (Revision of Project Design Matrix)

2) Project Monitoring Sheet II (Revision of Plan of Operation)

Annex Minutes of JCC(1)

Minutes of Meeting for First Joint Coordinating Committee
on
the Project for the Improvement of Planning and Operation of Power System

With regard to the Annex 1 3.3) of the Record of Discussions (herein after referred to as "RD") signed on the 25th of October 2021 between PNG Power Ltd (herein after referred to as "PPL") and Japan International Cooperation Agency (herein after referred to as "JICA"), First Joint Coordination Committee was held on 27th of May 2022.

In this meeting, JICA side and PPL side exchanged views for the smooth implementation of the Project for the Improvement of Planning and Operation of Power System (hereinafter referred to as "Project")

As a result of the discussions, both sides agreed on the matters referred to in the document attached hereto.

Port Moresby
27th May, 2022

Mr. Obed Batia
Chairperson
Joint Coordinating Committee
Chief Executive Officer, PPL

Mr. Seiji Ueoka
Chief Advisor

Witness

Mr. Takahiro Yokota
Senior Representative, JICA PNG Office

The Attached Document

1. Opening remarks
   Mr. Obed Batia, CEO of PPL

   I would like to take this opportunity to thank the people Japan, Government of Japan and JICA for making this Technical cooperation project.
   We appreciate every citizen of Japan whose financial contribution enable the Government of Japan to honor its commitment to the PEP by channeling this assistance through its agency, JICA. It is the tax payers of Japan that contributes to the development of PNG through PNG Power Limited.
   People run the company so focusing on the development of it people is a strategic move that ensures the future of the company.
   Training is like reproduction, we multiply ourselves and thereby ensuring our own prosperity.
   I note that this technical cooperation project is geared toward engineers, the people that are entrusted with technical success of the company, as you will be the leaders of this company.
   It is the right plan for when we change the head, the body will follow.
   Through this project we can learn not only the technical but also on the Japanese culture and lifestyle which would have a bigger impact in the mindset of our people.
   In the past, we have had engineers attached with oversea power companies and that has greatly benefitted our employees through the experience and knowledge gain abroad.
   We have a lot of foreign nationals working with ELCOM (before it was change to PNG Power) and this was attributed to the Kina being very strong and we were able to attract good people.
   Unfortunately, this arrangement was stopped before most of us joined the company and when the Kina was de-valued against foreign currencies.
   I would like to challenge you engineers to be the agent of change by first embracing this project and committing to give all your effort and time in making this training a success. The future of our company is your hands, we need you to become the best in the particular field your chosen to a part of and when you have attained the status of a trainer and to embrace the role of training others.
   In others words, your success will be measured by how many people you trained.
   Finally, I wish you all success in this very import project!

2. Work Plan of the Project
   Mr. Ueoka, chief advisor of the Project and the leaders of each WG, explained the summary and schedule of the Work Plan of the Project.
   Both sides confirmed a basic concept on the contents of the Work Plan, and if there are any comments about the contents of the Work Plan, PPL side will inform them by June 15th.
   The Work Plan is attached in Annex-1.

3. Confirmation of the list of members of each Working Group (WG).
   Both sides confirmed the list of the members of each WG as shown in Annex-2.

4. Discussion
   Mr. Yokota asked and proposed that other stakeholders in the power sector be provided with an opportunity to understand the project outline when updating and approving the work plan after the end of the first year, for information sharing and PR of this project among stakeholders.

   Ms.Karo, WG1-2 member, commented 'I think it's good to allow their stakeholders and other development partners to explain this project. Because I think it's good also for the development partners to know their activities in order to avoid duplication.'

5. Closing remarks
   Mr. Takahiro Yokota, Senior representative of JICA PNG office

   JICA welcome and thank you all for your efforts towards commencing the activities under this project even under the impact of COVID-19.
   This three-year project aims to enhance the capacity of PPL, especially for System planning, Transmission line & Substation and protection coordination.
   Besides with this technical cooperation, JICA also provided loan financing for Ramu Transmission System Reinforcement Project, and its on-going works for the extension of transmission line, a total of five substation will be upgraded with a state-of-art equipment.
   JICA would highly appreciate PPL to operate and maintain those assets properly, and this technical cooperation will contribute on the part as well.
   Those JICA's support, together with Grant Assistance from Embassy of Japan for distribution and generation equipment will be a series of cooperation towards PNG government's initiative to achieve "70% of households to have electricity access by 2030".
   This year, JICA is taking initiatives to incorporate gender considerations into all our projects. Therefore, we encourage the project team and PPL to mainstream gender into our project activities.
   We recognized that female officers were already appointed as trainer candidates, and we would appreciate your higher consideration and further cooperation.
   For example, giving good opportunities for females to participate in our project related trainings. Inclusiveness is important.
   Finally, JICA would like to emphasize that sustainability of the project is important. "Utilization of local resources" and "Co-creation" are the core of our technical cooperation project to guarantee sustainability after project completion. That is why, your proactive commitments are fundamental and essential for this project, together with JICA expert team.
   Thank you all for your time today, and JICA looks forward to working closely with you all in improving the access for stable electricity in PNG.

6. Participants of the First JCC

Participants of the First JCC are shown in Annex-3.

Annex-1	Finalization of the Work Plan
Annex-2	WG member list
Annex-3	Participants List of the First JCC

Project Monitoring Sheet I （Revision of Project Design Matrix）

Project Title: The Project for the Improvement of Planning and Operation of Power System

Implementing Agency: PNG Power Ltd

Target Group: Engineers in PPL

Period of Project: March 2022 to March 2025

Project Site: N/A **Model Site:** N/A

Version 1

July,2022

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
The quality and reliability of electricity is improved.	The number of incidents violating grid codes in terms of power quality (voltage, frequency, etc.) decreases by XX % by year YYYY.	Data from PPL			
	System investment planning is regularly revised by PPL, and XX projects are implemented by Year	submission of revision of system planning			
	The number of faults resulting from the lack of maintenance and asset management decreases by XX% by Year YYYY.	Questionarre for PPL staffs in charge.		Not Achieved yet	
	The duration of power interruption resulting from the lack of coordination is shortened by XX% compared to the Year YYYY.	Questionarre for PPL staffs in charge.			
Project Purpose	Revised system investment planning is proposed by PPL based on simulation and, financial and economic analysis.	Report from Japanese experts	PPL continues commitment to the Project by securing budget allocation as well as assignment of personnel for post- Project activity.	In progress	
PPL can properly implement system planning for the transmission line and maintenance for transmission line and substations on its own.	The maintenance for transmission line and substations, and asset management is regularly implemented.	Report from Japanese experts.			
	The setting for protection coordination is regularly confirmed.	Report from Japanese experts			
Outputs	Knowledge for system planning, simulation, and financial and economic analysis is improved.	Exam results (Pre-exam and Post-exam)		A survey was conducted on the identification and role of related departments in conducting system planning and system interconnection studies.We are also investigating the capabilities of PPL staff.	
Capacity of system planning for the transmission line is improved.	The XX of engineers are trained by trainer.	Report from Japanese experts			
	Least Cost Development Plan is verified by PPL.	Report from Japanese experts			
Capacity of maintenance for transmission line and substation is improved	Knowledge for maintenance for transmission line and substation, and asset management is improved.	Exam results (Pre-exam and Post-exam)		A survey on the identification and role of related departments in the fields of transmission ine and substation.We are also investigating the capabilities of PPL staff.	
	The XX of engineers are trained by trainer.	Report from Japanese experts Questionarre for staff in charge.			
	XX times of preventive maintenance for transmassion line and substations, and asset management are annually implemented.	Report from Japanese experts Questionarre for staff in charge.			
Capacity of protection coordination is improved	Knowledge for protection coordination is improved.	Exam results (Pre-exam and Post-exam)		A survey was conducted on the identification and role of departments related toprotection coordination.We are also investigating the capabilities of PPL staff.	
	The XX of engineers are trained by trainer.	Report from Japanese experts			
	The setting of protection coordination is confirmed by PPL.	Report from Japanese experts			

Activities	Inputs		Important Assumption
	The Japanese Side	**The PNG Side**	
1-1 : The current capacity of system planning for the transmission line is	1. Short-term Experts a. Chief advisor/System planning b. Grid technology c. Financial and economical analysis d. Transmission line (maintenance) e. Substation (maintenance) f. Equipment Testing/ Evaluation g. Protection coordination h. Human resource management / traing planning i. Grid technology asistant / Business coordination 2. Equipment 3. Trainings a. Training online b. Training in Japan	1. Office place for Japanese experts 2. Utility 3. Counterpart personnel 4. all expenses for PPL staffs (salaries, in-country transportation, allowance, etc.) 5. Tax exemption 6. Customs clearance for equipment	
1-2 : The current system for human resource development is assessed and workable system is proposed.			
1-3 : 2 Working Groups (WG) for (1) system planning and (2) financial and economic analysis are formulated.			
1-4 : Training for trainer candidates on basis on system planning for the transmission line is conducted.			
1-5 : Training for trainer candidates on system simulation using tools such as PSS/E is conducted.			
1-6 : Training for trainer candidates on financial and economic analysis is conducted.			
1-7 : Sustainable system for human resource development is established.			
1-8 : The training manual for system planning, system simulation, and financial and economic analysis is formulated considering systematic human resource development and the manuals is officially			
1-9 : Based on the training manual, the training for the engineers is implemented by trainers.			
1-10 : The operational manual and Standard Operating Procedure (SOP) for system planning, system simulation, financial and economic analysis are formulated, and the manual and SOP are officially approved by PPL			
1-11 : Based on the operational manual and SOP, PPL verifies the Least Cost Development Plan.			
2-1 The current capacity and technical, structural, and planning challenges of maintenance for transmission line and substations are assessed. Measures for these challenges are proposed			
2-2 : The current system for human resource development is assessed and workable system is proposed.			
2-3 : 2 WGs for maintenance for (1) transmission line and (2) substations are formulated.			
2-4 : Training for trainer candidates on planning of preventive maintenance and asset management is implemented.			
2-5 : Training for trainer candidates on the implementation of preventive maintenance and asset management is implemented.			
2-6 : Sustainable system for human resource development is established.			
2-7 : The training manual for maintenance for transmission line and substations is formulated considering systematic human resource development and the manuals is officially approved by PPL			
2-8 : Based on the training manual, the training for the engineers is conducted by the trainers.			
2-9 : The operational manual and Standard Operating Procedure (SOP) for transmission line and substations are			
2-10: Based on the operational manual and SOP, PPL implements the maintenance of transmission line and substation, and the manuals and SOP are officially approved by PPL			
3-1 The current capacity and technical, structural, and planning challenges of protection coordination is assessed.The measures for these challenges are			
3-2 : The current system for human resource development is assessed and workable system is proposed.			
3-3: WG for protection coordination is formulated.			
3-4:Training to improve capacity of protection coordination setting is implemented for candidate trainers.			
3-5 : Sustainable system for human resource development is built.			
3-6 : The training manual for protection coordination is formulated considering systematic human resource development and the manuals is officially approved by			
3-7 : Based on the training manual, the training for the rest of engineers is implemented by candidate trainers.			
3-8 : The operational manual and Standard Operating Procedure (SOP) for protection coordination are formulated.			
3-9 : Based on the operational manual and SOP, PPL modifies the setting for the protection coordination, and the manuals and SOP is officially approved by PPL.			

Pre-Conditions
1. Political, security, COVID-19 situation etc do not detriorate significantly. 2. Input from PNG and JICA is iplemnted in timely manner. 3. Necessary budget for implementation of project is secured during the project.

<Issues and countermesures>

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 1

July,2022

Project Title: The Project for the Improvement of Planning and Operation of Power System

Inputs	Year	2022				2023				2024				2025	Remarks	Monitoring: Issue	Monitoring: Solution
		Ⅰ	Ⅱ	Ⅲ	Ⅳ	Ⅰ	Ⅱ	Ⅲ	Ⅳ	Ⅰ	Ⅱ	Ⅲ	Ⅳ	Ⅰ			
Expert																	
Short - Term (Visiting) Expets	Plan																
	Actual																
Long - Term (Resident) Experts	Plan	To be assigned by JICA															
	Actual																
Equipment																	
	Plan																
	Actual																
Training online																	
	Plan																
	Actual																
Training in Japan																	
	Plan																
	Actual																
In-country/Third country Training																	
	Plan																
	Actual																

Activities / **Sub-Activities**	Year	1st Year				2nd Year				3rd Year				4th Year	Responsible Organization: Japan	Responsible Organization: GOPNG	Achievements	Issue & Countermeasures
		Ⅰ	Ⅱ	Ⅲ	Ⅳ	Ⅰ	Ⅱ	Ⅲ	Ⅳ	Ⅰ	Ⅱ	Ⅲ	Ⅳ	Ⅰ				
Output 1:																		
1.1 The current capacity of system planning for the transmission line is assessed.	Plan																We surveyed the current situation in PPL.	
	Actual																	
1.2 The current system for human resource development is assessed and workable system is proposed.	Plan																Identified that there is no training system for engineers.	A framework for human resource development will be discussed and a suggestion will be proposed.
	Actual																	
1.3 2 Working Groups (WG) for system planning and financial and economic analysis are formulated.	Plan																In JCC held at 27th May 2022, members of WG1-1 and WG1-2 have been formulated. We confirmed members at second trip and established contact systems.	
	Actual																	
1.4 Training for trainer candidates on basis on system planning for the transmission line is conducted.	Plan																	
	Actual																	
1.5 Training for trainer candidates on system simulation using tools such as PSS/E is conducted.	Plan																	
	Actual																	
1.6 Training for trainer candidates on financial and economic analysis is conducted.	Plan																	
	Actual																	
1.7 Sustainable system for human resource development is established.	Plan																	
	Actual																	
1.8 The training manual for system planning, system simulation, and financial and economic analysis is formulated considering systematic human resource development and the manuals is officially approved by PPL.	Plan																We collected information on the current state of PPL to the formulate the manuals.	
	Actual																	
1.9 Based on the training manual, the training for the rest of engineers is implemented by trainers.	Plan																	
	Actual																	
1.10 The operational manual and Standard Operating Procedure (SOP) for system planning, system simulation, financial and economic analysis are formulated, and the manual and SOP are officially approved by PPL.	Plan																We collected information on the current state of PPL to the formulate the manuals.	
	Actual																	
1.11 Based on the operational manual and SOP, PPL verifies the Least Cost Development Plan.	Plan																	
	Actual																	
2.1 The current capacity and technical, structural, and planning challenges of maintenance for transmission line and substations are assessed. Measures for these challenges are proposed	Plan																(1)We surveyed the current situation of O&M in PPL. (2)We exposed the O&M problem in PPL.	
	Actual																	
2.2 The current system for human resource development is assessed and workable system is proposed.	Plan																Identified that there is no training system for engineers.	A framework for human resource development will be discussed and a suggestion will be proposed.
	Actual																	

2.3	2 WGs for maintenance for (1) transmission line and (2) substations are formulated.	Plan Actual	In JCC held at 27th May 2022, members of WG2-1"Transmission" and WG2-2"Substation" have been formulated. We confirmed members at second trip and established contact systems.	
2.4	Training for trainer candidates on planning of preventive maintenance and asset management is implemented.	Plan Actual	Not started	
2.5	Training for trainer candidates on the implementation of preventive maintenance and asset management is implemented.	Plan Actual	Not started	
2.6	Sustainable system for human resource development is established.	Plan Actual	Not started	
2.7	The training manual for maintenance for transmission line and substations is formulated considering systematic human resource development and the manuals is officially approved by PPL.	Plan Actual	(1)We collected information on the current state of PPL to the formulate the manuals.	
2.8	Based on the training manual, the training for the engineers is conducted by the trainers.	Plan Actual	Not started	
2.9	The operational manual and Standard Operating Procedure (SOP) for transmission line and substations are formulated.	Plan Actual	(1)We collected information on the current state of PPL to the formulate the O&M manuals and SOP.	
2.10	Based on the operational manual and SOP, PPL implements the maintenance of transmission line and substation, and the manuals and SOP are officially approved by PPL.	Plan Actual	Not started	

Output 3:					
3.1	The current capacity and technical, structural, and planning challenges of protection coordination is assessed.The measures for these challenges are proposed.	Plan / Actual	Interviews and questionnaires were conducted as a capability assessment.		
3.2	The current system for human resource development is assessed and workable system is proposed.	Plan / Actual	Identified that there is no training system for engineers.	A framework for human resource development will be discussed and a suggestion will be proposed.	
3.3	WG for protection coordination is formulated.	Plan / Actual	WG was established and approved by the JCC.		
3.4	Training to improve capacity of protection coordination setting is implemented for candidate trainers.	Plan / Actual			
3.5	Sustainable system for human resource development is built.	Plan / Actual			
3.6	The training manual for protection coordination is formulated considering systematic human resource development and the manuals is officially approved by PPL.	Plan / Actual	Items needed for the training manual are being organized.		
3.7	Based on the training manual, the training for the rest of engineers is implemented by candidate trainers.	Plan / Actual			
3.8	The operational manual and Standard operating Procedure (SOP) for protection coordination are formulated.	Plan / Actual			
3.9	Based on the operational manual and SOP, PPL modifies the setting for the protection coordination, and the manuals and SOP is officially approved by PPL.	Plan / Actual		The ETAP model does not exist in the POM and Gazelle systems, which may affect the protection coordination study. We will coordinate with CP at an early stage to discuss countermeasures.	
Duration / Phasing		Plan / Actual			

Monitoring Plan	Year	1st Year				2nd Year				3rd Year				4th Year	Remarks	Issue	Solution
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I			
Monitoring																	
Joint Coordinating Committee	Plan															JCC was held on May 27, 2022	
	Actual																
Set-up the Detailed Plan of Operation	Plan																
	Actual																
Submission of Monitoring Sheet	Plan																
	Actual																
Monitoring Mission from Japan	Plan																
	Actual																
Post Monitoring	Plan														**Three years after project completion**		
	Actual																
Reports/Documents																	
Inception Report	Plan															2022.5 Work plan submitted	
	Actual																
Progress Report	Plan																
	Actual																
Project Completion Report	Plan																
	Actual																
Public Relations																	
	Plan																
	Actual																
	Plan																
	Actual																

To CR of JICA PNG Office

Project Monitoring Sheet

Project Title: PROJECT FOR THE IMPROVEMENT OF PLANNING AND OPERATION OF POWER SYSTEM

Version of the Sheet: Ver.2 (Dec. 2022)

Name: Obed Batia
Title: Project Director

Name: Seiji Ueoka
Title: Chief Advisor / System Planning

Submission Date: 9th December, 2022

PROJECT FOR THE IMPROVEMENT OF PLANNING
AND OPERATION OF POWER SYSTEM
Monitoring Sheet

Table of Contents

ABBREVIATIONS

Symbol	English
C/P	Counterpart
DFAT	Australian's Department of Foreign Affairs and Trade
IPP	Independent Power Producer
JCC	Joint Coordination Committee
KCH	Kumul Consolidated Holdings Limited
KPI	Key Performance Indicators
NEA	National Energy Authority
NSO	National system operation
PDM	Project Design Matrix
PEP	PNG Electrification Partnership
PNG	Papua New Guinea
PO	Plan of Operation
POM	Port Moresby
PPL	Papua New Guinea Power Ltd
PSSE	Power System Simulator for Engineering
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SMEC	SMEC Holdings Limited
SOP	Standard Operating Procedures
STATCOM	Self-commutated Static Var Compensator
WG	Working Group

I. Summary

1. Progress

1-1. Progress of Input

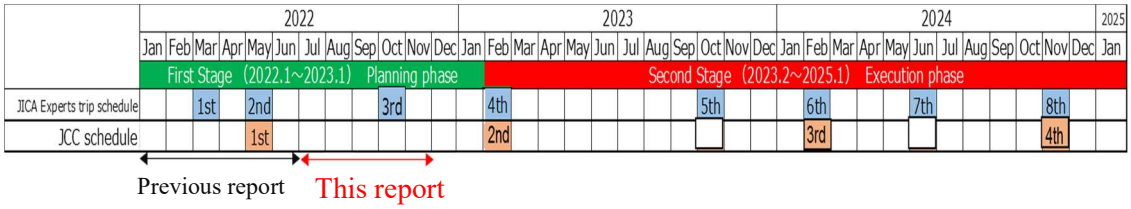


Fig.1 Activity Schedule

A contract for the implementation of this project was signed on 14th January 2022, and the project has started for about three years (until 24th January 2025).

This report describes the results in the latter half of the first year (July to November 2022).

From Japan Side

Third Dispatch

The third dispatch was carried out for about three weeks from October 2022. In the third dispatch, we conducted a survey of the current situation of PPL through WG activities. Interviews were conducted with PPL staff mainly from the perspectives of human resources, organizational and operational structures, and facilities. These results are compiled as a capacity assessment report.

In addition, we coordinated with the C/P regarding the revision of the PDM, which is scheduled to be approved at the 2nd Joint Coordination Committee meeting scheduled to be held during the 4th visit, and agreed on the revised draft.

Please refer to the attachment1 for the detailed survey results.

Training

Since August 2022, each WG has conducted online training for the purpose of imparting knowledge to C/Ps and grasping the capabilities of C/Ps. Please refer to the attachment2 for the details of the lecture content of the training.

Table 1-1-1 shows the planned and actual input of these personnel.

Table 1-1-1 Personnel input status

No.	Field of expertise	Total Man/Month(M/M) (M/M of Jul 2022-Nov 2022)	
		In PNG	In Japan
1	Team Leader / System Planning	2.20 (0.80)	2.50 (1.20)
2	Grid Technology	1.60 (0.80)	1.40 (0.65)
3	Financial and Economic Analysis	1.33 (0.63)	1.40 (0.85)
4	Transmission Line	1.60 (0.80)	1.40 (0.65)
5	Substation	2.10 (0.73)	1.60 (0.60)
6	Equipment Testing / Evaluation	0.70 (0.70)	1.60 (0.65)
7	Protection Coordination	2.20 (0.80)	1.65(0.65)
8	Human Resource Management / Training Planning	1.60 (0.80)	1.10 (0.35)
9	Grid Technology(Assistant) / Business Coordination	2.20 (0.80)	0.75(0.20)

From PNG side

WG member

21 people were appointed as WG members of this project.

Provision of office and WG space

An office space was prepared in the PPL for the 3rd dispatch of experts. PNG side also arranged meeting rooms and other facilities necessary for WG activities and cooperated in the smooth implementation of WG activities.

1-2. Progress of Activities

The progress of each activity is described in Table 1-2-1.

Output 1

Table.1.2.1 The progress of each activity (Output 1)

Activities in Project Design Matrix (PDM)		Activities conducted in the period
1-1	The current capacity of system planning for the transmission line is assessed.	In addition to the capacity assessment by the baseline survey, the current situation survey of the C/P was conducted through the WG activities. ・The current situation survey through WG activities was conducted from the three perspectives of people, organization, and equipment. It was found that the rules for grid interconnection work were not well established and the construction of a system to continuously secure human resources capable of conducting technical studies on grid interconnection applications was an issue.
1-2	The current system for human resource development is assessed and workable system is proposed.	It was confirmed that there is no human resource development system for engineers. Based on the requests from C/P obtained through WG activity, we proposed to C/P a trainer certification system and a training system for engineers.
1-3	2 Working Groups (WG) for (1) system planning and (2) financial and economic analysis are formulated.	One member was additionally assigned for WG 1-1. Due to the resignation of a member of WG1-2, an additional staff member was assigned.
1-4	Training for trainer candidates on basis on system planning for the transmission line is conducted.	Two online trainings were conducted on the concept of power system planning and supply and demand planning. During online trainings, both screens are turned on, but it is difficult to draw diagrams and tables, and it is difficult to communicate well. In addition, there is a problem that it is difficult to understand the level of understanding of the WG member because there are few comments from the C/P. In this regard, it is necessary to follow up on the

		content of the training when traveling.
1-5	Training for trainer candidates on system simulation using tools such as PSS/E is conducted.	As a result of interviews about the system analysis software, it was found that although the system analysis software was available, the data required for the study had not been prepared and the items to be considered had not been determined. Next step, we will provide support for data maintenance and set items for consideration. In addition, the results of confirming the usage status of the system analysis software are as follows. Survey results on system analysis software Systematic analysis software is not standardized by department, and skills are scarce. In addition, different departments use different system analysis software, and three types of analysis software are currently in use, but there is no movement within PPL to unify the software. There are two types of system analysis software in the department that conducts technical studies related to grid interconnection, but there is no reason to introduce two types. In addition, regarding PSSE, one license is held in the Network Planning Department. However, there is currently no one in the Network Planning department who can use it because the engineer who has the skill to use it has been transferred to another department.
1-6	Training for trainer candidates in financial and economic analysis is conducted.	During the third mission, a total of eight lecture sessions including supplementary classes were conducted in four days. The lesson subjects were: (i) how to read financial statements, (ii) the structure of the statements, (iii) indicators used in financial statement analysis, and (iv) the method of analytical calculation. In the November training, a total of five exercise sessions were held in five days. Since one member could not participate in the sessions, a supplementary class will be held over the period November 29 – December 1.

		The exercise is aimed at strengthening the members' capacity to fully understand theories by having them calculate various financial indicators by themselves. In the exercise, individual members evaluated the financial performance of the PPL, Solomon Islands Electricity Authority and Tonga Power Limited using financial indicators. In addition, they contemplated problems in business operation suggested by the financial indicators.
1-7	Sustainable system for human resource development is established.	Through activities in the training phase, the human resource development system proposed in the planning year will be brushed up to create a human resource development system that meets the needs of C/P and is sustainable.
1-8	The training manual for system planning, system simulation, and financial and economic analysis is formulated considering systematic human resource development and the manuals is officially approved by PPL.	For WG1-1, some draft training manuals were created and training was conducted using the draft training manuals. Next step, other training manual drafts will be created, and adjustments will be made with the C/P based on the created training manual drafts so that they can be adjusted as training manuals within the PPL. For WG1-2, two textbooks, i.e., Financial Statements and Financial Statement Analysis, were prepared and distributed to the members. In the November training, exercise problems (pdf files) and their answers (MS Excel files) were prepared and distributed.
1-9	Based on the training manual, the training for the engineers is implemented by trainers.	[Not started yet]
1-10	The operational manual and Standard Operating Procedure (SOP) for system planning, system simulation, financial and economic analysis are formulated, and the manual and SOP are	A survey was conducted on the regulations held by PPL in preparation for the creation of operational manuals and SOP. Next step, we plan to coordinate with the C/P and decide on the operational manuals and SOP to be created in this project.

	officially approved by PPL.	
1-11	Based on the operational manual and SOP, PPL verifies the Least Cost Development Plan.	[Not started yet]

Output 2

Table.1.2.2 The progress of each activity (Output 2)

Activities in PDM		Activities conducted in the period
2-1	The current capacity and technical, structural, and planning challenges of maintenance for transmission line and substations are assessed. Measures for these challenges are proposed	[WG2-1] The capacity assessment was conducted through a baseline survey, and a survey of the current situation of C/P was carried out through WG activities. The WG activities were carried out about the points of "people, organization, and equipment". Lack of maintenance workers, tools and materials. In addition, there is a large discrepancy between planned and actual inspection operations. The development of various rules and manuals for the formulation of sustainable preventive maintenance plans that consider resources and establishment of asset management systems are founded issues that need to improve in the future. [WG2-2] 【Ongoing】The current situation was identified from the perspectives of personnel, organization, and equipment through the inspection of substations in the baseline survey and interviews with WG members. Issues such as the lack of personnel for substation maintenance, the lack of preventive maintenance to prevent equipment failures, and the lack of maintenance management that views substations as a system were identified, and therefore the introduction of an asset management system is not expected to be effective.

		In the future, education on the preventive maintenance concept in Japan will be provided in the online WG. The differences between the equipment conditions in Japan and PPL will also be explained. The importance of maintaining not only main equipment, such as transformers and circuit breakers but also smaller equipment and viewing substations as a system will also be educated.
2-2	The current system for human resource development is assessed and workable system is proposed.	It was confirmed that there is no human resource development system for engineers. Based on the requests from C/P obtained through WG activity, we proposed to C/P a trainer certification system and a training system for engineers.
2-3	WGs for maintenance for (1) transmission line and (2) substations are formulated.	【Completed】 WG2-1 and 2-2 don't change initial members, and have been progressing WG activities.
2-4	Training for trainer candidates on planning of preventive maintenance and asset management is implemented.	**WG2-1** Before the third visit, the on-line training was carried out once regarding preventive maintenance works. In addition, the contents of last lecture were reviewed and basic design concepts of transmission facilities are lectured newly during the third visit. The difficulties of online meeting As C/P makes few remarks and it is difficult to check the level of understanding for each C/P, it is necessary to follow up on the contents of the training when visiting in PPL. In addition, as each C/P is busy with his/her works and there are many unexpected works, it takes time and changes to arrange the meeting date and time. **WG2-2** 【Ongoing】In the WG at the baseline survey, we

		proposed the measurement frequencies in patrol and inspection considering the actual situation of PPL. PPL is creating a preventive maintenance plan that defines its frequencies. In future online WGs, education about the concept and introduction of patrol and inspection will be provided to create the preventive maintenance plan.
2-5	Training for trainer candidates on the implementation of preventive maintenance and asset management is implemented.	**WG2-1** WG2-1 shared the progress of annual inspection plan that have been started since this year and the contents of checklist as a result of inspections, and grasped the current problems while introducing our company's cases. In addition, unexpected future risks were pointed out from the perspective of equipment maintenance and design as well as recovery methods for equipment abnormalities, and training has been started to improve a sensitivity for preventive maintenance works. (E.g. The basic loading mechanism on the steel tower) **WG2-2** 【Ongoing】Education such as lectures on insulating oil degradation in transformers and introduction and overview of Kansai Transmission and Distribution's asset management system were conducted in the WG during the baseline survey. In future online WGs, knowledge and education related to preventive maintenance will also be provided.
2-6	Sustainable system for human resource development is established.	Through activities in the training phase, the human resource development system proposed in the planning year will be brushed up to create a human resource development system that meets the needs of C/P and is sustainable.
2-7	The training manual for maintenance for transmission line and substations is formulated	**WG2-1** The lectures on the basics of transmission line maintenance have been given to C/P, and further

	considering systematic human resource development and the manuals is officially approved by PPL.	materials have been prepared for the next. Through future lectures, training materials and manuals will be established systematically grasping the level of understanding for each C/P and their requests. **WG2-2** [Not started yet]
2-8	Based on the training manual, the training for the engineers is conducted by the trainers.	**WG2-1 & WG2-2** [Not started yet]
2-9	The operational manual and Standard Operating Procedure (SOP) for transmission line and substations are formulated.	A survey was conducted on the regulations held by PPL in preparation for the creation of operational manuals and SOP. Next step, we plan to coordinate with the C/P and decide on the operational manuals and SOP to be created in this project.
2-10	Based on the operational manual and SOP, PPL implements the maintenance of transmission line and substation, and the manuals and SOP are officially approved by PPL.	**WG2-1 & WG2-2** [Not started yet]

Output 3

Table.1.2.3 The progress of each activity (Output 3)

Activities in PDM		Activities conducted in the period
3-1	The current capacity and technical, structural, and planning challenges of protection coordination is assessed. The measures for these challenges are proposed.	In addition to capacity assessment through interviews and questionnaires, a baseline survey was conducted to analyze current issues. Further, measures to address the issues will be considered for the next step.
3-2	The current system for human resource development is assessed and workable system is proposed.	It was confirmed that there is no human resource development system for engineers. Based on the requests from C/P obtained through WG activity, we proposed to C/P a trainer certification system and a training system for engineers.
3-3	WG for protection coordination is	WG was established and approved by the 1st JCC.

	formulated.	
3-4	Training to improve capacity of protection coordination setting is implemented for candidate trainers.	As of this point in time, three online training sessions have been conducted for the first year. Training will continue to be conducted.
3-5	Sustainable system for human resource development is built	Through activities in the training phase, the human resource development system proposed in the planning year will be brushed up to create a human resource development system that meets the needs of C/P and is sustainable.
3-6	The training manual for protection coordination is formulated considering systematic human resource development and the manuals is officially approved by PPL.	Training manuals are being prepared as needed for required training items. A training manual on "Overview of Protection Relay[1]" was prepared and online training was conducted. The manual is currently being reviewed by the CP. Other training manuals will be prepared as needed.
3-7	Based on the training manual, the training for the rest of engineers is implemented by candidate trainers.	Not done yet Problem: PPL has only two protection engineers in CP and no one is eligible for training at this time. SOLUTION: The five new employees to be hired will be targeted for training.
3-8	The operational manual and Standard Operating Procedure (SOP) for protection coordination are formulated.	Draft SOPs for new projects have been prepared. The CP is currently reviewing the contents. Other SOPs will be prepared for the next step.
3-9	Based on the operational manual and SOP, PPL modifies the setting for the protection coordination, and the manuals and SOP is officially approved by PPL.	[Not started yet]

1-3. Achievement of Output

Output 1

"Capacity of system planning for the transmission line is improved", we conducted a

[1] Relay (protection relay): A device that instantly detects an electrical fault and sends a signal to the circuit breaker to shut down the circuit. There are several types of relays, including distance relays, differential relays, overcurrent relays, frequency relays, and voltage relays.

survey of the current status of power system planning work and extracted issues by dividing them into three points: "Human and resource, organization, and facility." In addition, online training was started with the aim of improving basic power system planning capabilities.

As a result of the current situation survey, the following three issues were found.

・It is necessary to develop grid interconnection business rules.

・It is necessary to continuously secure human resources who can conduct technical studies on grid connection applications.

・It is necessary to implement an appropriate power system plan based on the GridCode.

In the future, we will formulate an action plan for the second and third years to resolve the above issues.

Output 2

"Capacity of maintenance for transmission line and substation is improved", a survey of the current situation was conducted, and challenges were identified in three areas: people, organization, and equipment. In addition, in the WG at the baseline survey, we shared the challenges and improvement points of the PPL.

WG2-1

The survey at WG2-1 of the current situation revealed three issues.

・Sustainable preventive maintenance plans should be developed that takes into account resources such as maintenance personnel and materials and equipment.

・By the asset management systems improvement, to improve quality of maintenance work, evaluation and repairing abnormal facilities.

・The luck of tools and materials have caused delays in preventive maintenance and repair work, and replenishment should be based on priority. Lack of knowledge about equipment is a contributing factor, so C/P knowledge needs to be improved through training.

WG2-2

As a result of the current situation investigation, the following challenges were found.

・Due to a lack of personnel for substation maintenance, PPL is unable to adequately respond to the occurrence of equipment failures. Therefore, it is necessary to introduce preventive maintenance (condition-based maintenance) in order to perform maintenance work efficiently.

・Preventive maintenance (condition-based maintenance) has not been implemented due to lack of know-how and measuring instruments, etc. Therefore, provision of measuring instruments for maintenance and education on condition-based maintenance are necessary.

・Due to the poor state of maintenance of equipment other than the main substation

equipment, education is needed to view the substation as a single system and to manage its maintenance.

- The substation should be viewed as a single system, and asset management should be carried out by introducing preventive maintenance (condition-based maintenance) using measuring instruments. It is also necessary to establish an asset management system.

To improve these issues, need to decide working activity plans for the rest of the years.

Output 3

"Capacity of protection coordination[2] is improved", a baseline survey was conducted through the WG activities, and the following issues were identified.

- Training manuals, operational manuals, and standard operation procedures (SOP) need to be organized.
  In particular, the lack of confirmation of protection coordination at the time of grid interconnection, which resulted in the blackout of the entire Port Moresby grid, requires the appropriate SOP to be created.
- In the distance relay[3], it is necessary to enable a function to prevent maloperation.
  To activate these functions, training for CP will be required. Therefore, this content will be included in the training to be conducted.

Human Resource Development

Human resource development based on the needs of C/P to ensure to develop trainers, a draft of a trainer certification system to train trainers in stages was proposed. In addition, since C/P are motivated to improve their abilities, it is expected that they will actively utilize the training system to be established through this project. The content of the training program will be developed in consideration of the needs of C/P obtained through the activities of each WG

1-4. Achievement of Project Purpose

As for the Project Purpose, when we achieve the Output 1-3 as described in 1-3, the Project Purpose "PPL can properly implement system planning for the transmission line and maintenance for transmission line and substations on its own ." will be achieved.

A baseline survey of PPL staff and an understanding of the current situation of PPL's work

[2] Protection coordination: Adjustment of the setting values of protection relays in order to prevent the spread of power outage by disconnecting only the minimum range in the event of an electrical fault caused by various abnormalities that may occur in the power system.

[3] Distance relay: A relay that can be timed for each operating section (Zones 1 to 3) according to the distance to the point of fault.

structure and facilities were completed, and issues in PPL were sorted out. In order to achieve the project purpose, we will formulate an activity plan for the second and third years based on the organized issues.

The evaluation results based on the DAC evaluation criteria are as follows.

A. Validity

In Papua New Guinea, as further expansion of power facilities is required, there is an urgent need to improve the capacity of human resources engaged in the power business, which is consistent with the goals of this project. In addition, the project's approach, which aims to establish a mechanism for training instructors, is appropriate in order to establish a human resource development system for engineers who have not yet implemented PPL.

B. Effectiveness

The Project Purpose is appropriate as a goal to achieve the Overall Goal. Furthermore, in order to increase the effectiveness of future projects, we are adjusting whether some of the training that was originally planned to be conducted online can be conducted in PNG.

C. Impact

Since PPL does not have a system in place for training engineers, it is necessary to develop human resources for engineers through this project in order to achieve the overall goal.Since we were able to grasp the issues within PPL through the first-year survey, we will build a human resource development system that matches the actual situation of PPL.

D. Efficiency

In order to increase the efficiency of the project, the activity plan for the 2nd and 3rd year of this project is currently being prepared. The activity plan for the 2nd and 3rd years will be approved at the 2nd JCC to be held in February 2023.

E. Sustainability

In order to increase the sustainability of the effects of this project, in addition to creating a manual through this project, we plan to confirm the needs of PPL and establish a human resource development system and training system within PPL.

1-5. Changes of Risks and Actions for Mitigation

Following factors are considered to become obstacles for the smooth implementation of the Project.

(1) Inadequate assignment of C/P

If the adequate C/P will not be assigned at the proper time and necessary numbers, activities

of the technology transfer could not be carried out on schedule.
As one of the members of WG1-2 left the company this time, the WG members were changed.
Since we will enter the training implementation stage in the future, if WG members leave their jobs, the contents of training from experts will not be accumulated, and it is possible that we will not be able to train trainers.

(2) Inadequacy of working environment and necessary equipment
Proper working environment and equipment will be indispensable for implementing the Project on schedule.
Lack of proper working environment and equipment would be obstacles for the smooth implementation of the Project.

(3) Shortage of budgetary allocation
In order to carry out the Project on schedule, necessary budget should be prepared in adequate time. If the necessary budget would not be allocated on time, we cannot expect the Project running smoothly.
If some risks occurred in these factors, Project will face a serious problem.
Therefore the expert team has exchanged views with C/P of PNG frequently and has confirmed the important issues by the Minutes of Understandings in order to avoid misunderstanding with each other and has tried to minimize the risks of above mentioned factors.

Assumed risks and countermeasures for minimizing risks are shown in Table 1-5-1. Fortunately there occur no problems so far now.

Table 1-5-1. Risk items

No.	Risk Factor	Countermeasures for Mitigation	Results
1	Assignment of C/P	During the 3rd trip in October 2022, it was found that one member on the C/P side was leaving the company, so we discussed the project manager as a WG member.	A new member was added in place of the member who left the company.
2	Assignment of Japanese Expert	As for the contents and method of technology transfer were discussed and confirmed in the Work Plan in May 2022. And this Work Plan was agreed between JICA and PNG side in the first JCC held on 27th May 2022. Base on the schedule	No problems occurred so far now

		in the Work Plan, the expert team was dispatched	
3	Management of Scheduling and Implementation	The expert team and Project Manager exchange views frequently mainly about the schedule of the technology transfer.	No problems occurred so far now
4	Share of Information	Regarding the daily job management, the expert team discuss with the Project Manager and the progress of the project is reported in the JCC and shared among the related people.	No problems occurred so far now
5	Office Space and Working Environment	The expert team requested the office space to PNG side in the kickoff meeting in MArch 2022. PNG side provided the office space with air condition to the expert team.	No problems occurred so far now

1-6. Progress of Actions undertaken by JICA

(1) Conducted WG activities on the third trip.
(2) Conducted online training.
(3) To Convene a consultant for the PEP meeting

1-7. Progress of Actions undertaken by Gov. of PNG

(1) To provide the expert team office space with necessary equipment
(2) To provide meeting rooms for WG activity
(3) WG members participated in WG activities and online training.
(4) To cooperate in collecting various data necessary for technical cooperation.

1-8. Progress of Environmental and Social Considerations (if Applicable)

No relevant matters

1-9. Progress of Considerations on Gender/Peace Building/Poverty Reduction (if applicable)

Five women are participating as WG members.

1-10. Other remarkable/considerable issues related/affect to the project (such

as other JICA`s projects, activities of counterparts, other donors, private sectors, NGOs etc.)

No relevant matters

2. Delay of Work Schedule and/or Problems (if any)

2-1. Detail

About two months delay from the original schedule.

2-2. Cause

In addition to security considerations from the PNG general election, training for staff selected from PNG public companies will be taken place in Australia in September 2022, and it was revealed that some C / Ps will participate in this training. Therefore it was decided to postpone the third dispatch period by about two months.

2-3. Action to be taken

This delay will be absorbed in the whole schedule in the first year of the Project.

2-4. Roles of Responsible Persons/Organization (JICA, Gov. of PNG, etc.)

No relevant matters

3. Modification of the Project Implementation Plan

3-1. PDM

Ver1： Obtained approval at the 1st JCC in May 2022.

Ver2： A revised draft was prepared and explained to the C/P. Regarding the revision plan, we plan to obtain approval at the 2nd JCC.

3-2. PO

A revised draft was prepared and explained to the C/P. Regarding the revision plan, we plan to obtain approval at the 2nd JCC.

3-3. Other modification on detailed implementation plan

No change

4. Preparation of Gov. of PNG toward after completion of the Project

Based on the manuals and training plans created in this project, the engineers trained in this project will continue to provide training.

II. Project Monitoring Sheet I & II

1） Project Monitoring Sheet I (Revision of Project Design Matrix)

Project Design Matrix

Project Title: The Project for the Improvement of Planning and Operation of Power System

Version 1

27,May,2022

Implementing Agency: PNG Power Ltd

Target Group: Engineers in PPL

Period of Project: March 2022 to January 2025

Project Site: N/A **Model Site:** N/A

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
The quality and reliability of electricity is improved.	The number of incidents violating grid codes in terms of power quality (voltage, frequency, etc.) decreases by XX % by year YYYY.	Data from PPL			
	System investment planning is regularly revised by PPL, and XX projects are implemented by Year	submission of revision of system planning			
	The number of faults resulting from the lack of maintenance and asset management decreases by XX% by Year YYYY.	Questionarre for PPL staffs in charge.			
	The duration of power interruption resulting from the lack of coordination is shortened by XX% compared to the Year YYYY.	Questionarre for PPL staffs in charge.			
Project Purpose	Revised system investment planning is proposed by PPL based on simulation and, financial and economic analysis.	Report from Japanese experts	PPL continues commitment to the Project by securing budget allocation as well as assignment of personnel for post- Project activity.		
PPL can properly implement system planning for the transmission line and maintenance for transmission line and substations on its own.	The maintenance for transmission line and substations, and asset management is regularly implemented.	Report from Japanese experts.			
	The setting for protection coordination is regularly confirmed.	Report from Japanese experts			
Outputs	Knowledge for system planning, simulation, and financial and economic analysis is improved.	Exam results (Pre-exam and Post-exam)			
Capacity of system planning for the transmission line is improved.	The XX of engineers are trained by trainer.	Report from Japanese experts			
	Least Cost Development Plan is verified by PPL.	Report from Japanese experts			
Capacity of maintenance for transmission line and substation is improved	Knowledge for maintenance for transmission line and substation, and asset management is improved.	Exam results (Pre-exam and Post-exam)			
	The XX of engineers are trained by trainer.	Report from Japanese experts Questionarre for staff in charge.			
	XX times of preventive maintenance for transmassion line and substations, and asset management are annually implemented.	Report from Japanese experts Questionarre for staff in charge.			
Capacity of protection coordination is improved	Knowledge for protection coordination is improved.	Exam results (Pre-exam and Post-exam)			
	The XX of engineers are trained by trainer.	Report from Japanese experts			
	The setting of protection coordination is confirmed by PPL.	Report from Japanese experts			

Activities	Inputs		Important Assumption
	The Japanese Side	**The PNG Side**	
1-1 : The current capacity of system planning for the transmission line is	1. Short-term Experts a. Chief advisor/System planning b. Grid technology c. Financial and economical analysis d. Transmission line (maintenance) e. Substation (maintenance) f. Equipment Testing/ Evaluation g. Protection coordination h. Human resource management / traing planning i. Grid technology asistant / Business coordination 2. Equipment 3. Trainings a. Training online b. Training in Japan	1. Office place for Japanese experts 2. Utility 3. Counterpart personnel 4. all expenses for PPL staffs (salaries, in-country transportation, allowance, etc.) 5. Tax exemption 6. Customs clearance for equipment	
1-2 : The current system for human resource development is assessed and workable system is proposed.			
1-3 : 2 Working Groups (WG) for (1) system planning and (2) financial and economic analysis are formulated.			
1-4 : Training for trainer candidates on basis on system planning for the transmission line is conducted.			
1-5 : Training for trainer candidates on system simulation using tools such as PSS/E is conducted.			
1-6 : Training for trainer candidates on financial and economic analysis is conducted.			
1-7 : Sustainable system for human resource development is established.			
1-8 : The training manual for system planning, system simulation, and financial and economic analysis is formulated considering systematic human resource development and the manuals is officially			
1-9 : Based on the training manual, the training for the engineers is implemented by trainers.			
1-10 : The operational manual and Standard Operating Procedure (SOP) for system planning, system simulation, financial and economic analysis are formulated, and the manual and SOP are officially approved by PPL			
1-11 : Based on the operational manual and SOP, PPL verifies the Least Cost Development Plan.			
2-1 The current capacity and technical, structural, and planning challenges of maintenance for transmission line and substations are assessed. Measures for these challenges are proposed			
2-2 : The current system for human resource development is assessed and workable system is proposed.			
2-3 : 2 WGs for maintenance for (1) transmission line and (2) substations are formulated.			
2-4 : Training for trainer candidates on planning of preventive maintenance and asset management is implemented.			
2-5 : Training for trainer candidates on the implementation of preventive maintenance and asset management is implemented.			
2-6 : Sustainable system for human resource development is established.			
2-7 : The training manual for maintenance for transmission line and substations is formulated considering systematic human resource development and the manuals is officially approved by PPL			
2-8 : Based on the training manual, the training for the engineers is conducted by the trainers.			
2-9 : The operational manual and Standard Operating Procedure (SOP) for transmission line and substations are formulated.			
2-10: Based on the operational manual and SOP, PPL implements the maintenance of transmission line and substation, and the manuals and SOP are officially approved by PPL			
3-1 The current capacity and technical, structural, and planning challenges of protection coordination is assessed.The measures for these challenges are			
3-2 : The current system for human resource development is assessed and workable system is proposed.			
3-3: WG for protection coordination is formulated.			
3-4:Training to improve capacity of protection coordination setting is implemented for candidate trainers.			
3-5 : Sustainable system for human resource development is built.			
3-6 : The training manual for protection coordination is formulated considering systematic human resource development and the manuals is officially approved by			
3-7 : Based on the training manual, the training for the rest of engineers is implemented by candidate trainers.			
3-8 : The operational manual and Standard Operating Procedure (SOP) for protection coordination are formulated.			
3-9 : Based on the operational manual and SOP, PPL modifies the setting for the protection coordination, and the manuals and SOP is officially approved by PPL.			

Pre-Conditions

1. Political, security, COVID-19 situation etc do not detriorate significantly.
2. Input from PNG and JICA is iplemnted in timely manner.
3. Necessary budget for implementation of project is secured during the project.

<Issues and countermesures>

2） Project Monitoring Sheet II (Revision of Plan of Operation)

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 1

July,2022

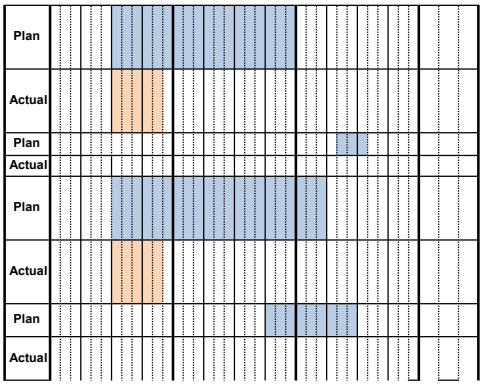
Project Title: The Project for the Improvement of Planning and Operation of Power System

Inputs	Year	2022				2023				2024				2025	Remarks	Monitoring: Issue	Monitoring: Solution
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I			
Expert																	
Short - Term (Visiting) Expets	Plan	To be assigned by JICA															
	Actual																
Long - Term (Resident) Experts	Plan																
	Actual																
Equipment																	
	Plan																
	Actual																
Training online																	
	Plan																
	Actual																
Training in Japan																	
	Plan																
	Actual																
In-country/Third country Training																	
	Plan																
	Actual																

Activities	Sub-Activities	Year	1st Year				2nd Year				3rd Year				4th Year	Responsible Organization: Japan	Responsible Organization: GOPNG	Achievements	Issue & Countermeasures
			I	II	III	IV	I	II	III	IV	I	II	III	IV	I				
Output 1:																			
1.1	The current capacity of system planning for the transmission line is assessed.	Plan																In addition to the capacity assessment by the baseline survey, the current situation survey of the C/P was conducted through the WG activities.	
		Actual																	
1.2	The current system for human resource development is assessed and workable system is proposed.	Plan																It was confirmed that there is no human resource development system for engineers. We proposed to C/P a trainer certification system and a training system for engineers.	
		Actual																	
1.3	2 Working Groups (WG) for system planning and financial and economic analysis are formulated.	Plan																In JCC held at 27th May 2022, members of WG1-1 and WG1-2 have been formulated. We confirmed members at second trip and established contact systems.	
		Actual																	
1.4	Training for trainer candidates on basis on system planning for the transmission line is conducted.	Plan																A total of two online trainings were given on the concept of power system planning and supply and demand planning.	
		Actual																	
1.5	Training for trainer candidates on system simulation using tools such as PSS/E is conducted.	Plan																As a result of the interview, it was found that although C/P had system simulation software, the data necessary for simulation had not been prepared, and the simulation items had not been determined.	
		Actual																	
1.6	Training for trainer candidates on financial and economic analysis is conducted.	Plan																During the third mission, a total of eight lecture sessions including supplementary classes were conducted in four days. In the November training, a total of five exercise sessions were held in five days.	
		Actual																	
1.7	Sustainable system for human resource development is established.	Plan																	

1.7		Actual		
1.8	The training manual for system planning, system simulation, and financial and economic analysis is formulated considering systematic human resource development and the manuals is officially approved by PPL.	Plan Actual	In WG1-1, some draft training manuals were created and training was conducted using the draft training manuals. WG1-2 created two textbooks and exercises problems on financial statements and financial statement analysis.	
1.9	Based on the training manual, the training for the rest of engineers is implemented by trainers.	Plan Actual		
1.10	The operational manual and Standard Operating Procedure (SOP) for system planning, system simulation, financial and economic analysis are formulated, and the manual and SOP are officially approved by PPL.	Plan Actual	We collected information on the current state of PPL to the formulate the manuals.	
1.11	Based on the operational manual and SOP, PPL verifies the Least Cost Development Plan.	Plan Actual		
2.1	The current capacity and technical, structural, and planning challenges of maintenance for transmission line and substations are assessed. Measures for these challenges are proposed	Plan Actual	The capacity assessment was conducted through a baseline survey, and a survey of the current situation of C/P was carried out through WG activities.	
2.2	The current system for human resource development is assessed and workable system is proposed.	Plan Actual	It was confirmed that there is no human resource development system for engineers. We proposed to C/P a trainer certification system and a training system for engineers.	
2.3	2 WGs for maintenance for (1) transmission line and (2) substations are formulated.	Plan Actual	In JCC held at 27th May 2022, members of WG2-1"Transmission" and WG2-2"Substation" have been formulated. We confirmed members at second trip and established contact systems.	
2.4	Training for trainer candidates on planning of preventive maintenance and asset management is implemented.	Plan Actual	The on-line training was carried out once regarding preventive maintenance works. In addition, basic design concepts of transmission facilities was lectured during the third visit.	
2.5	Training for trainer candidates on the implementation of preventive maintenance and asset management is implemented.	Plan Actual	We shared the progress of annual inspection plan and the contents of checklist as a result of inspections, and grasped the current problems while introducing our company's cases. Education such as lectures on insulating oil degradation in transformers and introduction and overview of Kansai Transmission and Distribution's asset management system	
2.6	Sustainable system for human resource development is established.	Plan Actual		

2.7	The training manual for maintenance for transmission line and substations is formulated considering systematic human resource development and the manuals is officially approved by PPL.	Plan Actual	The lectures on the basics of transmission line maintenance have been given to C/P, and further materials have been prepared for the next.	
2.8	Based on the training manual, the training for the engineers is conducted by the trainers.	Plan Actual		
2.9	The operational manual and Standard Operating Procedure (SOP) for transmission line and substations are formulated.	Plan Actual	We collected information on the current state of PPL to the formulate the O&M manuals and SOP.	
2.10	Based on the operational manual and SOP, PPL implements the maintenance of transmission line and substation, and the manuals and SOP are officially approved by PPL.	Plan Actual		



Output 3:						
3.1	The current capacity and technical, structural, and planning challenges of protection coordination is assessed.The measures for these challenges are proposed.	Plan / Actual			In addition to capacity assessment through interviews and questionnaires, a baseline survey was conducted to analyze current issues.	
3.2	The current system for human resource development is assessed and workable system is proposed.	Plan / Actual			It was confirmed that there is no human resource development system for engineers. We proposed to C/P a trainer certification system and a training system for engineers.	
3.3	WG for protection coordination is formulated.	Plan / Actual			WG was established and approved by the JCC.	
3.4	Training to improve capacity of protection coordination setting is implemented for candidate trainers.	Plan / Actual			Three online training sessions have been conducted for the first year. Training will continue to be conducted.	
3.5	Sustainable system for human resource development is built.	Plan / Actual				
3.6	The training manual for protection coordination is formulated considering systematic human resource development and the manuals is officially approved by PPL.	Plan / Actual			Training manuals are being prepared as needed for required training items. A training manual on "Overview of Protection Relay " was prepared and online training was conducted. The manual is currently being reviewed by the CP.	
3.7	Based on the training manual, the training for the rest of engineers is implemented by candidate trainers.	Plan / Actual				
3.8	The operational manual and Standard operating Procedure (SOP) for protection coordination are formulated.	Plan / Actual			Draft SOPs for new projects have been prepared. The CP is currently reviewing the contents. Other SOPs will be prepared for the next step.	
3.9	Based on the operational manual and SOP, PPL modifies the setting for the protection coordination, and the manuals and SOP is officially approved by PPL.	Plan / Actual				The ETAP model does not exist in the POM and Gazelle systems, which may affect the protection coordination study. We will coordinate with CP at an early stage to discuss countermeasures.
Duration / Phasing		Plan / Actual				

Monitoring Plan	Year	1st Year				2nd Year				3rd Year				4th Year	Remarks	Issue	Solution
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I			
Monitoring																	
Joint Coordinating Committee	Plan															JCC was held on May 27, 2022	
	Actual																
Set-up the Detailed Plan of Operation	Plan																
	Actual																
Submission of Monitoring Sheet	Plan																
	Actual																
Monitoring Mission from Japan	Plan																
	Actual																
Post Monitoring	Plan														Three years after project completion		
	Actual																
Reports/Documents																	
Inception Report	Plan															2022.5 Work plan submitted	
	Actual																
Progress Report	Plan																
	Actual																
Project Completion Report	Plan																
	Actual																
Public Relations																	
	Plan																
	Actual																
	Plan																
	Actual																

October 24th, 2022

The Project for the Improvement of Planning and Operation of Power System

3rd Mission Report

Kansai Transmission and Distribution, Inc.
NEWJEC Inc.
SeED Okinawa LLC

1. Purpose of this dispatch

In the 1st and 2nd mission, WGs for each technical field was established and baseline survey was conducted for counterparts in order to assess their capacity at the beginning of this project.
In this mission, the status quo of PPL was surveyed by discussions with counterparts, the site observation, and gathering data and information in terms of "engineers and resource", "organization and work process", and "facilities". These activities will be concluded in the capacity assessment report and be applied to 2nd and 3rd year training program and manuals.

2. Activity of 3rd mission

(1) Discussion about PDM ver.2 and 2nd JCC
JICA team explained the draft PDM ver.2 to Project Manager and Mr. Mairawesi Pulayasi mainly about the overall goal and project purpose and output, and got their consent to the draft.
Also discussion was carried out for the participants and schedule for 2nd JCC. As a conclusion, PNG side is flexible for the observers such as SOE, KCH, and NEA and PPL will send an invitation to them if Japan side requests for their participation to the JCC. Draft schedule of the JCC is around mid of February (22nd Feb. 2023, tentatively) and the venue would be arranged by PPL. The date and agenda is to be informed in advance.
[Ref. Attachment 1]

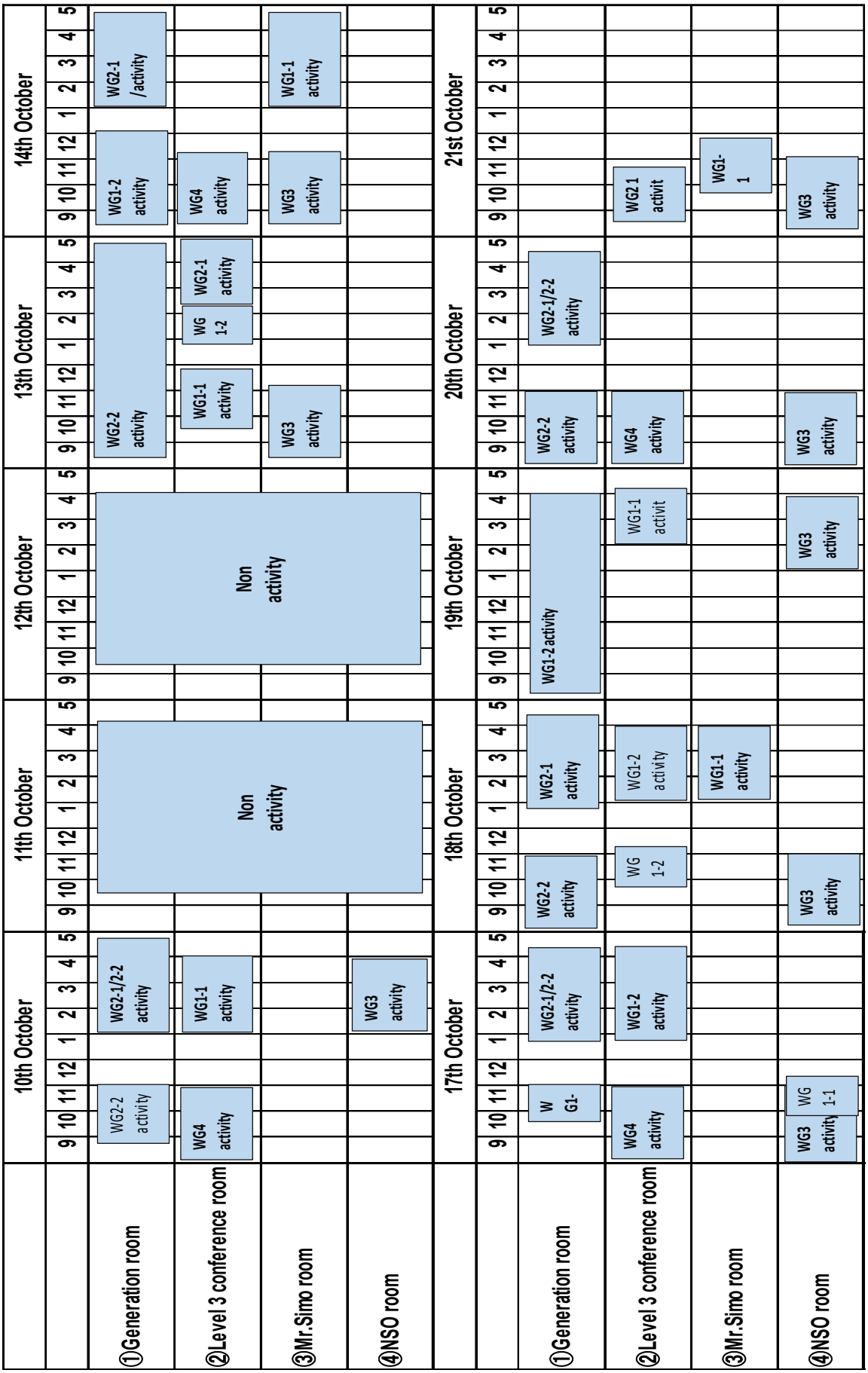
(2) Conducting a baseline survey
Since new counterparts joined to the WG1-1 and WG1-2, interview was conducted same as other counterparts in the 2nd mission.

WG	Name	Organization
WG 1-1	Haidi Wanya	Network Planning, Strategy & Innovation
WG 1-2	Beda Kuglame	Government Relations and Regulations, Strategy & Innovation

[Ref. Attachment 2]

(3) WGs' activities
Individual WG activity result is reported in the Attachment 3.

WG schedule


10th October
11th October
12th October
13th October
14th October
9 10 11 12 1 2 3 4 5
①Generation room
②Level 3 conference room
③Mr.Simo room
④NSO room
WG2-2 activity
WG2-1/2-2 activity
WG1-2 activity
WG2-1 /activity
WG4 activity
WG1-1 activity
WG1-1 activity
WG4 activity
WG3 activity
WG3 activity
WG1-1 activity
Non activity
WG2-2 activity
WG1-1 activity
WG 1-2
WG2-1 activity
17th October
18th October
19th October
20th October
21st October
WG1-2 activity
WG2-1 activity
WG1-2 activity
WG2-2 activity
WG2-1/2-2 activity
WG4 activity
WG3 activity

3. Others

On the 14th October, one of JICA trainers was diagnosed as positive for Covid-19. Therefore all JICA trainers had been worked remotely in the hotel until 16th October, according to the discussion with PPL's project manager and JICA team's leader. Then JICA trainers resumed the WG activity on 17th October. The trainer who diagnosed positive got recovered soon but he had worked remotely through the 3rd dispatch just in case.

4. The next schedule

The next JICA Experts trip is scheduled for about 3 weeks in February 2023. The 2nd JCC (Joint Coordinating Committee) is going to be held in this period. The main points of the 2nd JCC is to approve 2nd and 3rd year activity plan and schedule. The date and agenda will be informed separately.

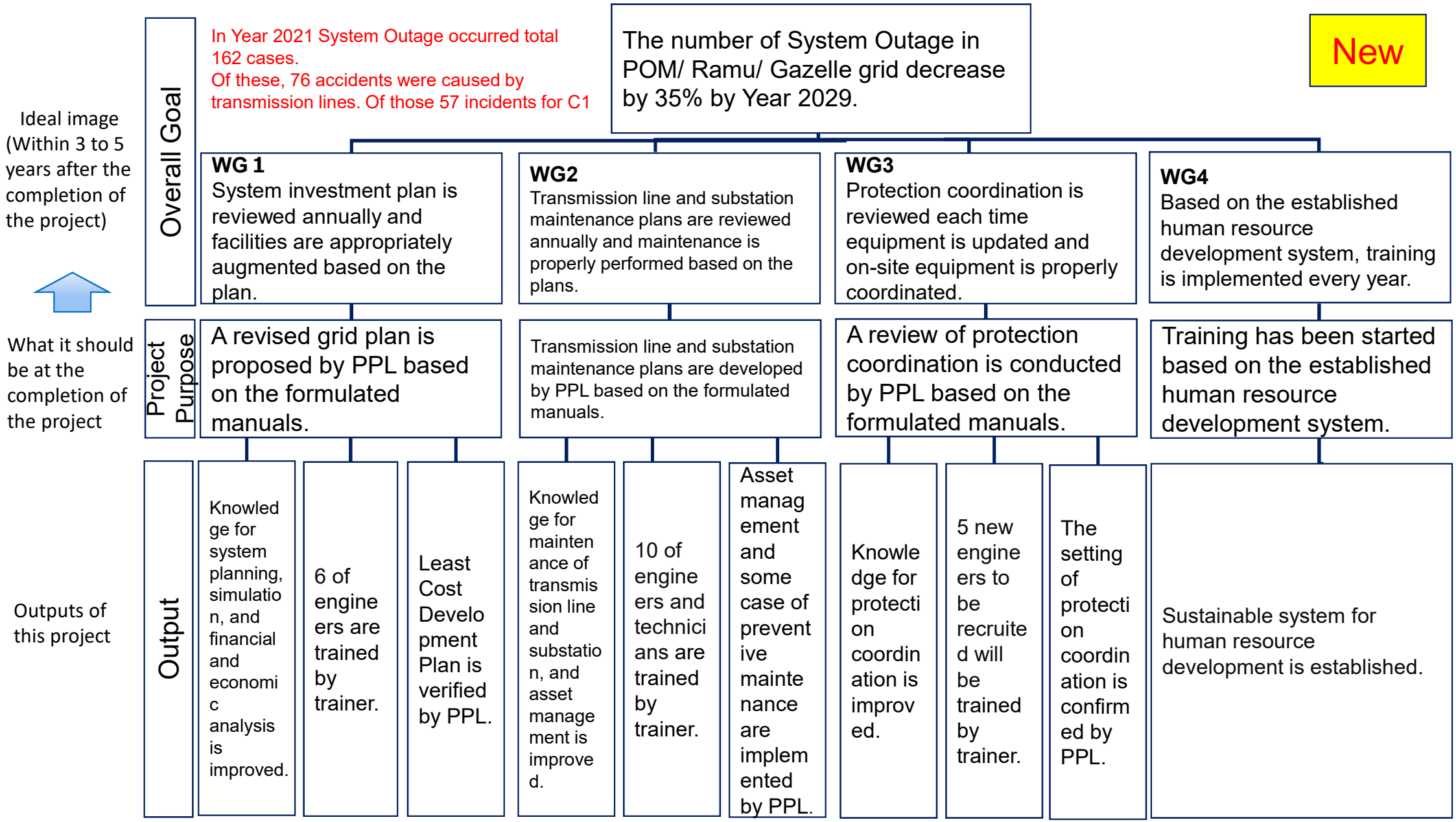
Attachment
Attachment1: Draft of PDM (Project Design Matrix) ver. 2
Attachment2: Revised WG member list
Attachment3: WGs activity report
Attachment4 :HRD System

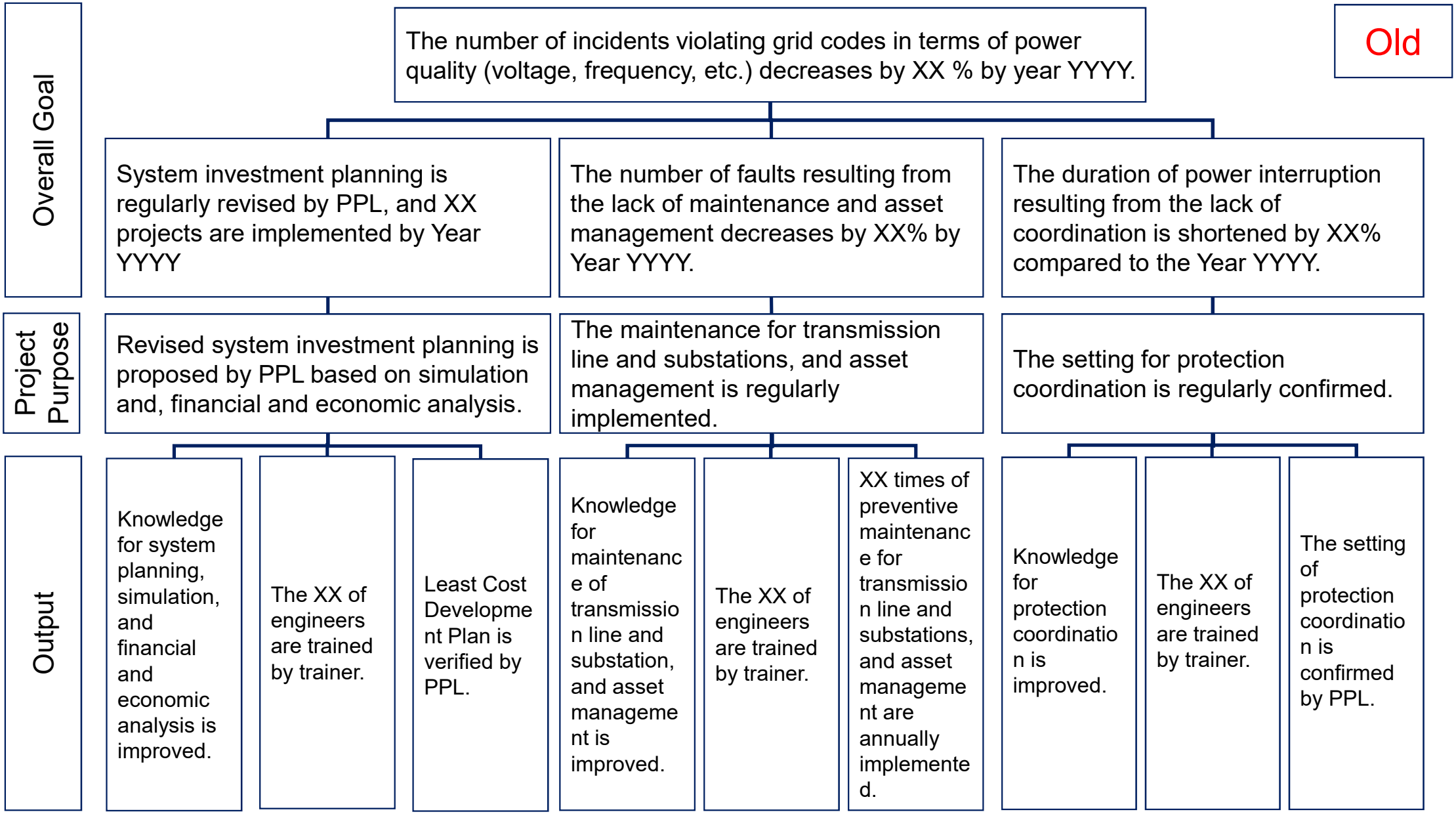
Overall Flow Chart of the Project

PNG POWER Ltd

	2022												2023												2024												2025
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
	First Stage (2022.1～2023.1) Planning phase												Second Stage (2023.2～2025.1) Execution phase																								
JICA Experts trip schedule			1st		2nd					3rd				4th								5th				6th				7th					8th		
JCC schedule					1st									2nd								3rd				4th				5th					6th		

Component	Planning Phase (1st year)	Training Phase (2nd year)	Training Phase (3rd year)
1.Training of trainer	Confirmation of project implementation policy Formation of WG Baseline survey 1st Online training Capacity assessment	PDM / PO update 2nd Online training Training in Japan On-site training (JICA expert to trainer candidate)	Confirmation of this year's results and next year's plan On-site training (Trainer candidate to PPL staffs) Confirmation of the project results
2.Formulation of manuals	Survey on business processes and facilities	Training manuals, Operational Manuals, Standard Operating Procedures (SOP) Formulation	
3.Establishing sustainable framework for Human Resource Development (HRD)	Survey on the current training framework Considering the HRD framework	Proposal and approval of HRD framework	


Ideal image (Within 3 to 5 years after the completion of the project)
What it should be at the completion of the project
Outputs of this project
Overall Goal
In Year 2021 System Outage occurred total 162 cases.
Of these, 76 accidents were caused by transmission lines. Of those 57 incidents for C1
The number of System Outage in POM/ Ramu/ Gazelle grid decrease by 35% by Year 2029.
New
WG 1
System investment plan is reviewed annually and facilities are appropriately augmented based on the plan.
WG2
Transmission line and substation maintenance plans are reviewed annually and maintenance is properly performed based on the plans.
WG3
Protection coordination is reviewed each time equipment is updated and on-site equipment is properly coordinated.
WG4
Based on the established human resource development system, training is implemented every year.
Project Purpose
A revised grid plan is proposed by PPL based on the formulated manuals.
Transmission line and substation maintenance plans are developed by PPL based on the formulated manuals.
A review of protection coordination is conducted by PPL based on the formulated manuals.
Training has been started based on the established human resource development system.
Output
Knowledge for system planning, simulation, and financial and economic analysis is improved.
6 of engineers are trained by trainer.
Least Cost Development Plan is verified by PPL.
Knowledge for maintenance of transmission line and substation, and asset management is improved.
10 of engineers and technicians are trained by trainer.
Asset management and some case of preventive maintenance are implemented by PPL.
Knowledge for protection coordination is improved.
5 new engineers to be recruited will be trained by trainer.
The setting of protection coordination is confirmed by PPL.
Sustainable system for human resource development is established.


Old
Overall Goal
The number of incidents violating grid codes in terms of power quality (voltage, frequency, etc.) decreases by XX % by year YYYY.
System investment planning is regularly revised by PPL, and XX projects are implemented by Year YYYY
The number of faults resulting from the lack of maintenance and asset management decreases by XX% by Year YYYY.
The duration of power interruption resulting from the lack of coordination is shortened by XX% compared to the Year YYYY.
Project Purpose
Revised system investment planning is proposed by PPL based on simulation and, financial and economic analysis.
The maintenance for transmission line and substations, and asset management is regularly implemented.
The setting for protection coordination is regularly confirmed.
Output
Knowledge for system planning, simulation, and financial and economic analysis is improved.
The XX of engineers are trained by trainer.
Least Cost Development Plan is verified by PPL.
Knowledge for maintenance of transmission line and substation, and asset management is improved.
The XX of engineers are trained by trainer.
XX times of preventive maintenance for transmission line and substations, and asset management are annually implemented.
Knowledge for protection coordination is improved.
The XX of engineers are trained by trainer.
The setting of protection coordination is confirmed by PPL.

Project Name: The project for the Improvement of Planning and Operation of Power System

WG Member List

2 or more roles/positions

WG1

		Department	Name	E-mail address
	Leader	National System Operation (NSO)	Ivan Pekaea	ipekaea@pngpower.com.pg
WG1-1 SystemPlanning	Trainer candidates	NSO	Charlie Enos	cenos@pngpower.com.pg
		NSO	Benedicta Savage	bsavage@pngpower.com.pg
		Strategic Partnership IPP Development	Haidi Wanya	hwanya@pngpower.com.pg
WG1-2 Financial and economic analysis	Trainer candidates	NSO	Jonah David	jdavid@pngpower.com.pg
		Finance	Keith Kalama	kkalama@pngpower.com.pg
		Finance	Beda Kuglame	bkuglame@pngpower.com.pg
		Strategic Partnership IPP Development	Jimmy Yareba	jyareba@pngpower.com.pg
		Asset Management	Vera Lama	vlama@pngpower.com.pg
		Asset Management	Cathy Kutkue	ckutkue@pngpower.com.pg
		Strategic Partnership IPP Development	Kero Tom	KTom@pngpower.com.pg

WG2

		Department	Name	E-mail address
	Leader	Transmission and Substation	Simo Kaupa	skaupa@pngpower.com.pg
		Asset Management	Vera Lama	vlama@pngpower.com.pg
WG2-1 Tansmission Line	Trainer candidates	Transmission and Substation	Chris Luther	cluther@pngpower.com.pg
		Transmission and Substation	Ben Kaum	bkaum@pngpower.com.pg
		Transmission and Substation (Ramu)	Roger Tau	rtau@pngpower.com.pg
		Asset Management	Deanne Kilamanu-Naime	dkilamanu-naime@pngpower.com.pg
		Alu (Asset info)	Esorom Passingan	epassingan@pngpower.com.pg
WG2-2 Submission	Trainer candidates	Transmission and Substation	Simon Robert	srobert@pngpower.com.pg
		Informarions & Engineering	Simon Deveo	sdeveo@pngpower.com.pg
		Transmission and Substation	Brian Inamo	binamo@pngpower.com.pg
		Transmission and Substation	Terry Naipu	tnaipu@pngpower.com.pg
		Reliability Engineers & Condition Monit	Rawali Rawali	rrawali@pngpower.com.pg

WG3

		Department	Name	E-mail address
WG3 Protection coordination	Leader	NSO	Ivan Pekaea	ipekaea@pngpower.com.pg
	Trainer candidates	NSO (Protection)	Melvin Angi	mangi@pngpower.com.pg
		NSO (Protection)	Michael Akep	makep@pngpower.com.pg

WG4

		Department	Name	E-mail address
WG4 Human Resource Development	Leader	Recruitment & Performance Management	Andrew Kavanamur	akavanamur@pngpower.com.pg
		Human Resource - Training	Andrew Yuants	ayuants@pngpower.com.pg
	Trainer candidates	NSO	Jonah David	jdavid@pngpower.com.pg
		Transmission and Substation	Chris Luther	cluther@pngpower.com.pg
		NSO (Protection)	Melvin Angi	mangi@pngpower.com.pg

WG1-1 (Power System Planning, Grid Connection) Report on the Third Travel Activities

1.Results of grasping the current status

Problems were extracted by dividing them into three points: human, organization (and way of work), and equipment.

I Engineer

・Lack of experience in actual work related to grid interconnection

PPL has limited experience in grid interconnection based on applications from IPPs, which occur only once every few years. Therefore, PPL does not have a system in place to maintain in-house personnel with skills related to grid interconnection, and does not have a continuous supply of experienced personnel for actual grid interconnection work. For this reason, the technical review at the time of receiving an application for grid interconnection is done both in-house and outsourced to SMEC, a consulting company.

・The sharing of roles in grid interconnection has not been established.

The technical studies required for PPL after receiving an application for grid interconnection are shared between Network Planning, which is the receiving point, and NSO (National System Operation), which is the grid operation point. Network Planning either conducts the technical review itself or requests the NSO to do so based on the decision of the Strategy & Innovation Department, which is the receiving point, but no explicit rules for sharing the responsibility have been confirmed. As a practical matter, Network Planning does not have experienced staff in technical review, and therefore, Network Planning usually requests NSO to conduct technical review.

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II Organization and work practices

・Documents related to grid connection are not in place.

The Grid Code requires PPL to establish the forms of documents that need to be mutually delivered between PPL and IPP at the time of grid interconnection, but this has not been fully developed. As a matter of fact, when a new application for grid interconnection is received by PPL, the necessary documents are prepared by referring to the documents used in past applications. In addition, there is no standardization of internal regulations or past review methods, and the way work is carried out differs from person to person.

・A work workflow has not been established.

The internal workflow after receiving an application for grid interconnection has not been established, and work is being conducted based on past memories and experiences. As a result, the items to be considered in the technical study for grid interconnection are unclear. In addition, the relationship between the results of the technical study and the response to the applicant (IPP) is unclear. In particular, it is difficult to understand the rationale for omitting facilities that were indicated as necessary in the technical study in the response to the applicant.

・Information cannot be shared among departments.

Departments are vertically divided, and there is no place to discuss the results of technical studies at the practitioner level, and cross-departmental discussions are held only at the GM and other executive levels. As a result, NSO practitioners who were in charge of technical studies feel a gap between the facilities they consider necessary based on the technical studies and the facilities that will actually be constructed, for reasons that cannot be grasped. In particular, NSO practitioners who are in charge of the technical studies think that it is desirable to share the recognition of the issues regarding the installation of two transmission lines to ensure the reliability required by the grid code and the installation of additional reactive power supply facilities to substations to maintain proper voltage. The reason for this thought is that several problems of concern have already occurred in the grid related to the proposed facilities not being built, and accidental spillovers and rolling blackouts are occurring frequently.

III Equipment

・System analysis software is not unified by departments, and skill is poor.

Different departments use different grid analysis software, and although three types of analysis software are currently in use, there has been no movement within PPL to unify the software. The department that conducts technical studies related to grid interconnection has two types of grid analysis software, but there is no reason for them to use two different types.

In addition, one license of PSSE is held by Network Planning. However, the engineer with the skills to use PSSE has been transferred to another department, so there is currently no one who can use it in the Network Planning section. In addition, PPL is not able to complete the grid analysis necessary for grid interconnection, and is currently relying on outsourcing.

・Facility construction based on Grid Code has not been achieved.

Although Grid Code requires the construction of N-1 facilities on major grids, IPPs' interconnection lines currently do not meet the N-1 requirement, and in many locations, they consist essentially of a single transmission line.

In addition, the transmission lines connecting to IPP power plants must be constructed by PPL, but

PPL is unable to finance the construction costs, so IPPs are constructing them*. As a result, only the minimum facilities are constructed, resulting in violation of the Grid Code. In particular, the transmission line connecting to the Niu Power power plant, which covers about 50% of the POM's demand capacity, consists of practically one line, so that an outage on this line would cause a blackout in the POM system. The problem is so great that one line will be constructed on a new route from the Niu Power and Dirio power plants to the Kanudi substation with the support of DFAT.

*The cost paid by IPPs for the construction of transmission facilities for grid interconnection will be added to the electricity tariff of the power purchase agreement between IPPs and PPL, thus putting pressure on PPL's financial situation.

・The facility expansion plan considering reactive power has not been made.

In the POM system, the transmission line voltage trends differ between the west and east sides. Specifically, the west side maintains relatively high voltage due to large power supplies, while the east side suffers from voltage drops due to mainly demand. To solve this voltage problem, it is necessary to install a regulating facility at the load end that can supply leading reactive power. Therefore, a STATCOM that can continuously regulate reactive power from leading phase to lagging phase is installed at the Boroko substation. However, the STATCOM has experienced problems that were difficult to resolve after installation, and the STATCOM continues to be out of service. As a result of these circumstances, it has become necessary to address the voltage problem by methods other than phase-regulating equipment, and planned power outages on distribution lines are being implemented to control voltage drops by reducing the load on an emergency basis.

Capacitors, which are less expensive than STATCOMs and easier to maintain by the grid operator, are sufficient to supply the leading reactive power. Although it is not clear how STATCOMs were installed, it is assumed that this is due to the fact that the plan to install reactive power regulators was not properly considered when the grid plan was implemented.

2. Challenges in PPL

I Development of rules for grid interconnection

In order to solve the problems arising from the fact that the work contents are personalized and that there are few opportunities for work related to grid interconnection, it is necessary to establish work documents and workflow, and to conduct business operations based on these documents and workflow, thereby formalizing the work.

II Continuously secure human resources capable of conducting technical studies related to grid-

connection applications

Though the number of applications related to the grid interconnection is limited, it is predicted that the technical study related to the grid interconnection will continue to occur in the future. Therefore, it is necessary to develop the human resources who can carry out the technical study by utilizing the opportunity of a new grid connection.

Implementation of appropriate system planning based on iii Grid Code

Based on Grid Code, a grid plan should be developed that meets the N-1 requirements. In addition, it is necessary to develop a grid plan that also takes reactive power into account.

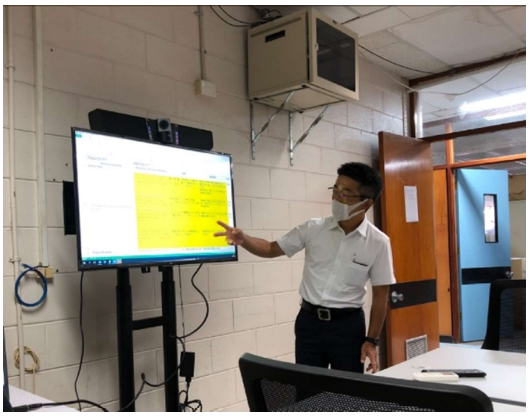
3. Future Implementation Items

Development of internal rules, etc.

Prepare manuals and SOP for grid interconnection based on data from previous studies of grid interconnection, and prepare PPL business rules and workflows by establishing in-house regulations.

Implementation of training based on the established human resource development system

Training based on the human resource development system proposed this time is required to continuously secure personnel who can conduct technical studies on grid interconnection within PPL. Therefore, a training manual will be prepared through this project to enable continuous human resource development.



Report on the activities of WG1-2 (Economic and Financial Analysis)

1. WG members
   - Since Ms. Karo Henao, one of the five assigned members, left the company, two persons have been additionally assigned.
   - These two, Messrs. Beda Kuglame (Financial Analyst) and Jimmy Yareba (Business Analyst), are on the staff of the Department of Strategic Business Development & Government Relations, and meet our expectations for human resources.

2. Division involved in economic and financial analysis
   - From the viewpoint of future investment planning, the group of Strategic Business Development is the unit in charge.
   - The current workforce consists of two persons: Messrs. Kero Tom (Senior Manager) and Jimmy Yareba
   - Although Mr. Kuglame is in charge of Government Relations, he also performs work related to Strategic Business Development, if necessary.

3. Facilities and equipment
   - It is possible to conduct economic and financial analysis and operate financial models by using MS Excel. Individual members have their own laptop PCs.

4. Issues
   - The WG members generally understood the theories taught in the training. However, when they did exercises, they occasionally made mistakes. It seems that they acquired fundamental knowledge but have some difficulties with its application.
   - It is therefore necessary for them to repeat exercises and get a deeper knowledge. We plan to enhance their capacities further by using Zoom Webinar after going back to Japan.

5. What we did
   - In the training, we started out by giving the members an understanding of the fundamentals related to financial statements.
   - In other words, we taught them how to read the three components of financial statements, i.e., balance sheet, income statement, and cash flow statement.
   - At the next stage, they evaluated PPL business performance by using several indicators, such

as the profit margin ratio, return on equity (ROE), return on assets (ROA), and interest coverage ratio (ICR).

Training on October 17, 2022

Report on WG2-1 Activities during the Third Travel

１． Results of grasping the current status

① People and resources

○Insufficient number of workers and resources necessary for maintenance work of transmission facilities

In POM system, nine workers (seven workers capable of tower climbing work) are engaged in maintenance work and have one vehicle. On the other hand, RAMU system has eight workers, nine workers and two and three vehicles in Costal and Highland areas, respectively. Some of the cars owned by RAMU system are not in the best condition.

Considering the quantity of equipment under control in each system, the number of workers and the number of vehicles required for maintenance work is absolutely insufficient, and the annual plan for equipment inspection is in a state of being delayed. According to the results of this survey, some lines were inspected with a delay of up to three months from the plan. Many of the reasons why the inspection was not carried out as planned are that the preventive maintenance work is put back in place because of the urgent restoration work required due to unscheduled power outages and accidents.

② Organization and work practices

○Establishment of inspection plans and implementation of periodic inspections

PPL aims at the inspection execution based on the annual inspection plan from this year, and the inspection plan in every system was approved in May. The Asset Management Division was in charge of managing the inspection plan, and the operation flow was started, in which the operation instruction based on the inspection plan was directed to the maintenance team, and after the maintenance team carried out the inspection, the inspection report was submitted to the Asset Management Division.

However, it has just been introduced, and the coordination between the asset management department and the maintenance team is not working well. For example, the inspection work on about 10 lines was already completed last year or this year before the annual inspection plan was issued, and the inspection results already exist. However, since the work instruction sheet is still issued only for two lines, the past inspection results remain unreported. The results of the inspection were immediately reported, and it was desirable from the viewpoint of preventive maintenance of the equipment that the whole was shared, so we felt it necessary to improve this situation.

○Lack of acceptance criteria for the evaluation of equipment anomalies

PPL aims to manage the inspection report in a regular form from this year. Together with the report, a checklist to be implemented at the time of inspection is also attached. Though trial

operation is under way at present, if there is no abnormality in the basis, check mark "レ" is put in, and if there is abnormality, the details are described.

However, the judging criteria for evaluating equipment abnormality is left to the experience and competence of the inspection worker, and the photograph is not attached, so that the condition of the equipment can be grasped only by the worker. It was felt necessary to establish a judging criteria capable of evaluating the degree of abnormality according to the equipment, and to establish an operation rule capable of always ensuring a fixed quality without assigning a person to make a judgment such as continued monitoring of abnormality and necessity of replacement and repair.

③ Equipment

○Actual Conditions of Transmission Equipment Incidents in PPL jurisdictions

As a result of investigating a transmission line accident caused by a transmission line in a POM system and a RAMU system (a case in which a line power outage occurred and a repairing work was required), it was confirmed that in a POM system, various factors such as wood arm corrosion degradation of concrete poles, degradation of insulators, contact of trees, contact of snakes, etc. were carried out in at least 10 cases in the last one year, and that approaching of trees occupied most of them in a RAMU system. Basically, the restoration work will be carried out immediately after the accident. However, in August of this year, when a transmission line accident occurred on a L401 transmission line in a POM jurisdiction, materials and tools for repairing cannot be secured, and has not been repaired yet.

In addition, the gantry located in the Waigani substation was being corroded, and WG members inspected at the site and discussed how to carry out to determine the repair policy.

The damage to the transmission facilities caused by the earthquake that struck PNG in September was also investigated, and it was confirmed that the steel tower collapsed in L602 transmission line RAMU system, but it has already been restored.

Fig1. The steel tower was collapsed in L602 Fig2. The gantry is being corroded in Waigani substation

2.Challenges in PPL

① Continuously secure and foster personnel and resources capable of performing maintenance work on transmission facilities

While there is a shortage of human resources capable of performing maintenance tasks in both systems and it is desirable to increase the number of personnel in recruiting activities in the future, we felt that it is necessary to improve individual technical capabilities and operational efficiency by providing knowledge and know-how to the present engineers and technicians.

In addition, the deterioration and shortage of tools necessary for facility repairing work are also becoming apparent, and we felt that preferential replenishment from those that are frequently used leads to efficiency and safety improvement of the work.

② To improve inspection plans, report inspections, and establish operational flow

Although the inspection flow based on the inspection plan was started from this fiscal year, the gap between the plan and the actual results is still large, so we felt that it was necessary to improve the inspection cycle and the cooperation between the asset management division and the maintenance team while analyzing the causes of this.

③ Upgrading inspection operations and asset management

Evaluation of equipment abnormality discovered in the inspection has become a private person. In addition, work flow was established. However, the flow is not flowing well, so the report of the result is stagnant. In order to improve these present states, we felt that it was necessary to review the contents of business and execution methods, to arrange the points of attention, and to improve the judgment standards and operation rules.

3.Future Implementation Items

① Implementation of training related to maintenance work of transmission facilities and asset management

Through on-line training and training in Japan, maintenance work of transmission facilities, knowledge improvement of asset management, and upgrading of business will be attempted. Concrete training programs are currently under consideration, but for example, the functions of transmission facilities and basic design philosophy are considered to be important contents in fostering attention points and susceptibility in inspection work and repair work, and in addition, they are planned to cover attention points of patrol inspections accompanied with work, judgement criteria of equipment abnormality evaluation, etc.

② Preparation of training manuals and operational manuals

In order to continuously secure human resources with basic knowledge on transmission facilities within PPL. the Government will work on the preparation of materials for the above-mentioned training content and manuals to establish a human resource development system. In addition, this project is planning to arrange the maintenance work and the work manuals that arrange the work flow and the points of attention of the asset management.

WG2-2 Activity Report on the 3rd Trip

２． Result of grasping the current situation

① Human and Resource

○ The personnel shortage for substation maintenance work and the necessity of introducing preventative maintenance.

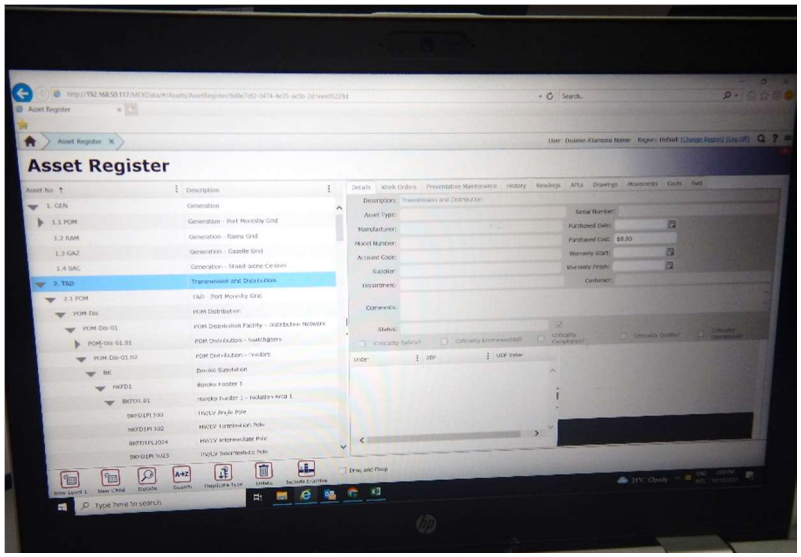
There is a shortage of personnel due to a large number of equipment failures and the fact that there are only about eight people involved in the maintenance of substation equipment in the POM grid. PPL is also aware of this issue and intends to introduce preventive maintenance, especially condition management maintenance (Mainly handled by the asset management team).

Condition management maintenance is a method of determining inspection frequency and replacement timing based on equipment condition. It is necessary to infer the state from each measured value related to the equipment, consider the probability of an accident and the impact from the state, and determine the inspection frequency and replacement timing that can maintain stable operation. Know-how for grasping the problem and criteria for judging whether or not to respond is required. But currently, PPL is considered to lack such know-how.

In addition, systematic management is required to perform condition management maintenance for many facilities, and the introduction of a management system, generally called an asset management system, is needed.

Currently, PPL is also developing an asset management system. Still, due to the diversity of substation equipment and lack of know-how, the system construction of substation equipment is not progressing.

1. PPL's asset management system



② Organization and way of working

○Education of personnel necessary for maintenance work of substation equipment

An education system for human resource development is necessary since there is a shortage of personnel required for substation maintenance work as mentioned above. On the other hand, PPL currently has training facilities and a part of the education curriculum for technicians, but there is no education system for engineers.

○Operation of measuring instruments

PPL has separate teams; one handles measuring instruments, and a maintenance team. For this reason, some points seem inefficient in the operation of measuring instruments, such as the need for multiple teams to be dispatched even for simple measurements in maintenance (In Japan, maintenance teams are often able to handle measuring instruments as well.).

③ Facilities

○Facility configuration and condition, the impact of an accident

The facility configuration of PPLs uses one transmission line and one transformer (one bank) to transmit power. It is considered there is no redundancy in the facility configuration compared to Japan (In Japan, redundant facilities are configured, such as two lines for transmission lines, so that a simple accident or failure does not hinder power transmission.). For this reason, accidents lead to power outages for consumers, etc., and the impact tends to be significant. In addition, many facilities have been installed by overseas companies for assistance to developing countries, etc. In the event of a severe failure, it may take time to respond or be unable to respond, further increasing the impact.

In addition, due to the lack of redundancy in the equipment configuration, it is difficult to obtain scheduled power outages for equipment required for maintenance. For this reason, it is difficult to respond quickly, even to facilities with minor failures. As a result, it is considered that there is a bad cycle in which it is not possible to respond until the degree of failure becomes severe. Eventually, a serious failure occurs, leading to a long-term power outage.

○Asset management

As mentioned above, PPL needs an asset management system, but it is currently in the development stage, and due to a lack of know-how, future progress is uncertain. In addition, PPL lacks measuring instruments to grasp the condition of equipment (ex., Dissolved gas analyzer for capturing the state of insulating oil in transformers), which is necessary for condition management maintenance, and the completion of asset management cannot be foreseen.

2. Oil leakage from Trans. in Waigani Sub.

3. Collapsed circuit breaker part in Rouna2 Sub.

２． Challenges in PPL

④ Introduction of preventive maintenance and the impact of severe failures on substation equipment

As described, due to the equipment configurations, the impact tends to be more significant when a serious failure occurs in the equipment. To mitigate the impact from the viewpoint of substation maintenance with limited personnel, it is important to take measures at the early stage when the failure is light. PPL aims to introduce preventive maintenance (condition management maintenance) as a method for that purpose, but it is difficult due to a lack of know-how and measuring instruments.

⑤ Shortage of personnel necessary for substation maintenance work

As mentioned, there is a shortage of personnel for the substation maintenance work, and it is necessary to develop an educational system for human resource development.

３． Future actions

③ Implementation of education on preventive maintenance of substation equipment

To support the construction of a system for preventive maintenance (condition management maintenance) of substation equipment in PPL, we will work on the following contents after the next online training.

- Education on the range of equipment conditions required and criteria for judging the necessity of response.
- Education about the asset management system operated in Japan.
- Provision of measuring instruments for grasping equipment status and education on how

to use them.

- Education on specific countermeasures in the stage of minor equipment failures.

④ Development of a training system for personnel involved in substation maintenance work

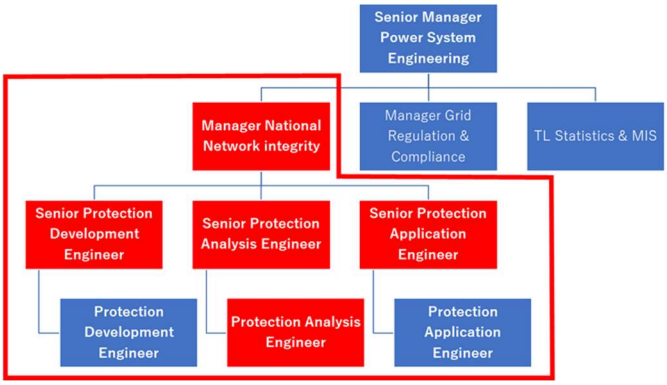
To develop a training system for personnel engaged in maintenance work for substation equipment at PPL, we will formulate a training curriculum and provide training materials.

Report on WG3 Activities

1． Results of Current Situation Assessment

I. About the Organization and Counterparts

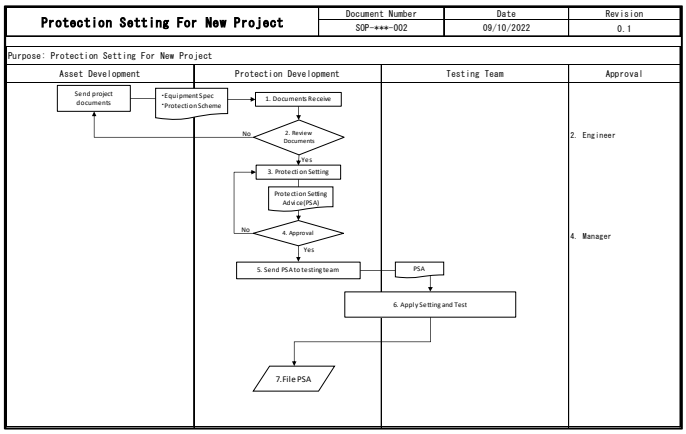
The WG3 Protection Coordination consists of two members of the Protection Team. The Protection Team is part of the NSO Group's Power System Engineering, and its organization is shown in the figure below. Five of the seven positions (red box) are vacant (red fill), and the five new positions will be hired. In the third year of the project, the prospective trainers will provide training for the engineers, and the five newly hired engineers will be the target of the training.



Protection Team Organization Structure

II. Workflow

Currently, there is no clear SOP in place, so the request approval for the setting is done at the level of the person in charge of the project. Based on the interviews, a draft version of the SOP for the protection relay setting for new projects was prepared (see figure below), and it is expected that by creating the SOP and clarifying the approval procedures and the required documents and materials for setting, the setting work can be handled appropriately even when new personnel are assigned to the work.



Protection setting SOP (draft version)

III. Equipment (protection relay)

■ Identify unprotected areas

Substations without bus protection are protected using distance relays (zone 2 or reverse), and we recognize that there is no problem as long as proper settings are made. If unprotected sections exist, there is a possibility of a major power outage, so the following checks were conducted.

- Check for blind spots in protection relays (check for unprotected equipment)
- Whether or not there are any unprotected areas due to equipment failure

Based on the interviews, it is considered that there are no facilities that are unprotected at current conditions.

■ Simulation Software ETAP

We tried to check each relay operation in the ETAP software, but since no simulation tool is used in the current work, it was difficult to check due to lack of knowledge of how to handle the software. Although it is possible to calculate the fault current, it is difficult to show the characteristic diagram. In addition, the software needs to be upgraded (additional purchase) to display the characteristic diagram of the distance relay. Being able to conduct simulations will enable early recognition of protection maloperations. This project will provide education on a simulation software used in Japan through training, relay response checks, and operation checks.

２． Issues related to protection relays

I. Unclear operating procedures

A system blackout occurred on April 13, 2022, due to lack of protection relay coordination at IPP, a key factor in that PPL did not have SOPs in place and grid interconnection was initiated with unknown approval procedures. As for follow-up actions, it was confirmed that the procedures were properly handled, from fault analysis to identification of the cause of the relay maloperation and implementation of the setting change. However, since there is no clear SOP, it is required to create an appropriate SOP to complete the process from the fault occurrence to the protection relay setting review by conducting a fault analysis.

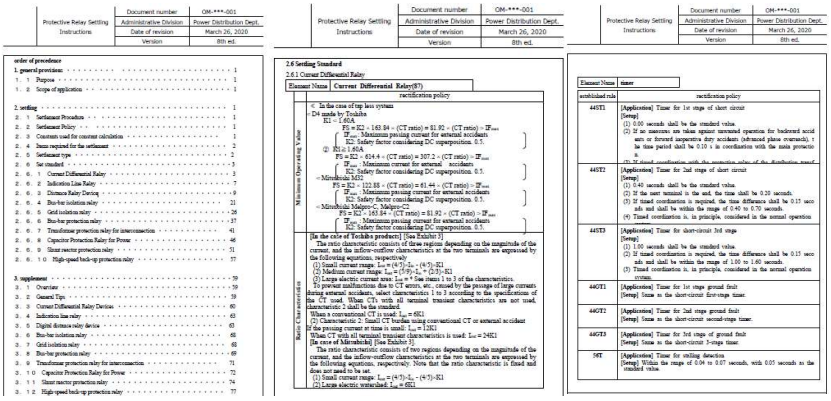
II. Protection relay maloperation measures

Protection relays have various functions (fail-safes) to prevent unnecessary operation and resulting power outages. PPL's protection relays have flexible operating logic, but there is no concept of fail-safes, and distance relays operate with a simple combination of a distance element and a timer. In Gazelle system, maloperation of the distance relay has caused power outages even when no fault has occurred, and an additional fail-safe function is required.

３． For the next step

The following items will be implemented as future activities.

- SOP, Operation manual, Online training
  - Conduct a thorough review of the draft SOP.
  - Prepare an Operation Manual for protection relay setting, including the addition of fail-safe functions.
  - To create the Operation Manual, technical training on protection setting is required, which will be provided through online training.



Protection Setting Operations Manual

Report on the Third Travel WG4 Activities

1.Results of grasping the current status

i Man

・Since PPL staff members are sufficiently motivated to improve their skills, it is fully expected that they will actively participate in the training established in this project.

Ii Organization and work practices

・The training system for engineers is not in PPL, so engineering skills are not being passed on appropriately, and work is not standardized

・Technicians are taking internal technical training and external TOT to develop their trainer skills, but it doesn't work for engineers to utilize this existing training due to the characteristics of their jobs.

・ For positions that are currently vacant, it usually takes up to two months from the start of the recruiting process until a decision is made to hire.

・However, if both the manager and the engineer are currently vacant, the senior manager will hire the manager (maximum 2 months), and then the manager will hire the engineer (maximum 2 months), so the total time required is 4 months maximum.

・Employees are evaluated based on Key Performance Indicators (KPI) every three years, and their employment contracts are renewed.

Iii Equipment

・Training facilities are obsolete, but the facilities will not be updated for approximately 20 years due to no allocated budget.

2. Challenges in PPL

・While there is training for technicians, there is no training for engineers, and thus there is no system to ensure that the skills required for engineers are properly passed on.

3.Future Implementation Items

① Establish a trainer certification system

・Trainer certification system will be established to ensure that trainers are trained.

②Establish a training system for engineers.

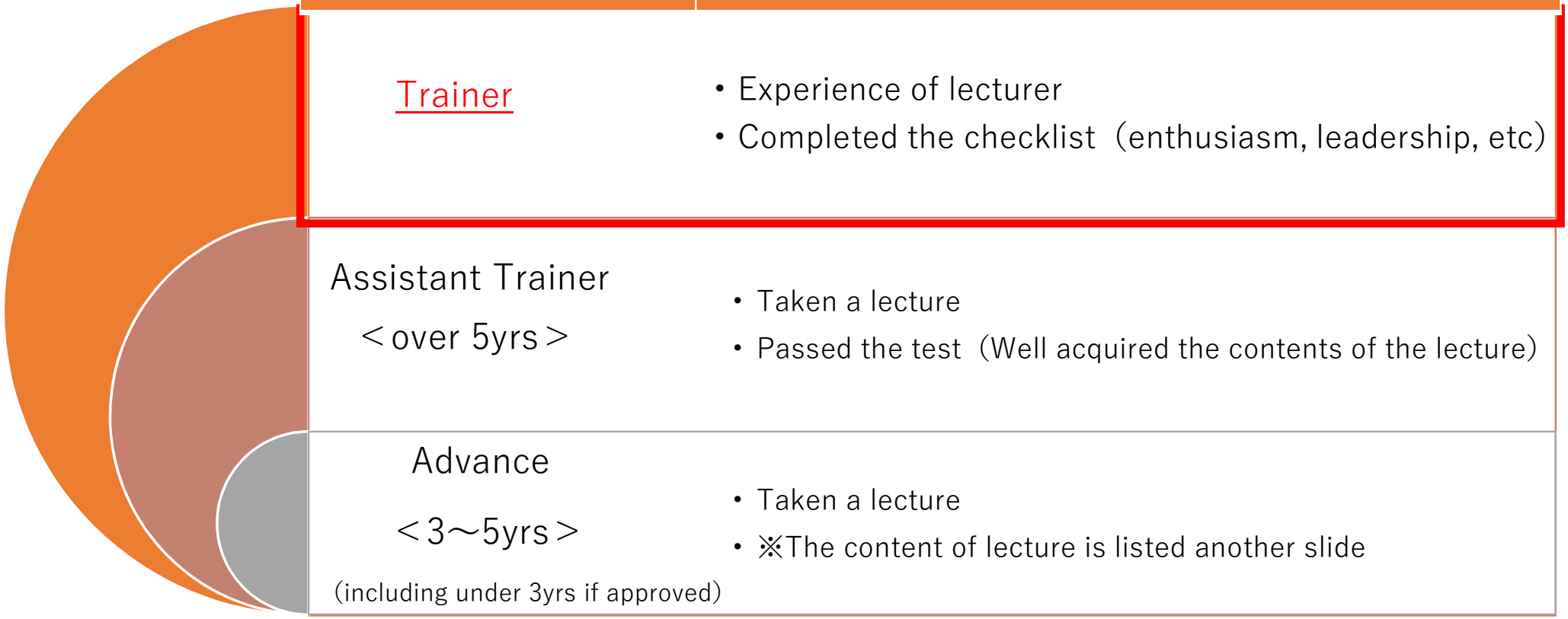
・Establish a training system to be held regularly to improve the skills of engineers.

・The content of the training will be based on the needs of PPL interviewed through the baseline survey.

(Draft) Trainer Certificateion System

Ability requirements （draft）

(Each title is certified by meeting the requirements)



タイトル	要件
Trainer	• Experience of lecturer • Completed the checklist（enthusiasm, leadership, etc）
Assistant Trainer ＜over 5yrs＞	• Taken a lecture • Passed the test（Well acquired the contents of the lecture）
Advance ＜3～5yrs＞ (including under 3yrs if approved)	• Taken a lecture • ※The content of lecture is listed another slide

(Draft) Training System

◎The content will be updated based on interviews with WG members.
◎This slide is a draft of a training program that will be implemented for engineers in general after the PJ.
◎Training for trainers needs to be discussed separately.

	Time/Frequency	Place	Course Eligibility	Main Topics	style
WG1-1	Once a year in May	・Training Center ・NSO Room	PPL Engineer	1)Principle of Power System Planning 2)Demand and Supply Plan 3)Asset Management 4)Power System Analysis by PSSE	Seminar
WG1-2	Once a year in May	・Training Center	Any job title is acceptable, as long as you are involved in or interested in project evaluation.	1)Way to read financial statements 2)Analysis of Financial Statements 3)Financial analysis of investment projects 4)Economic analysis of investment projects	1) Exercises 2) Teaching in mock lectures
WG2-1	Once a year in May	・Training Center ・On-site	PPL Engineer	1) Inspection method and inspection focus 2) Judgment method of abnormality rank 3) Inspection practice 4) Report of inspection results 5) Usage of tools and measuring instruments 6) Management of tools and measuring instruments	1) Seminar 2) Demonstration
WG2-2	Once a year in May	・Training Center ・On-site	PPL Engineer	1) Items and methods of patrol inspection 2) Inspection of substation equipment and safety measures for restoration in the event of an accident 3) Quality control items and measuring methods for substation facilities 4) Asset management 5) Methods for detecting accident points 6) Usage of tools and measuring instruments 7) Management of tools and measuring instruments	Seminar
WG 3	Once a year in May	・Training Center	PPL Engineer	1) Overview of Protection Relay 2) Settling Method of Protection Relay 3) Coordination Method of Protection Relay 4) Explanation of Manual, SOP	Seminar

Folw chart of trainer certification

JICA experts | WG members (1st generation of trainer) | 2nd generation | 3rd generation | 4th generation | Engineer (only take a lecture)

	1st year	2nd year	3rd year	(After Project) 4th year	5th year
Timing of evaluation			△	△	△
Trainer	Baseline Survey	Provide training (Online & Hands-on & In Japan)	・Evaluate Assistant Trainers Certificated as a trainer	・Provide a training ・Evaluate Assistant Trainers Certificated as a trainer	・Provide a training ・Evaluate Assistant Trainers Certificated as a trainer
Assistant Trainer (Professional)			Provide an Onsite-training Certificated as an assistant trainer	Provide a training Certificated as an assistant trainer	Provide a training Certificated as an assistant trainer
Advance		・Take a lecture ・Take a test	・Take a lecture ・Take a test	・Take a lecture ・Take a test	・Take a lecture ・Take a test
Engineer	Get Baseline Survey		Take a lecture	Take a lecture	Take a lecture

・Engineers can be a trainer passing a test and conducting training which is evaluated by a trainer.
・Only taking a lecture would be acceptable.

TRAINING RECORD

First-year training was conducted in each WG. The training schedule and contents are shown in following Tables.

Table.1 WG1-1 Online Training Contents of System Planning

Date and time	Contents	Attendees
2022/8/22 10:00-11:00 (JPN time)	・Basic concept of power system planning for bulk power system ・History of system development in Japan	Benedicta Savage Charlie Enos
2022/10/3 10:00-11:00 (JPN time)	・ About Flexible Alternating Current Transmission System technology ・History of Electricity Market Reform in Japan ・Concept of equipment configuration	Benedicta Savage Charlie Enos Haidi Wanya

Table.2 WG1-2 Training of the Financial and Economic in PNG

Date and time	Theme	Participants
2022/10/14 9:30 – 11:00 (PNG time)	Financial statements - Importance of financial statements - Classification - Profit and cash flow	David Jonah Cathy Kutkue Vera Lama Keith Kalama
2022/10/14 11:00 – 12:00 (PNG time)	Financial statements - Importance of financial statements - Classification - Profit and cash flow	Beda Kuglame Jimmy Yareba
2022/10/17 14:00 – 15:00 (PNG time)	Financial statements - Balance sheet - Profit and loss statement	David Jonah Cathy Kutkue
2022/10/17 15:00 – 16:00 (PNG time)	Financial statements - Balance sheet - Profit and loss statement	Beda Kuglame Keith Kalama
2022/10/18	Financial statements	Vera Lama

11:00 – 12:00 (PNG time)	- Balance sheet - Profit and loss statement	
2022/10/18 13:30 – 15:00 (PNG time)	Financial statements - Cash flow statement	Cathy Kutkue Beda Kuglame Keith Kalama
2022/10/19 11:00 – 12:00 (PNG time)	Financial statements - Cash flow statement	Vera Lama David Jonah
2022/10/19 13:30 – 15:00 (PNG time)	Financial statement analysis - Profit rate - ROE, ROA - ICR	Cathy Kutkue, Beda Kuglame Keith Kalama Vera Lama, David Jonah

Table.3 WG1-2 Online Training of the Financial and Economic

Date and time	Theme	Participants
2022/11/8 13:30 – 15:00 (PNG time)	Financial statement analysis using PPL financial statements - Profit rate (gross, EBIT, net)	Cathy Kutkue Beda Kuglame Keith Kalama Vera Lama
2022/11/9 13:30 – 15:00 (PNG time)	Financial statement analysis using PPL financial statements - Profit rate (gross, EBIT, net) - Return on equity (ROE) - Return on assets (ROA)	Cathy Kutkue Beda Kuglame Keith Kalama Vera Lama
2022/11/10 13:30 – 15:00 (PNG time)	Financial statement analysis using PPL financial	Cathy Kutkue Beda Kuglame Keith Kalama Vera Lama

	statements - Debt-equity (D/E) ratio - Interest coverage ratio (ICR)	
2022/11/15 10:30 – 12:00 (PNG time)	Financial statement analysis using Solomon Power financial statements - Gross profit, EBIT, net profit, ROE, ROA - D/E ratio, ICR	Cathy Kutkue Beda Kuglame Vera Lama
2022/11/16 13:30 – 15:00 (PNG time)	Financial statement analysis using Tonga Power financial statements - Gross profit, EBIT, net profit, ROE, ROA - D/E ratio, ICR	Cathy Kutkue Beda Kuglame Vera Lama
2022/11/29 13:30 – 15:00 (PNG time)	Financial statement analysis using PPL financial statements Profit rate (gross, EBIT, net)	David Jonah
2022/11/30 13:30 – 15:00 (PNG time)	Financial statement analysis using PPL financial statements - Profit rate (gross, EBIT, net)	David Jonah

	- Return on equity (ROE) Return on assets (ROA)	

Table.4 WG2-1 Online Training Contents of Transmission line

Date and time	Contents	Attendees
2022/9/1 14:00-16:00 (PNG time)	・Maintenance Work for Overhead Transmission Line in Kansai TD ・Required Clearance between HV transmission lines	Chris Luther Ben Kaum Deanne Kilamanu-Naime Esorom Passingan
2022/11/25 13:00-15:00 (PNG time)	・Basic Design Concepts for Transmission Tower	Chris Luther Ben Kaum Deanne Kilamanu-Naime Esorom Passingan

Table.5 WG2-2 Online Training Contents of Substation

Date and time	Contents	Attendees
2022/12/15 9:00-11:00 （JPN time）	Introduction of the operating and monitoring systems in Kansai T&D	Simon Deveo Simon Robert Rawali Rawali Brian Inamo Terry Naipu Deanne Kilamanu-Naime
2022/12/15 13:00-15:00 （JPN time）	Explanation of concept and overview of preventive maintenance in Kansai T&D after clarifying the differences between the actual equipment of Kansai T&D and PPL.	Same as above.
2022/12/16	Same as above.	Same as above.

9:00-11:00 （JPN time）		
2022/12/16 13:00-15:00 （JPN time）	Explanation of insulating oil analysis related to transformer abnormality diagnosis.	Same as above.

Table.6 WG3 Online Training Contents of Protection coordination

Date and time	Contents	Attendees
2022/9/14 09:00AM～10:00AM （JPN time）	・Power System Overview ・Overview of Protection Relay	Melvin Angi Michael Akep
2022/9/26 09:00AM～10:30 AM （JPN time）	・Overview of Protection Relay	Melvin Angi Michael Akep
2022/9/26 09:00AM～10:30 AM （JPN time）	・Distance Relay Setting Part 1	Melvin Angi Michael Akep

To CR of JICA PNG Office

Project Monitoring Sheet

Project Title: PROJECT FOR THE IMPROVEMENT OF PLANNING AND OPERATION OF POWER SYSTEM

Version of the Sheet: Ver.3 (Aug. 2023)

Name: Obed Batia

Title: Project Director

Name: Seiji Ueoka

Title: Chief Advisor / System Planning

Submission Date: 18th August, 2023

PROJECT FOR THE IMPROVEMENT OF PLANNING
AND OPERATION OF POWER SYSTEM
Monitoring Sheet

Table of Contents

ABBREVIATIONS

Symbol	English
C/P	Counterpart
DFAT	Australian's Department of Foreign Affairs and Trade
IPP	Independent Power Producer
JCC	Joint Coordination Committee
KCH	Kumul Consolidated Holdings Limited
KPI	Key Performance Indicators
NEA	National Energy Authority
NSO	National system operation
PDM	Project Design Matrix
PEP	PNG Electrification Partnership
PNG	Papua New Guinea
PO	Plan of Operation
POM	Port Moresby
PPL	Papua New Guinea Power Ltd
PSSE	Power System Simulator for Engineering
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SMEC	SMEC Holdings Limited
SOP	Standard Operating Procedures
STATCOM	Self-commutated Static Var Compensator
WG	Working Group

I. Summary

1. Progress

1-1. Progress of Input

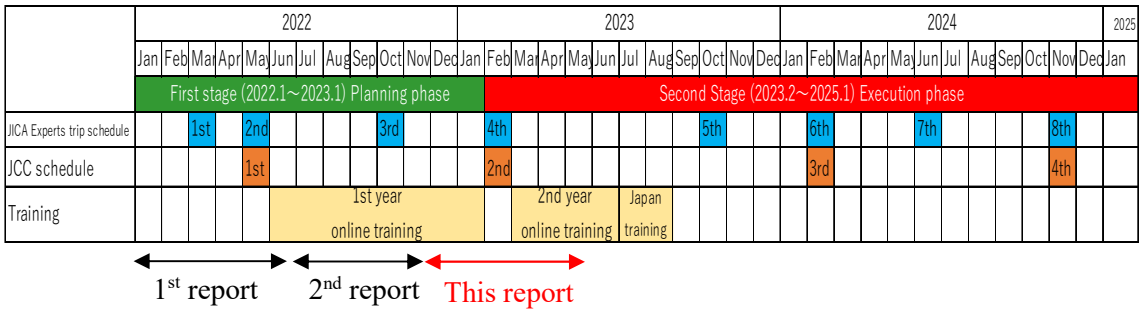


Fig.1 Activity Schedule

A contract for the implementation of this project was signed on 14th January 2022, and the project has started for about three years (until 24th January 2025).

This report describes the results in the first half of the second year (December 2022 to May 2023).

For the first half of the second year, based on the results of the first year's activities, the plan was to formulate activity plans for the second and third years and start the second year's activities, in addition to coordinating the implementation of training in Japan and implementing various procedures for the procurement of materials and equipment. At present, progress is being made as planned, and the results of the various activities are shown below.

From Japan Side

Fourth Dispatch

The fourth dispatch was carried out for about three weeks from February 2023. In the fourth dispatch, the 2nd JCC meeting was held and the results of the 1st year's activities, activity plans for years 2nd and 3rd , and revised PDM were explained and approved. In addition, training was conducted and a manual was prepared. And, as the project manager on the PPL side changed in January 2023, an overview of the project and an explanation of the activities to date were provided.

Please refer to the attachment1 for the detailed activity results.

Online WG

Since February 2023, each WG has conducted online WG for the purpose of imparting knowledge to C/Ps and gathering information for manual preparation. Please refer to the attachment2 for the details of the content of the online WG.

Table 1-1-1 shows the planned and actual input of these personnel.

Table 1-1-1 Personnel input status

No.	Field of expertise	Total Man/Month(M/M) (M/M of Dec 2022-May 2023)	
		In PNG	In Japan
1	Team Leader / System Planning	2.97(0.77)	3.65(1.15)
2	Grid Technology	2.13(0.53)	2.05(0.65)
3	Financial and Economic Analysis	1.87(0.53)	2.10(0.70)
4	Transmission Line	2.13(0.53)	2.05(0.65)
5	Substation	2.87(0.77)	2.40(0.80)
6	Equipment Testing / Evaluation	1.23(0.53)	2.60(1.00)
7	Protection Coordination[1]	2.97(0.73)	2.85(1.20)
8	Human Resource Management / Training Planning	1.60(0.00)	1.80(0.70)
9	Grid Technology(Assistant) / Business Coordination	2.97(0.73)	1.00(0.25)

From PNG side

WG member

21 people were appointed as WG members of this project.

Provision of office and WG space

An office space was prepared in the PPL for the 4th dispatch of experts. PNG side also arranged meeting rooms and other facilities necessary for WG activities and cooperated in the smooth implementation of WG activities.

Provision of related documents

The existing PPL materials needed for the preparation of the manual were provided.

1-2. Progress of Activities

The progress of each activity is described in Table 1-2-1.

The PDM reflects the latest version approved by the 2nd JCC.

For a comparison of old and new PDM, see the attachement3.

Output 1

Table.1.2.1 The progress of each activity (Output 1)

[1] Protection coordination: Adjustment of the setting values of protection relays to prevent the spread of power outage by disconnecting only the minimum range in the event of an electrical fault caused by various abnormalities that may occur in the power system.

Activities in Project Design Matrix (PDM)		Activities conducted in the period
1-1	Assess the current capacity of system planning for the transmission line	The results of the baseline survey were explained at the 2nd JCC.
1-2	Formulate Working Groups (WG) for (1) system planning and (2) financial and economic analysis	【Completed】 WG1-1 and 1-2 don't change members, and have been progressing WG activities.
1-3	Conduct training for trainer candidates on basis on system planning for the transmission line	A total of 6 trainings, 4 on-site and 2 on-line, were given on the concept of power system planning including examples of system analysis, supply and demand planning, and supply and demand adjustment. In particular, the training focused on the theoretical content behind the system analysis software used for system planning, such as the process of deriving the equation that expresses system stability and the interpretation of the equation, which was difficult to explain in the online training. Utilizing various training opportunities such as online training, training in Japan, and on-site training, JICA consultant team will continue to improve the capabilities of WG1-1 members.
1-4	Conduct training for trainer candidates on system simulation using tools such as PSS/E	There is no movement within PPL to unify software for grid analysis. We plan to give a lecture on grid analysis during the training in Japan to improve the capability of WG members in grid analysis.
1-5	Conduct training for trainer candidates on basis on financial and economic analysis	During the third mission, we conducted a total of eight lecture sessions including supplementary classes in four days. The subjects of these lessons were: (i) how to read financial statements, (ii) the structure of the statements, (iii) indicators used in financial statement analysis, and (iv) the method of analytical calculation. As the online training between the third and fourth missions, we conducted a total of seven exercise sessions

		in seven days in November and three sessions in three days in January. The exercise is aimed at strengthening the members' capacity to fully understand theories by having them calculate various financial indicators by themselves. In the exercise, individual members evaluated the financial performance of the PPL, Solomon Islands Electricity Authority and Tonga Power Limited using financial indicators. In addition, they contemplated problems in business operation suggested by the financial indicators. During the fourth mission, we conducted a total of nine lecture and exercise sessions in seven days. The subject of these lessons was financial analysis for a project. As the online training after the fourth mission, we conducted a total of seven lecture and exercise sessions in five days in March, eight sessions in five days in April, and ten sessions in five days in May.
1-6	Develop the PPL Official Training Manual for system planning, system simulation, and financial and economic analysis through considering systematic human resource development	WG1-1 continued to prepare a draft training manual and conducted training using the prepared draft training manual. WG1-1 will continue to prepare the draft training manual and coordinate with C/P based on the prepared draft training manual so that it will become a training manual for PPL. For WG1-2, we prepared and distributed to the members textbooks (pdf files) on matters including financial statements, financial statement analysis, financial analysis for a project, and use of the Excel functions for financial analysis. In addition, we prepared and distributed six kinds of exercise books (pdf files) and answer sheets (Excel files).
1-7	Support trainers to conduct the training for the engineers based on the training manual	[Not started yet]
1-8	Develop the PPL Official	For WG1-1, interviews were conducted with PPL staff

	Operational Manual and Standard Operating Procedure (SOP) for system planning, system simulation, financial and economic analysis	members other than WG members, and preparation of an operational manual was also started. We will discuss with the WG members based on the draft operational manual prepared by the survey team, and make adjustments so that it will become an operational manual within PPL. For WG1-2, we have begun to compile a draft training manual based on the outcomes of the lectures and exercises up to now.
1-9	Assess the Least Cost Development Plan based on the operational manual and SOP	[Not started yet]

Output 2

Table.1.2.2 The progress of each activity (Output 2)

Activities in PDM		Activities conducted in the period
2-1	Assess the current capacity and technical, structural, and planning challenges of maintenance for transmission line and substations are assessed and propose measures for these challenges	[WG2-1] The capacity assessment was conducted through a baseline survey, and a survey of the current situation of C/P was carried out through WG activities. The WG activities were carried out about the points of "people, organization, and equipment". Lack of maintenance workers, tools and materials. In addition, there is a large discrepancy between planned and actual inspection operations. The development of various rules and manuals for the formulation of sustainable preventive maintenance plans that consider resources and establishment of asset management systems are founded issues that need to improve in the future. In order to resolve the issue confirmed through the survey in 1st year, we have been carried out local and online training and provided PPL WG member with basic knowledge of inspection work. Furthermore, we have proposed the form of inspection / patrol planning and checklists to introduce PPL's work. [WG2-2] (Ongoing) During the fourth trip and online training, discussions

		with WG members continued to grasp the current situation. Since the inspection plan prepared by PPL is uniform and the basis of intervals is not clear, the planning method considering the actual condition of facilities and characteristics of each equipment type was arranged and proposed.
2-2	Formulate 2 WGs for maintenance for (1) transmission line and (2) substations	(Completed) WG2-1 and 2-2 don't change initial members, and have been progressing WG activities.
2-3	Conduct training for trainer candidates on planning of preventive maintenance and asset management	**WG2-1** Before the third visit, the on-line training was carried out once regarding preventive maintenance works. In addition, the contents of last lecture were reviewed and basic design concepts of transmission facilities are lectured newly during the third visit. The difficulties of online meeting As C/P makes few remarks and it is difficult to check the level of understanding for each C/P, it is necessary to follow up on the contents of the training when visiting in PPL. In addition, as each C/P is busy with his/her works and there are many unexpected works, it takes time and changes to arrange the meeting date and time. **WG2-2** (Ongoing) As an aid to the development of PPL's asset management system in the fourth trip, the composition of the asset management system in the Kansai T&D (diagram showing the linkage of each equipment) was explained. In addition to communicating the preventive maintenance system of the Kansai T&D in the online WG, we explained the monitoring and control system of the company, explains the relationship between the development of preventive maintenance plans and the monitoring and control system, and especially proposes and discusses the improvement of the monitoring and

		control system of PPL. We explained the problems in the actual condition of PPL facilities based on photographs of each department, explained the importance of maintenance and points to be aware of, and also tried to raise the level of awareness regarding the attitude toward asset management.
2-4	Conduct training for trainer candidates on the implementation of preventive maintenance and asset management	**WG2-1** WG2-1 shared the progress of annual inspection plan that have been started since last year and the contents of checklist as a result of inspections, and grasped the current problems while introducing our company's cases. Furthermore, we proposed checklist for inspection work and malfunction criteria for each transmission facilities. We will upgrade them reflecting on WG member's opinion about how to operate. In addition, unexpected future risks were pointed out from the perspective of equipment maintenance and design as well as recovery methods for equipment abnormalities, and training has been started to improve a sensitivity for preventive maintenance works. (E.g. The basic loading mechanism on the steel tower) **WG2-2** (Ongoing) On the fourth trip, we explained the inspection work flow, how to deal with transformer and circuit breaker failure, checkpoints during daily inspection and completion inspection, and how to diagnose battery deterioration. In addition, lectures were given at the online WG on how to manage the leakage current of the arrester and how to use the direct-current grounded probe, and preparations were made to improve the technical capabilities and to facilitate training after the provision of equipment for testing.
2-5	Develop the PPL Official Training Manuals for maintenance for transmission line and	**WG2-1** The lectures on the basics of transmission line maintenance have been given to C/P, and further materials have been prepared for the next.

	substations considering systematic human resource development	Through future lectures, training materials and manuals will be established systematically grasping the level of understanding for each C/P and their requests. **WG2-2** (Ongoing) In online WG, we explained the system of manuals in the Kansai T&D and how to proceed with manual preparation in this project. We organized and explained the manual system and contents in accordance with the actual situation of PPL, and gave them an understanding of how to create manuals in the future.
2-6	Support the trainers to conduct the training for the engineers based on the training manual	**WG2-1 & WG2-2** [Not started yet]
2-7	Develop the PPL Official Manual and Standard Operating Procedure (SOP) for transmission line and substations	A survey was conducted on the regulations held by PPL in preparation for the creation of operational manuals and SOP. Next step, we plan to coordinate with the C/P and decide on the operational manuals and SOP to be created in this project. **WG2-2** (Ongoing) Same as 2-5.
2-8	Support PPL to implement the maintenance of transmission line and substation based on the approved PPL Official Operational Manual and SOP	**WG2-1 & WG2-2** [Not started yet]

Output 3

Table.1.2.3 The progress of each activity (Output 3)

Activities in PDM		Activities conducted in the period
3-1	Assess the current capacity and technical, structural, and planning	The results of the baseline survey were explained at the JCC.

	challenges of protection coordination and propose the measures for these challenges	
3-2	Formulate WG for protection coordination	Completed; no personnel changes in WG3.
3-3	Conduct training to improve capacity of protection coordination setting for candidate trainers	Four training sessions have already been conducted as the first-year online training. Training will continue to be conducted.
3-4	Develop the PPL Official Training Manual for protection coordination considering systematic human resource development	Training manuals are being prepared as needed for required training items. The "Protection Relay[2] Overview" and "Distance Relay Setting" manuals have been prepared and online training sessions have been conducted.
3-5	Support trainers candidate to conduct the training for the rest of engineers based on the PPL Official Training Manual	[Not started yet] Issue: PPL has only two protection relay engineers as C/P and no one is eligible for training at the moment. Solution: The two new employees to be hired will be targeted for training.
3-6	Develop the PPL Official Operational Manual and Standard Operating Procedure (SOP) for protection coordination.	The workflow was confirmed, and three draft SOPs were prepared. The C/P is currently examining the contents of the SOPs.
3-7	Support PPL to modify the setting, for the protection coordination based on the operational manual and SOP	[Not started yet]

[2] Relay (protection relay): A device that instantly detects an electrical fault and sends a signal to the circuit breaker to shut down the circuit. There are several types of relays, including distance relays, differential relays, overcurrent relays, frequency relays, and voltage relays.

Output 4

Table.1.2.4 The progress of each activity (Output 4)

Activities in Project Design Matrix (PDM)		Activities conducted in the period
4-1	Assess the current system for human resource development	The results of the baseline survey were explained at the 2nd JCC.
4-2	Develop the PPL Official system of human resource development	We prepared a draft (table of contents) of human resource development manual for engineers,[3] incorporating the needs of C/Ps.

1-3. Achievement of Output

Output 1

"Capacity of system planning for the transmission line is improved", the following initiatives were implemented.

【WG1-1】

The issues and future activity plans, which were extracted from a survey of the current situations, were explained at the 2nd JCC. In addition, online training was conducted to improve the capacity of PPLs for grid planning. And, training manuals and operational manuals were prepared to establish a system for sustainable human resource development.

We will continue to improve the capacity of WG members and prepare manuals by utilizing various training opportunities such as online training, training in Japan, and on-site training.

【WG1-2】

With regard to how to read financial statements and conduct basic financial statement analysis, trainees acquired fundamental knowledge and became able to apply it for problem-solving.

However, as regards financial analysis for a project, although they became able to make a simple model, they still need to deepen their understanding by repeated exercise. We are determined to continue building up their capacity in the latter part of the second year so that they will acquire the ability to make complex models for analysis.

[3] Engineer: Office-based workers who are in charge of system planning, inspection planning, asset management, and protection coordination, et

Output 2

"Capacity of maintenance for transmission line and substation is improved", a survey of the current situation was conducted, and challenges were identified in three areas: people, organization, and equipment. In addition, in the WG at the baseline survey, we shared the challenges and improvement points of the PPL.

WG2-1

The survey at WG2-1 of the current situation revealed three issues.

・Sustainable preventive maintenance plans should be developed that takes into account resources such as maintenance personnel and materials and equipment.

・By the asset management systems improvement, to improve quality of maintenance work, evaluation and repairing abnormal facilities.

・The lack of tools and materials have caused delays in preventive maintenance and repair work, and replenishment should be based on priority. Lack of knowledge about equipment is a contributing factor, so C/P knowledge needs to be improved through training.

・In order to resolve the above issues, we carried out online training for the purpose of fostering maintenance and asset management skill as a program in 2nd and 3rd years. Furthermore, we proposed training manuals and SOPs to operate sustainable structure of human training.

WG2-2

The details of the implementation and the way forward in the WG2-2 are as follows.

I. Lectures were given on specific measures to be taken in patrol and inspections, principles of measuring instruments to be newly supplied to PPL, and how to use them. In the future, we will continue to give lectures, and after the fifth trip, we will practice using materials and measuring instruments that we will actually provide.

II. As for the manual, based on the investigation up to now, it is considered that PPL has not been able to manage systematically what was provided by the supplier at the time of installation of the equipment, and that PPL has created few manuals independently for the purpose of using them for education, etc. Based on this, in an online WG, we explained the manual system (what kind of manual is being developed for the purpose of education, etc.) in the Kansai T&D. In the future, discussions with the WG members using the draft manual will be held at the training session in Japan, and after that, the online WG will proceed with the joint preparation with the WG members at the fifth trip.

III. Regarding the asset management system, we explained the structure of the asset management system of the Kansai T&D (diagram showing the linkage of each facility)

as an aid to the development of PPL. As for the way forward, PPL is currently in the process of constructing a diagram from the aggregated equipment data, so we will check the development trend of PPL based on the information provided and give advice as needed. In addition, we plan to introduce how to use the asset management system from employees actually involved in maintenance at the maintenance office in the Kansai T&D during training in Japan.

Output 3

"Capacity of protection coordination is improved", the following actions have been taken.

[WG3]

- The work procedures of CP were discussed, and the standard procedure manuals were prepared. In preparing the document, the standards and rules required for the work were clearly stated, and the approvers were clarified.
- Training manuals were prepared in accordance with the training items required for PPL, and online trainings were conducted for "Protection Relay Overview" and "Distance Relay Setting".
- Based on the results of quizzes conducted after the online training, follow-up sessions were held to address items with weak comprehension.

Human Resource Development

・We prepared a draft (table of contents) of human resource development manual which will serve as the framework for the trainer certification system and training system, incorporating the needs of CPs.

・We confirmed the department which is in charge of this manual.

1-4. Achievement of Project Purpose

As for the Project Purpose, when we achieve the Output 1-3 as described in 1-3, the Project Purpose "PPL can properly implement system planning for the transmission line and maintenance for transmission line and substations on its own ." will be achieved.

In order to achieve the project goals, the activity plans for 2nd and 3rd years were formulated based on the issues identified through the first year's activities and approved at the 2nd JCC meeting. From now on, based on the approved activity plan, various activities will be carried out to achieve the project goals.

The evaluation results based on the DAC evaluation criteria are as follows.

A. Validity

In Papua New Guinea, as further expansion of power facilities is required, there is an urgent need to improve the capacity of human resources engaged in the power business, which is consistent with the goals of this project. In addition, the project's approach, which aims to establish a mechanism for training instructors, is appropriate in order to establish a human resource development system for engineers who have not yet implemented PPL.

B. Effectiveness

The Project Purpose is appropriate as a goal to achieve the Overall Goal. Furthermore, in order to increase the effectiveness of future projects, we are coordinating with WG members on training content and manual content.

C. Impact

Since PPL does not have a system in place for training engineers, it is necessary to develop human resources for engineers through this project in order to achieve the overall goal. Since we were able to grasp the issues within PPL through the first-year survey, we will build a human resource development system that matches the actual situation of PPL.

D. Efficiency

In order to increase the efficiency of the project, the activity plan for the 2nd and 3rd year of this project was prepared and approved at the 2nd JCC meeting held in February 2023. The approved activity plan will be used as the basis for future activities.

E. Sustainability

In order to increase the sustainability of the effects of this project, in addition to creating a manual through this project, we plan to confirm the needs of PPL and establish a human resource development system and training system within PPL.

1-5. Changes of Risks and Actions for Mitigation

Following factors are considered to become obstacles for the smooth implementation of the Project.

(1) Inadequate assignment of C/P

If the adequate C/P will not be assigned at the proper time and necessary numbers, activities of the technology transfer could not be carried out on schedule.

Since we will enter the training implementation stage in the future, if WG members leave their jobs, the contents of training from experts will not be accumulated, and it is possible that we will not be able to train trainers.

(2) Inadequacy of working environment and necessary equipment

Proper working environment and equipment will be indispensable for implementing the

Project on schedule.

Lack of proper working environment and equipment would be obstacles for the smooth implementation of the Project.

(3) Shortage of budgetary allocation

In order to carry out the Project on schedule, necessary budget should be prepared in adequate time. If the necessary budget would not be allocated on time, we cannot expect the Project running smoothly.

If some risks occurred in these factors, Project will face a serious problem.

Therefore the expert team has exchanged views with C/P of PNG frequently and has confirmed the important issues by the Minutes of Understandings in order to avoid misunderstanding with each other and has tried to minimize the risks of above mentioned factors.

Assumed risks and countermeasures for minimizing risks are shown in Table 1-5-1. Fortunately there occur no problems so far now.

Table 1-5-1. Risk items

No.	Risk Factor	Countermeasures for Mitigation	Results
1	Assignment of C/P	The project manager on the PPL side retired in December 2022; we requested the PPL side to determine the next project manager.	A new project manager has been appointed. In addition, a project coordinator was appointed to contact the WG members and secure a meeting room, as the project manager is very busy.
2	Assignment of Japanese Expert	As for the contents and method of technology transfer were discussed and confirmed in the Work Plan in May 2022. And this Work Plan was agreed between JICA and PNG side in the first JCC held on 27th May 2022. Base on the schedule in the Work Plan, the expert team was dispatched	No problems occurred so far now

3	Management of Scheduling and Implementation	The expert team and Project Manager exchange views frequently mainly about the schedule of the technology transfer.	No problems occurred so far now
4	Share of Information	Regarding the daily job management, the expert team discuss with the Project Manager and the progress of the project is reported in the JCC and shared among the related people.	No problems occurred so far now
5	Office Space and Working Environment	The expert team requested the office space to PNG side in the kickoff meeting in March 2022. PNG side provided the office space with air condition to the expert team.	No problems occurred so far now

1-6. Progress of Actions undertaken by JICA

(1) Conducted WG activities on the third trip.
(2) Conducted online training.
(3) Made various adjustments for the implementation of the training in Japan.
(4) Made various arrangements for procurement of materials and equipment to be provided.

1-7. Progress of Actions undertaken by Gov. of PNG

(1) To provide the expert team office space with necessary equipment
(2) To provide meeting rooms for WG activity
(3) WG members participated in WG activities and online training.
(4) To cooperate in collecting various data necessary for technical cooperation.
(5) Prepared and submitted to JICA various materials necessary for the implementation of the training in Japan.

1-8. Progress of Environmental and Social Considerations (if Applicable)

No relevant matters

1-9. Progress of Considerations on Gender/Peace Building/Poverty Reduction (if applicable)

Five women are participating as WG members.

1-10. Other remarkable/considerable issues related/affect to the project (such as other JICA`s projects, activities of counterparts, other donors, private sectors, NGOs etc.)

No relevant matters

2. Delay of Work Schedule and/or Problems (if any)

2-1. Detail

The overall schedule is as originally planned. However, there is a possibility that the procurement of materials and equipment may be delayed, and if so, procurement of materials and equipment is a task related to WG2, the timing of the fifth trip by some members may be delayed.

2-2. Cause

Because there were no bidders at the time of the first bid, it is necessary to conduct the bidding procedure again.

2-3. Action to be taken

The travel period for WG2, which is scheduled to provide education using materials and equipment, will be postponed. The delayed period will be absorbed into the overall schedule so that the project as a whole will not experience any process delays.

2-4. Roles of Responsible Persons/Organization (JICA, Gov. of PNG, etc.)

No relevant matters

3. Modification of the Project Implementation Plan

3-1. PDM

Ver1： Obtained approval at the 1st JCC in May 2022.

Ver2： Obtained approval at the 2nd JCC in February 2023.

3-2. PO

Obtained approval at the 2nd JCC in February 2023.

3-3. Other modification on detailed implementation plan

No change

4. Preparation of Gov. of PNG toward after completion of the Project

Based on the manuals and training plans created in this project, the engineers trained in this project will continue to provide training.

II. Project Monitoring Sheet I & II

1） Project Monitoring Sheet I (Revision of Project Design Matrix)

Project Monitoring Sheet I （Revision of Project Design Matrix）

Project Title: The Project for the Improvement of Planning and Operation of Power System
Implementing Agency: PNG Power Ltd
Target Group: Engineers in PPL
Period of Project: March 2022 to March 2025

Version 2
July,2023

Project Site: N/A **Model Site: N/A**

Narrative Summary	Objectively Verifiable Indicators (Rev)	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
The quality and reliability of electricity is improved.	By 2029, 50% reduction of total blackouts in 3 main grids caused by inadequate maintenance of PPL's transmission, substation, and protection coordination equipment compare to in 2021.	Data from PPL			
	The 15 Year Power Development Plan is executed with necessary budget and physical work.	Data from PPL			
	The number of faults resulting from the lack of maintenance and asset management decreases by 50% by 2029.	Data from PPL		Not Achieved yet	
	PPL can conduct review and protection coordination on 50% of the existing distance relays by 2029.	Data from PPL			
	New engineers assigned to the relevant department receive training within one year and always secure 10 trainers.	Data from PPL			
Project Purpose					
PPL can properly implement system planning for the transmission line and maintenance for transmission line and substations on its own.	Capacity for revising and proposing grid plan based on simulation and, financial and economic analysis is equipped with PPL.	Report from Japanese experts/Data from PPL	PPL continues commitment to the Project by securing budget allocation as well as assignment of personnel for post- Project activity.	In progress	
	The maintenance for transmission line and substations, and asset management are regularly implemented in accordance with manuals.	Report from Japanese experts/Data from PPL			
	The setting for protection coordination is regularly confirmed in accordance with manuals.	Report from Japanese experts/Data from PPL			
	Various Training are conducted by 10 trainers produced by the Project and improving trainees skill and knowledge effectively based on the established human resource development system.	Report from Japanese experts/Data from PPL			
Outputs					
Capacity of system planning for the transmission line is improved.	Knowledge for system planning, simulation, and financial and economic analysis is improved.	Exam results (Pre-exam and Post-exam)	Necessary budget is secured.	A survey was conducted on the identification and role of related departments in conducting system planning and system interconnection studies.Based on the results of the survey, an activity plan for the second and third years is developed, and training is conducted based on this activity plan.	
	5 of engineers who completed training gained sufficient knowledge and skills.	Report from Japanese experts			
	Least Cost Development Plan is verified by PPL.	Report from Japanese experts			
Capacity of maintenance for transmission line and substation is improved	Knowledge for maintenance of transmission line and substation, and asset management is improved.	Exam results (Pre-exam and Post-exam)		A survey on the identification and role of related departments in the fields of transmission ine and substation.Based on the results of the survey, an activity plan for the second and third years is developed, and training is conducted based on this activity plan.	
	10 of engineers and technicians who completed training gained sufficient knowledge and skills.	Report from Japanese experts Questionarre for staff in charge.			
	Asset management and preventive maintenance are implemented by PPL at least once based on the manuals developed by the Project.	Report from Japanese experts Questionarre for staff in charge.			
Capacity of protection coordination is improved	Knowledge for protection coordination is improved.	Exam results (Pre-exam and Post-exam)		A survey was conducted on the identification and role of departments related toprotection coordination.Based on the results of the survey, an activity plan for the second and third years is developed, and training is conducted based on this activity plan.	
	2 new engineers to be recruited who completed training gained sufficient knowledge and skills.	Report from Japanese experts			
	The setting of protection coordination is confirmed by PPL at least once.	Report from Japanese experts			
Sustainable system for human resource development is established	Qualified 10 of Trainers and 17 Engineers are produced, based on the established human resource development system by the end of the Project.				

Activities	Inputs		Important Assumption
	The Japanese Side	The PNG Side	
1-1 : The current capacity of system planning for the transmission line is assessed. 1-2 : 2 Working Groups (WG) for (1) system planning and (2) financial and economic analysis are formulated. 1-3 : Training for trainer candidates on basis on system planning for the transmission line is conducted. 1-4 : Training for trainer candidates on system simulation using tools such as PSS/E is conducted. 1-5 : Training for trainer candidates on financial and economic analysis is conducted. 1-6 : The training manuals for system planning, system simulation, and financial and economic analysis are formulated through considering systematic human resource development. Manuals are officially approved by PPL. 1-7 : Based on the training manual, the training for the engineers is implemented by trainers. 1-8 : The operational manual and Standard Operating Procedure (SOP) for system planning, system simulation, financial and economic analysis are formulated, and the manual and SOP are officially approved by PPL. 1-9 : Based on the operational manual and SOP, the Least Cost Development Plan is verified by PPL. 2-1: The current capacity and technical, structural, and planning challenges of maintenance for transmission line and substations are assessed. Measures for these challenges are proposed. 2-2:2 WGs for maintenance for (1) transmission line and (2) substations are formulated. 2-3:Training for trainer candidates on planning of preventive maintenance and asset management is implemented. 2-4:Training for trainer candidates on the implementation of preventive maintenance and asset management is implemented. 2-5: The training manuals for maintenance for transmission line and substations are formulated considering systematic human resource development. Manuals are officially approved by PPL. 2-6 : Based on the training manual, the training for the engineers is conducted by the trainers. 2-7 : The operational manual and Standard Operating Procedure (SOP) for transmission line and substations are formulated. 2-8: Based on the operational manual and SOP, PPL implements the maintenance of transmission line and substation.The manuals and SOP are officially approved by PPL. 3-1: The current capacity and technical, structural, and planning challenges of protection coordination is assessed.The measures for these challenges are proposed. 3-2: WG for protection coordination is formulated. 3-3:Training to improve capacity of protection coordination setting is implemented for candidate trainers. 3-4 : The training manual for protection coordination is formulated considering systematic human resource development. The manual is officially approved by PPL.	1. Short-term Experts a. Chief advisor/System planning b. Grid technology c. Financial and economical analysis d. Transmission line (maintenance) e. Substation (maintenance) f. Equipment Testing/ Evaluation g. Protection coordination h. Human resource management / traing planning i. Grid technology asistant / Business coordination 2. Equipment 3. Trainings a. Training online b. Training in Japan c. Training in PNG	1. Office place for Japanese experts 2. Utility 3. Counterpart personnel 4. all expenses for PPL staffs (salaries, in-country transportation, allowance, etc.) 5. Tax exemption 6. Customs clearance for equipment 7. Cost for JCC avenue 8. Expenses necessary for the transportation within PNG of the equipment as well as for the installation, operation and maintenance thereof.	**Pre-Conditions** 1. Political, security, COVID-19 situation etc do not detriorate significantly. 2. Input from PNG and JICA is iplemnted in timely manner. 3. Necessary budget for implementation of project is secured during the project. **<Issues and countermesures>**

3-5 : Based on the training manual, the training for the rest of engineers is implemented by trainers candidate.					
3-6 : The operational manual and Standard Operating Procedure (SOP) for protection coordination are formulated.					
3-7 : Based on the operational manual and SOP, the setting for the protection coordination is modified by PPL.The manuals and SOP are officially approved by PPL.					
4-1 : The current system for human resource development is assessed and workable system is proposed.					
4-2 : Sustainable system for human resource development is established, and officially approved by PPL.					

2） Project Monitoring Sheet II (Revision of Plan of Operation)

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 2

July,2023

Project Title: The Project for the Improvement of Planning and Operation of Power System

Inputs			Year	2022				2023				2024				2025	Remarks	Monitoring: Issue	Monitoring: Solution
				I	II	III	IV	I	II	III	IV	I	II	III	IV	I			
Expert																			
Short - Term (Visiting) Expets			Plan																
			Actual																
Long - Term (Resident) Experts			Plan	To be assigned by JICA															
			Actual																
Equipment																			
			Plan																
			Actual																
Training online																			
			Plan																
			Actual																
Training in Japan																			
			Plan																
			Actual																
In-country/Third country Training																			
			Plan																
			Actual																

Activities			Year	1st Year				2nd Year				3rd Year				4th Year	Responsible Organization		Achievements	Issue & Countermeasures
	Sub-Activities (Original)	Sub-Activities (Revision 23/2/2023)		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	Japan	GOPNG		
Output 1:																				
1.1	The current capacity of system planning for the transmission line is assessed.	Assess the current capacity of system planning for the transmission line	Plan																The results of the baseline survey were explained at the 2nd JCC.	
			Actual																	
1.2	2 Working Groups (WG) for system planning and financial and economic analysis are formulated.	Formulate Working Groups (WG) for (1) system planning and (2) financial and economic analysis	Plan																In JCC held at 27th May 2022, members of WG1-1 and WG1-2 have been formulated. We confirmed members at second trip and established contact systems.	
			Actual																	
1.3	Training for trainer candidates on basis on system planning for the transmission line is conducted.	Conduct training for trainer candidates on basis on system planning for the transmission line	Plan																A total of 6 trainings, 4 on-site and 2 on-line, were given on the concept of power system planning including examples of system analysis, supply and demand planning, and supply and demand adjustment. In particular, the training focused on the theoretical content behind the system analysis software used for system planning, such as the process of deriving the equation that expresses system stability and the interpretation of the equation, which was difficult to explain in the online training. Utilizing various training opportunities such as online training, training in Japan, and on-site training, JICA consultant team will continue to improve the capabilities of WG1-1 members.	
			Actual																	
1.4	Training for trainer candidates on system simulation using tools such as PSS/E is conducted.	Conduct training for trainer candidates on system simulation using tools such as PSS/E	Plan																There is no movement within PPL to unify software for grid analysis. We plan to give a lecture on grid analysis during the training in Japan to improve the capability of WG members in grid analysis.	
			Actual																	
1.5	Training for trainer candidates on financial and economic analysis is conducted.	Conduct training for trainer candidates on financial and economic analysis	Plan																During the third mission, we conducted a total of eight lecture sessions including supplementary classes in four days. The subjects of these lessons were: (i) how to read financial statements, (ii) the structure of the statements, (iii) indicators used in financial statement analysis, and (iv) the method of analytical calculation. As the online training between the third and fourth missions, we conducted a total of seven exercise sessions in seven days in November and three sessions in three days in January. The exercise is aimed at strengthening the members' capacity to fully understand theories by having them calculate various financial indicators by themselves. In the exercise, individual members evaluated the financial performance of the PPL, Solomon Islands Electricity Authority and Tonga Power Limited using financial indicators. In addition, they contemplated problems in business operation suggested by the financial indicators. During the fourth mission, we conducted a total of nine lecture and exercise sessions in seven days. The subject of these lessons was financial analysis for a project. As the online training after the fourth mission, we conducted a total of seven lecture and exercise sessions in five days in March, eight sessions in five days in April, and ten sessions in five days in May.	
			Actual																	
1.6	The training manual for system planning, system simulation, and financial and economic analysis is formulated considering systematic human resource development and the manuals is officially approved by PPL.	Develop the PPL Official Training Manual for system planning, system simulation, and financial and economic analysis through considering systematic human resource development.	Plan																WG1-1 continued to prepare a draft training manual and conducted training using the prepared draft training manual. WG1-1 will continue to prepare the draft training manual and coordinate with C/P based on the prepared draft training manual so that it will become a training manual for PPL. For WG1-2 , we prepared and distributed to the members textbooks (pdf files) on matters including financial statements, financial statement analysis, financial analysis for a project, and use of the Excel functions for financial analysis. In addition, we prepared and distributed six kinds of exercise books (pdf files) and answer sheets (Excel files). WG1-2	
			Actual																	
1.7	Based on the training manual, the training for the rest of engineers is implemented by trainers.	Support trainers to conduct the training for the engineers based on the training manual.	Plan																	
			Actual																	
1.8	The operational manual and Standard Operating Procedure (SOP) for system planning, system simulation, financial and economic analysis are formulated, and the manual and SOP are officially approved by PPL.	Develop the PPL Official Operational Manual and Standard Operating Procedure (SOP) for system planning, system simulation, financial and economic analysis.	Plan																For WG1-1, interviews were conducted with PPL staff members other than WG members, and preparation of an operational manual was also started. We will discuss with the WG members based on the draft operational manual prepared by the survey team, and make adjustments so that it will become an operational manual within PPL. For WG1-2 , we have begun to compile a draft training manual based on the outcomes of the lectures and exercises up to now.	
			Actual																	
1.9	Based on the operational manual and SOP, PPL verifies the Least Cost Development Plan.	Assess the Least Cost Development Plan based on the operational manual and SOP.	Plan																	
			Actual																	

2.1	The current capacity and technical, structural, and planning challenges of maintenance for transmission line and substations are assessed. Measures for these challenges are proposed	Assess the current capacity and technical, structural, and planning challenges of maintenance for transmission line and substations are assessed and propose measures for these challenges.	Plan	[WG2-1] The capacity assessment was conducted through a baseline survey, and a survey of the current situation of C/P was carried out through WG activities. The WG activities were carried out about the points of "people, organization, and equipment". Lack of maintenance workers, tools and materials. In addition, there is a large discrepancy between planned and actual inspection operations. The development of various rules and manuals for the formulation of sustainable preventive maintenance plans that consider resources and establishment of asset management systems are founded issues that need to improve in the future. In order to resolve the issue confirmed through the survey in 1st year, we have been carried out local and online training and provided PPL WG member with basic knowledge of inspection work. Furthermore, we have proposed the form of inspection / patrol planning and checklists to introduce PPL's work. [WG2-2] During the fourth trip and online training, discussions with WG members continued to grasp the current situation. Since the inspection plan prepared by PPL is uniform and the basis of intervals is not clear, the planning method considering the actual condition of facilities and characteristics of each equipment type was arranged and proposed.
			Actual	
2.2	2 WGs for maintenance for (1) transmission line and (2) substations are formulated.	Formulate 2 WGs for maintenance for (1) transmission line and (2) substations.	Plan	WG2-1 and 2-2 don't change initial members, and have been progressing WG activities.
			Actual	
2.3	Training for trainer candidates on planning of preventive maintenance and asset management is implemented.	Conduct training for trainer candidates on planning of preventive maintenance and asset management.	Plan	WG2-1 Before the third visit, the on-line training was carried out once regarding preventive maintenance works. In addition, the contents of last lecture were reviewed and basic design concepts of transmission facilities are lectured newly during the third visit. The difficulties of online meeting As C/P makes few remarks and it is difficult to check the level of understanding for each C/P, it is necessary to follow up on the contents of the training when visiting in PPL. In addition, as each C/P is busy with his/her works and there are many unexpected works, it takes time and changes to arrange the meeting date and time. WG2-2 (Ongoing) As an aid to the development of PPL's asset management system in the fourth trip, the composition of the asset management system in the Kansai T&D (diagram showing the linkage of each equipment) was explained. In addition to communicating the preventive maintenance system of the Kansai T&D in the online WG, we explained the monitoring and control system of the company, explains the relationship between the development of preventive maintenance plans and the monitoring and control system, and especially proposes and discusses the improvement of the monitoring and control system of PPL. We explained the problems in the actual condition of PPL facilities based on photographs of each department, explained the importance of maintenance and points to be aware of, and also tried to raise the level of awareness regarding the attitude toward asset management.
			Actual	
2.4	Training for trainer candidates on the implementation of preventive maintenance and asset management is implemented.	Conduct training for trainer candidates on the implementation of preventive maintenance and asset management.	Plan	WG2-1 WG2-1 shared the progress of annual inspection plan that have been started since last year and the contents of checklist as a result of inspections, and grasped the current problems while introducing our company's cases. Furthermore, we proposed checklist for inspection work and malfunction criteria for each transmission facilities. We will upgrade them reflecting on WG member's opinion about how to operate. In addition, unexpected future risks were pointed out from the perspective of equipment maintenance and design as well as recovery methods for equipment abnormalities, and training has been started to improve a sensitivity for preventive maintenance works. (E.g. The basic loading mechanism on the steel tower) WG2-2 (Ongoing) On the fourth trip, we explained the inspection work flow, how to deal with transformer and circuit breaker failure, checkpoints during daily inspection and completion inspection, and how to diagnose battery deterioration. In addition, lectures were given at the online WG on how to manage the leakage current of the arrester and how to use the direct-current grounded probe, and preparations were made to improve the technical capabilities and to facilitate training after the provision of equipment for testing.
			Actual	
2.5	The training manual for maintenance for transmission line and substations is formulated considering systematic human resource development and the manuals is officially approved by PPL.	Develop the PPL Official Training Manuals for maintenance for transmission line and substations considering systematic human resource development.	Plan	WG2-1 The lectures on the basics of transmission line maintenance have been given to C/P, and further materials have been prepared for the next. Through future lectures, training materials and manuals will be established systematically grasping the level of understanding for each C/P and their requests. WG2-2 (Ongoing) In online WG, we explained the system of manuals in the Kansai T&D and how to proceed with manual preparation in this project. We organized and explained the manual system and contents in accordance with the actual situation of PPL, and gave them an understanding of how to create manuals in the future.
			Actual	
2.6	Based on the training manual, the training for the engineers is conducted by the trainers.	Support the trainers to conduct the training for the engineers based on the training manual.	Plan	
			Actual	
2.7	The operational manual and Standard Operating Procedure (SOP) for transmission line and substations are formulated.	Develop the PPL Official Operational Manual and Standard Operating Procedure (SOP) for transmission line and substations.	Plan	A survey was conducted on the regulations held by PPL in preparation for the creation of operational manuals and SOP. Next step, we plan to coordinate with the C/P and decide on the operational manuals and SOP to be created in this project. WG2-2 (Ongoing) Same as 2-5.
			Actual	
2.8	Based on the operational manual and SOP, PPL implements the maintenance of transmission line and substation, and the manuals and SOP are officially approved by PPL.	Support PPL to implement the maintenance of transmission line and substation based on the approved PPL Official Operational Manual and SOP.	Plan	
			Actual	

Output 3:							
3.1	The current capacity and technical, structural, and planning challenges of protection coordination is assessed.The measures for these challenges are proposed.	Assess the current capacity and technical, structural, and planning challenges of protection coordination and propose the measures for these challenges.	Plan Actual			The results of the baseline survey were explained at the JCC.	
3.2	WG for protection coordination is formulated.	Formulate WG for protection coordination.	Plan Actual			Completed; no personnel changes in WG3.	
3.3	Training to improve capacity of protection coordination setting is implemented for candidate trainers.	Conduct training to improve capacity of protection coordination setting for candidate trainers.	Plan Actual			Four training sessions have already been conducted as the first-year online training. Training will continue to be conducted.	
3.4	The training manual for protection coordination is formulated considering systematic human resource development and the manuals is officially approved by PPL.	Develop the PPL Official Training Manual for protection coordination considering systematic human resource development.	Plan Actual			Training manuals are being prepared as needed for required training items. The "Protection Relay Overview" and "Distance Relay Setting" manuals have been prepared and online training sessions have been conducted.	
3.5	Based on the training manual, the training for the rest of engineers is implemented by candidate trainers.	Support trainers candidate to conduct the training for the rest of engineers based on the PPL Official Training Manual.	Plan Actual				PPL has only two protection relay engineers as C/P and no one is eligible for training at the moment. Solution: The two new employees to be hired will be targeted for training.
3.6	The operational manual and Standard operating Procedure (SOP) for protection coordination are formulated.	Develop the PPL Official Operational Manual and Standard Operating Procedure (SOP) for protection coordination.	Plan Actual			The workflow was confirmed, and three draft SOPs were prepared. The C/P is currently examining the contents of the SOPs.	
3.7	Based on the operational manual and SOP, PPL modifies the setting for the protection coordination, and the manuals and SOP is officially approved by PPL.	Support PPL to modify the setting for the protection coordination based on the operational manual and SOP.	Plan Actual				
Output 4:							
4.1	The current system for human resource development is assessed and workable system is proposed.	Assess the current system for human resource development.	Plan Actual			The results of the baseline survey were explained at the 2nd JCC.	
4.2	Sustainable system for human resource development is established.	Develop the PPL Official system of human resource development.	Plan Actual			We prepared a draft (table of contents) of human resource development manual for engineers, incorporating the needs of C/Ps.	
Duration / Phasing			Plan Actual				

Monitoring Plan	Year	1st Year				2nd Year				3rd Year				4th Year	Remarks	Issue	Solution
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I			
Monitoring																	
Joint Coordinating Committee	Plan																
	Actual																
Set-up the Detailed Plan of Operation	Plan																
	Actual																
Submission of Monitoring Sheet	Plan																
	Actual																
Monitoring Mission from Japan	Plan																
	Actual																
Post Monitoring	Plan														**Three years after project completion**		
	Actual																
Reports/Documents																	
Inception Report	Plan															2022.5 Work plan submitted	
	Actual																
Progress Report	Plan																
	Actual																
Project Completion Report	Plan																
	Actual																
Public Relations																	
	Plan																
	Actual																
	Plan																
	Actual																

Mar 2nd, 2023

The Project for the Improvement of Planning and Operation of Power System

4th Mission Report

Kansai Transmission and Distribution, Inc.
NEWJEC Inc.
SeED Okinawa LLC

1. Purpose of this dispatch

① Holding the 2nd JCC
② Conducting a training and preparing manuals
③ Explanation of this project to New Project Manager

2. Activity of 4th mission

① Holding the 2nd JCC

The second JCC was held on February 23 at Gateway Hotel, and the approvals of the revised PDM and the 2nd /3rd year's activities were made.
See Attachment 1 for details.

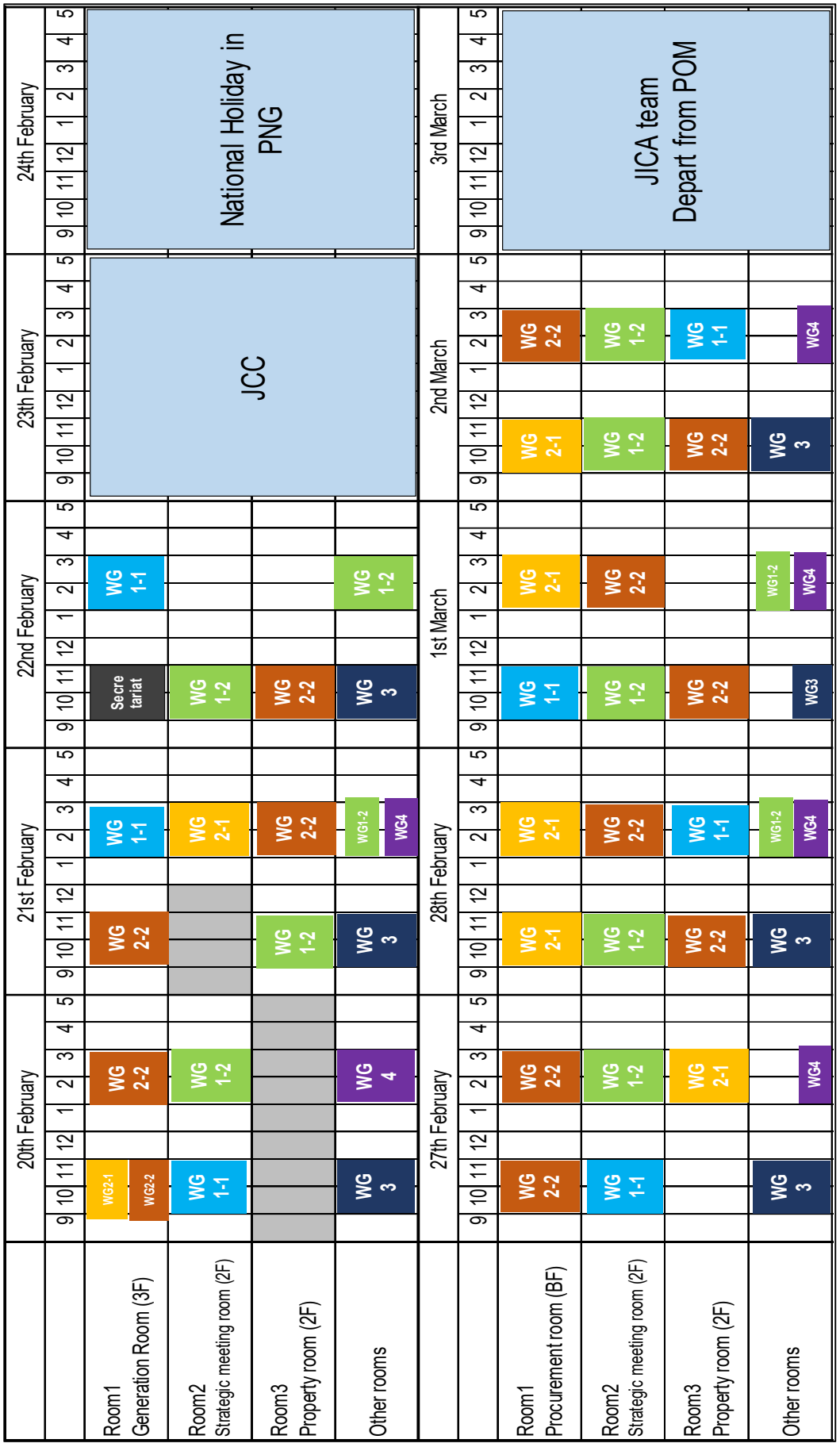
② Conducting a training and preparing manuals

As a 2nd year activity, each WGs started training and preparing manuals. (Details on later pages.)

③ Explanation of this project to New Project Manager

We explained this project outline and this dispatch purpose to Mr. Kevin(New Project Manager) and Mr. Mairawesi.

WG schedule


20th February
21st February
22nd February
23th February
24th February
27th February
28th February
1st March
2nd March
3rd March
9 10 11 12 1 2 3 4 5
Room1 Generation Room (3F)
Room2 Strategic meeting room (2F)
Room3 Property room (2F)
Other rooms
WG2-1
WG2-2
WG 1-1
WG 2-2
WG 2-1
WG 1-2
WG 3
WG 4
WG1-2
WG4
Secretariat
JCC
National Holiday in PNG
JICA team Depart from POM
Room1 Procurement room (BF)
Room2 Strategic meeting room (2F)
Room3 Property room (2F)
Other rooms

3. Activity of each WGs

WG1-1

WG1-1 conducted the following three main activities during this trip.

1. Preparation with WG members for the 2nd JCC

The WG reviewed the results to date and future plans for the development of training and manuals, which are the main goals of the WG. In addition, the contents of the JCC report, which summarizes the status of activities, and the changes to the PDM were mutually confirmed.

2. Income and Expenses of PPL

We checked with Kero Tom Senior Manager of Strategic Business Development about PPL's revenue and expenditure situation.

Currently, PPL's electricity tariffs continue to be kept low by PNG government policy, which does not give PPL the flexibility to design its electricity rates. As a result, PPL's current revenues from electricity tariffs are less than the expenditures required to operate the utility, and losses are incurred from time to time as PPL supplies electricity to meet demand. This ongoing incurrence of losses will likely not be eliminated until the government approves electricity rates that ensure a reasonable profit for PPL. In addition, even inappropriately low electricity rates often result in nonpayment by customers, which is problematic as a non-technical loss. In particular, delays in payment by government organizations, which are large customers, have become problematic.

Because of this balance-of-payments structure, PPL is unable to pay IPPs the majority of the compensation based on the amount of electricity purchased, due to the ongoing deterioration of PPL's financial situation. Despite the delay in PPL's payment, IPP is cooperative with PPL at this time. However, if this situation, where payments to IPP, which is the main supply source in PNG, are not smooth, continues, there is a concern that this will cause problems in securing supply in the long run.

3. Status of POM system

At the time of the previous trip, a planned power outage was being implemented in the POM system, so we checked with a member of the National System Operations (NSO) to confirm the current situation.

As for the active power P, a turbine generator has been installed temporarily to secure the shortfall in supply against demand. The installed turbine generator can be fueled by gas or diesel oil, and currently generates electricity using diesel oil as fuel. The ROUNA hydroelectric power plant is located in the eastern part of the POM system, but its output was limited due to the accumulation of debris in the dam of Unit 1. Since the ROUNA power stations group has a structure that utilizes water flow in a cascading manner, the output of all generators other than Unit 1 were limited as well.

On the other hand, with regard to reactive power Q, the broken STATCOMs installed at substations in POM grid had not been repaired, and the source of leading-phase reactive power was still insufficient. PPL has been negotiating with the Chinese company that manufactured the STATCOMs to repair them through an Australian distributor, but this has not yet been accomplished. Therefore, PPL asked IPPs to adjust the operating power factor of the generators and obtained their cooperation. As a result, the problem is being addressed on an emergency basis at this time, but the fundamental solution is needed to either repair the STATCOMs at the substations or install capacitors that are simpler in structure than STATCOMs and less prone to failure.

As a result of the above measures, the situation on the POM system is improving, but the planned outages have not been completely resolved. To solve the long-term problem, it is desirable to establish an organizational structure that can formulate a grid plan that reflects the formation of facilities that can secure the necessary active and reactive power, and that can execute the plan.

4. Training

After receiving an application for grid interconnection from IPP, PPL needs to analyze the impact on the grid using simulation software. Based on the simulation results, PPL will determine the necessary facility measures. Although simulation software can automatically calculate stability by

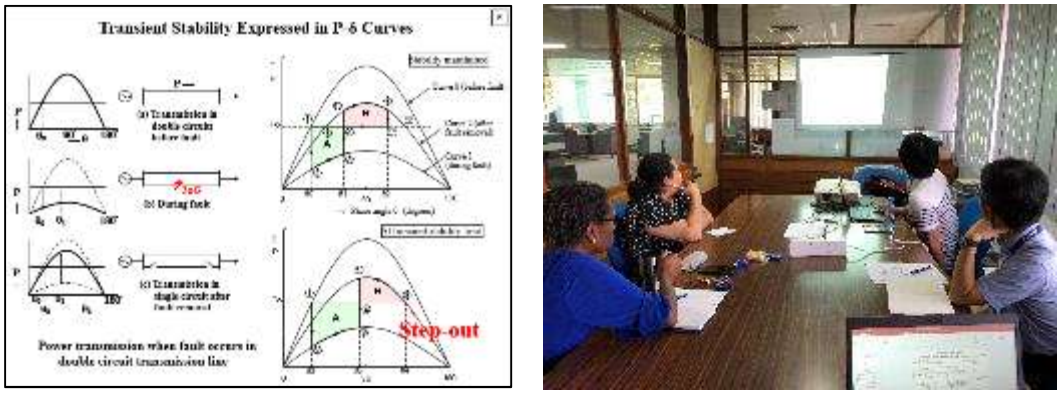


Figure: Excerpts from lecture materials (left) and lecture scene (right)

providing various constants of the grid and generator as conditions, it is important for engineers to understand the electrical theoretical principles and characteristics behind the software. Therefore, the lecture discussed the electrical theory of steady-state stability, transient stability, etc., and the behavior of the system during an accident, citing examples of accidents in Japan. In order to enhance understanding, the lectures were divided into several sessions and were conducted gradually, allowing sufficient time for questions and answers.

5. Gathering information for manual preparation

We asked Kero Tom, Senior Manager of Strategic Business Development, about the actual business conditions related to power plant grid-connection applications from IPPs.

There were two major patterns: publicly solicited and unsolicited. In the case of the publicly solicited type, a brief review is conducted before the application for grid interconnection from IPPs, but the basic workflow was the same for both types. In principle, the workflow was completed within the Strategic Business Development department, including technical review. However, since Strategic Business Development doesn't have enough personnel capable of conducting high-level technical studies, the department sought assistance from outside consultants such as SMEC, and National System Operations (NSO) for technical studies. In addition, Testing and Commissioning requires the participation of National System Operations (NSO), which is in charge of facility operations.

We reconfirmed that this workflow and division of responsibilities are not defined in PPL's internal documents. Therefore, in this WG activity, we interviewed PPL's internal workflow regarding grid interconnection and further collected related documents.

6. WG1-1 Activities in the 4th mission

The performance of WG1-1 activities during this mission is as follows;

Date & time	Room	Contents	Attendees
2023/02/20 10:00-12:00 (PNG time)	Strategic Meeting Room, PPL 2F	- Explanation of overview of 2nd JCC - Review of past activities	Benedicta Savage Charlie Enos Haidi Wanya
2023/02/22 14:00-16:00 (PNG time)	Generation Room, PPL 3F	- Confirmation of recent status of PPL - Confirmation of workflow of IPP interconnection application	Benedicta Savage Charlie Enos Haidi Wanya
2023/02/27 10:00-12:00 (PNG time)	Strategic Meeting Room, PPL 2F	- Interview with Mr. Kero Tom of Strategy Business regarding IPP interconnection and confirmation of investment status - Training for WG members on system analysis	Kero Tom Benedicta Savage Charlie Enos Haidi Wanya
2023/02/28 15:00-16:30 (PNG time)	Property Room, PPL 2F	- Training for WG members on system analysis - Preparing for manuals for IPP applications	Benedicta Savage Haidi Wanya
2023/03/01 13:00-14:00 (PNG time)	Property Room, PPL 2F	- Training for WG members on system analysis - Preparing for manuals for IPP applications	Benedicta Savage Charlie Enos Haidi Wanya
2023/03/02 14:00-16:00 (PNG time)	Property Room, PPL 2F	- Training for WG members on system analysis - Preparing for manuals for IPP applications	Benedicta Savage Charlie Enos Haidi Wanya

WG1-2

1. Overview

- The objective of the mission is to conduct face-to-face training following the 3rd mission.
- Throughout the 3rd mission and the Zoom-webinars in November 2022 – January 2023, the WG members acquired basic skills needed to read financial statements and analyze financial statements.
- This time, we proceeded to the next stage, i.e., financial analysis for a project.
- Of the five WG members, Kalama Keith was absent due to his long leave, but the remaining four members (David Jonah David, Beda Kuglame, Cathy Kutkue, Vera Lama) joined the training.
- However, because it was difficult for all of the four members to get together at once, I held

additional classes for the members who could not join the regular class, so that none of them would drop out.

- Specifically, I held a total of 12 classes for the five training sessions, and all trainers participated in the sessions

2. Understanding of basic theory of financial analysis for a project
   - Unlike financial statement analysis, "the time value of money" is taken into account.
   - For this reason, using the concept of discount rate, cashflows in the future are discounted, and all cashflows generated during the project life are converted to today's value.
   - Since this concept is not applied to financial statement analysis, it was the first time for all members to learn the theory of the discounting of future money by elapsed time.
   - Therefore, although they could understand the logic, all of them made mistakes in actual calculation at first.

3. Purposes of the lectures and exercises
   - To understand the concepts and calculation methods of present value (PV), net present value (NPV), and internal rate of return (IRR) that are necessary for financial analysis for a project.
   - To calculate a stream of cashflows by using several simple investment models.

4. Next steps
   - The members need to repeatedly perform exercise in order to deepen their understandings. After the mission, we will continue the training using Zoom to strengthen their capacity.

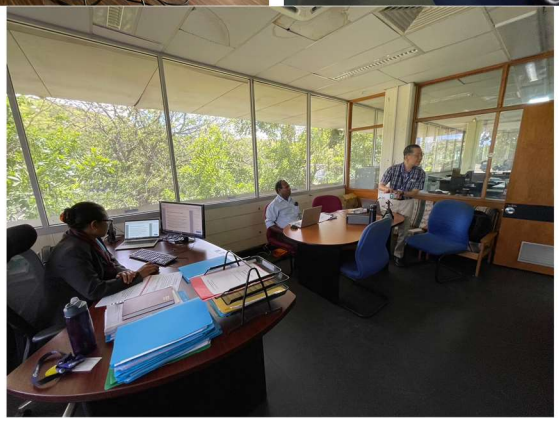


Photo. WG1-2 Classes on February 20 – March 1, 2023

WG2-1

The performance of WG2-1 activities during this visit in PNG is as follows;

Date	Theme	Attendee
Feb. 20th	Share of JCC report	Chris, Ben, Deanne, Esorom
Feb. 21st	Discussion of maintenance work role	Chris, Ben, Deanne, Esorom
Feb. 22nd	Site survey (Inspection work)	Ben
Feb. 23rd	JCC	Chris, Ben, Deanne, Esorom
Feb. 27th	Training of inspection work	Ben, Deanne, Esorom
Feb. 28th	Training of basic design concept	Chris, Ben, Deanne, Esorom
Mar. 1st	Discussion of patrol planning	Chris, Deanne, Esorom
Mar. 2rd	Wrap up	Chris, Ben, Deanne, Esorom

WG2-1 mainly carried out the following activities.

1) Continuous training

The following trainings are carried out through this visit.

(1) Basic design concept of transmission facilities

This training has been carried out several times so far though online. During this visit, the review of previous trainings and exercise problems were carried out to check each understanding of technical knowledge. Consequently, it was confirmed that some contents are difficult for WG members to understand exactly and JICA expert taught it to them again to enhance their understanding.

(2) Effective patrol / inspection method

This theme was trained to WG members in last online and done again adding some contents. It includes a criteria for judging malfunction, a patrol / inspection method and a checklist for each transmission facility, which will be prepared as SOP documents in this project. Therefore, JICA expert showed WG members a draft version of these documents prepared prior to this visit and training and exchanging information was carried out for realization of effective patrol and inspection in the future.

2) Collect further information and exchange opinions for manuals

The draft version of partial SOP documents has been prepared in accordance with data and information obtained during previous visits. It was shown to WG member and collecting further information and exchanging opinions were carried out. The main results are as follows;

< Work flow of maintenance work for transmission facilities >

In PPL, 3 teams are in charge of maintenance work for transmission facilities. Maintenance team belongs to maintenance center such as Boroko in POM. Planning team and Reliability team belong to asset management unit in headquarters. This flow shows that these 3 teams manage maintenance work effectively associating together, utilizing criteria for judging malfunction. WG members understood the concept of work flow and agreed to aim to complete it based on the contents of other manuals which will be prepared as well and further exchanging opinion.

< Criteria for judging malfunction >

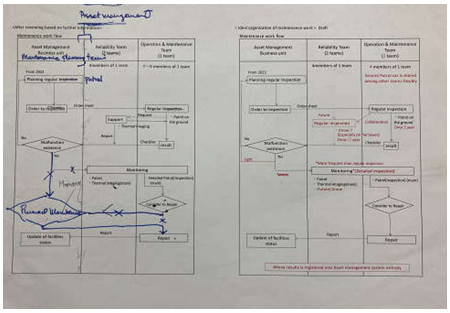
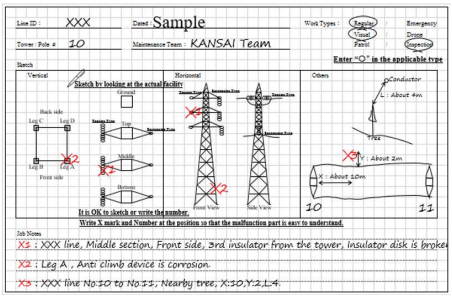
WG members understood the concept of criteria for judging malfunction level that consists of 3 categorization, and agreed to aim to complete it adding further malfunction case. JICA expert requested WG members to provide photos of malfunction detected in previous patrol / inspection work in PPL and that was agreed.

< Checklist for patrol / inspection work >
Comparing checklist that PPL has operated with revised version that is prepared by JICA expert, WG member agreed to revise latter one to be more simple and clearer. Furthermore, additional check sheet was proposed to record detailed malfunction condition clearly such as location of malfunction and cutting trees under the transmission lines, and it was agreed.

< Patrol / inspection plan >
JICA expert calculated required total days to carry out patrol / inspection for entire transmission facilities prior to this visit. Based on this result, the realistic interval of patrol / inspection was shown for entire transmission facilities and whether it is proper was discussed with WG members.

After this visit in PNG, training will be continued through online, and manuals will be prepared exchanging opinion with WG member regularly.


WG activities

Scenery of training and discussion, draft version of SOP

WG2-2

1. Summary of WG2-2

1). Attendance rate fluctuated between 60% and 80% due to accident response and difficulty in obtaining airline tickets.
2). Because we are increasing lecture content that is more in line with current practice, including question-and-answer sessions, rather than simply imparting knowledge using materials prepared in advance, it will be difficult to catch up later if the attendance rate drops.
3). I proceeded with activities while being conscious of cultivating a mindset to quickly apply the knowledge I gained in this project to my work.
4). At the beginning of each lecture, questions were asked in relation to past lecture materials, and the lecture proceeded while confirming the degree of understanding and making the students aware of the continuity and relevance of knowledge and practice.
5). There were many points in the originally envisioned curriculum that did not match the reality of PPL. In addition, the curriculum was formulated with consideration given to the restrictions on the test equipment that can be provided. This change is also reflected in the action plan

approved at this JCC.

1. Activity and participants

No.	Month/Day		Content	講師	Participants
1	2/20	AM	JCC briefing and Q&A	Katsuki, Okazaki, Miyashita	Brian Inamo, Simon Robert, Rawali Rawali
2	2/20	PM	Explanation of inspection work flow	Miyashita, Okazaki	
3	2/21	AM	Explanation of equipment provision. Basic knowledge test	Katsuki, Okazaki, Miyashita	
4	2/21	PM	Inspection work flow explanation, discussion. Explanation of fault point investigation method	Miyashita	
5	2/22	AM	Explanation of fault point investigation method	Miyashita	
6	2/22	PM	On-site survey of candidate locations for practical training.	Katsuki, Okazaki, Miyashita	Simon Robert
7	2/23	AM	JCC at Gateway hotel	Miyashita	Brian Inamo, Simon Robert, Rawali Rawali
8	2/27	AM	Technical Specification Overall design matter	Miyashita	Simon Robert, Tery Neipu, Rawali Rawali
9	2/27	PM	Relationship between transformer lifespan and operating temperature	Miyashita	
10	2/28	AM	Check points of Normal patrol and pre-commissioning	Miyashita	Simon Deveo, Simon Robert, Tery Neipu, Rawali Rawali
11	2/28	PM	Testing equipment and consumable materials	Katsuki, Okazaki	
12	3/1	AM	Investigation items and points to note when circuit breaker does not operate, even protection relay was operated	Miyashita	Brian Inamo, Simon Deveo, Simon Robert, Tery Neipu, Rawali Rawali
13	3/1	PM-1	Deterioration of Storage Battery and Lightning Arrestor and Diagnosis Method	Katsuki, Okazaki, Miyashita	Brian Inamo, Simon Deveo, Simon Robert, Tery Neipu, Rawali Rawali
14	3/1	PM-2	Investigation items for OLTC failure	Miyashita	

2. Check understanding
   1). The results of the comprehension check carried out in each lecture were generally good. A further state of mind becomes important.
3. On-site confirmation
   1). We surveyed places suitable for training using actual equipment, such as regular inspections scheduled in the future, usage of repair materials, survey of fault point, patrol inspection methods, and so on. We decided that the BOROKO substation and the CONEDOBU substation would be suitable, considering the availability of spare equipment used for training and the space available.
4. Lecture content
   While repeating questions and answers, WG activities were carried out with a wide range of contents while being conscious of important matters for PPL and care for current problems.

1). Explanation of periodic inspection flow
① Conducted for Circuit Breaker.
②He explained the importance of preliminary meetings and safety measures.
③As for the reality of PPL, it is almost impossible to carry out regular inspections due to the fragility of facility redundancy and the lack of equipment such as vacuum pumps. In the future, we will proceed on the inspection of oil circuit breakers only.

2). Accident point investigation method
①Explained typical examples of methods for estimating actual fault points from operating relays and Trip CBs.
② Training was conducted to simulate what kind of failure would occur based on the relationship between the temperature and oil level of the transformer and the relationship between the main body and the oil level in the OLTC room.
③We also explained peculiar Trip cases, including faulty protection relays.

3). We explained the items that should be specified when purchasing equipment using actual ordering specifications and Technical Particulars, and explained how they should be related to future database creation.

4). I explained the relationship between the rating items related to the withstand voltage of the equipment and the operating voltage of the lightning arrester.

5). We explained the relationship between temperature and life of transformers. Using actual figures and graphs, he explained how severe overload operation is in relation to the life of transformers. However, it was also explained that the number of years of service life obtained by this calculation does not immediately lead to an accident, and that various factors are related.

6). Explained the check items during patrol inspection and pre-commissioning.
①In terms of patrol inspections, we explained not only the condition of facilities but also small changes related to security so as not to overlook them. (Prevention of facility damage and personal injury due to third party intrusion)
② Explained relatively easy check items that should be carried out during pre-commissioning, including the structural characteristics of equipment.

7). Explained the failure detection method when the Circuit Breaker does not trip at the time of a system accident. In PPL, there are substations with a DC control voltage of 48V, and since the substation is not considered as a total system, there is a tendency to focus only on the main parts of the main equipment, so such problems actually occur. In fact, there have been cases where it occurred and led to large-scale power outages. Therefore, it is a very important theme.

5. Miscellaneous

Opinions were heard during daily conversations about how to proceed with future WGs and themes. In order to make the training in Japan planned for this year meaningful, we conducted awareness raising for the training in Japan.

Equipment Testing/Evaluation

1 . Activity overview

The 4th trip activity contents of WG2 Equipment Testing/Evaluation are shown in Table 1.

Table. 1 The 4th trip activity contents of WG2 Equipment Testing/Evaluation

Date	Activity contents
20th Feb	・ Explanation of JCC documents and 2nd/3rd year activities to WG members. ・ Meeting of measuring instruments and consumable items procurement with JICA .

21st Feb	・ Meeting for on-site training places in 5th trip. ・ Review test of online WG.
22nd Feb	・ Discussion about DB system development in WG2 ・ Field survey of possible on-site training sites.
23rd Feb	・ The 2nd JCC
27th Feb	・ Meeting for the procurement with potential purchasers.
28th Feb	・ Discussion about provision items with WG2-2 members
1st Mar	・ Principles, use, and judgment criteria of battery tester
2nd Mar	・ Meeting of the procurement with Mr. Simo

２． Activity report

① Coordination and investigation of equipment procurement

In the Equipment Testing/Evaluation area, we plan to provide equipment and materials to improve the maintenance ability of PPL in the project. The equipment to be provided are currently under discussion with JICA and PPL, but the current plan is shown in Table 2.

We discussed the equipment to be provided (draft) with PPL in the 4th trip. As a result, we have obtained needs for oil voltage testers and drones from the WG members, and we will continue considering them based on their opinions.

In addition, we held meeting with JICA and potential purchasers to coordinate procurement practice tasks. Specifically, we confirmed the transportation and duty-free procedures for procurement, temporary storage after arrival in PNG, and the inspection process.

Table. 2 Currently planned equipment to be provided (draft)

Categories	Equipment to be provided	Maintenance office to be supplied
Tools for transmission maintenance	・ Hydraulic compressor ・ Winch ・ Pulley, One Wheel Snatch ・ Cremona rope	Pom、Lae
	・ Come-along ・ Ladder with hook	Pom、Lae、Hagen
Measuring Instrument for maintenance	・ Battery tester ・ Gas leak detector	Pom 、 Lae 、 Hagen 、 Kokopo
	・ Leakage current measure ・ Oil acid value measure ・ DC ground fault detector ・ Laser Rangefinder	Pom

Materials for substation maintenance (just for education)	・Gasket ・Packing ・Caulking ・Putty ・Grease ・Cold galvanizing paint	—

② Field survey for on-site training in the 5th trip

Education using the above equipment is planned to be conducted during the next 5th trip. Therefore, we visited the Konedodu and Boroko substations, which were candidates for the on-site training sites. (Figures 1 and 2)

Figure.1 Line arrestor for the leakage current measurement training (Boroko substation)

Figure 2 Batteries for the battery tester training (Boroko substation)

As for measuring instruments, we confirmed that on-site training on DC ground fault detector and leakage current measure was available at Boroko substation. On the other hand, since the actual education will be coordinated with the maintenance training of WG2-2, the content of on-site training will be discussed in cooperation with WG2-2.

③ Training

Training in the fourth trip included a discussion on the development of the DB system conducted jointly by WG2, and review test of monitoring system and preventive maintenance trained in the online WG, as well as a lecture on the principles, use, and criteria of the battery tester (Figure 3). Training using the equipment to be provided will take place during the 5th trip, but in the meantime, lectures on preventive maintenance and measuring instruments will be provided through the online WG and training in Japan.

Figure 3 Image of training situation

WG3

1. Activity Results

- Term: 17/2/2023 – 2/3/2023
- Place: PPL National System Operation meeting
- Participants: Mr. Melvin Angi、Mr. Michael Akep
- Activity Results

Since no clear SOP currently exists, the following SOPs were developed based on discussion.

1. Protection Relay Setting
2. Fault Analysis
3. Impedance Study

※In the drafting process, Mr. Melvin and Mr. Michael took the lead in reviewing the work procedures.

※The workflow of grid interconnection is consistent with the relay setting process, so it is considered unnecessary to create SOP.

2. Projects of other donors

- 【WB】WB will fund the purchase of 2 protection control panels for the 66 kV Line protection for Bomana Substation in POM.
- 【USAID】USAID is collecting data to build a base model of POM system using Power Factory software. This project is coordinated by PPL Strategic Planning team. After completion the base model can be used to do protection grading and coordination study.

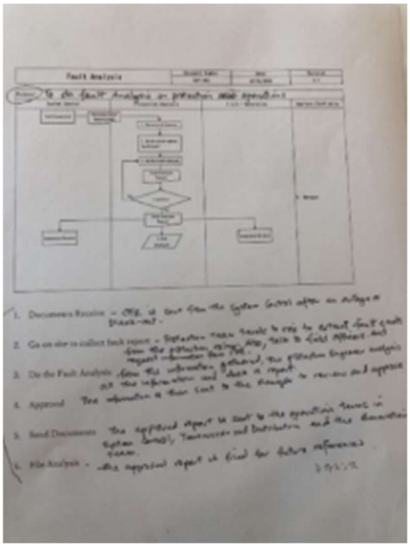
3. Next Step

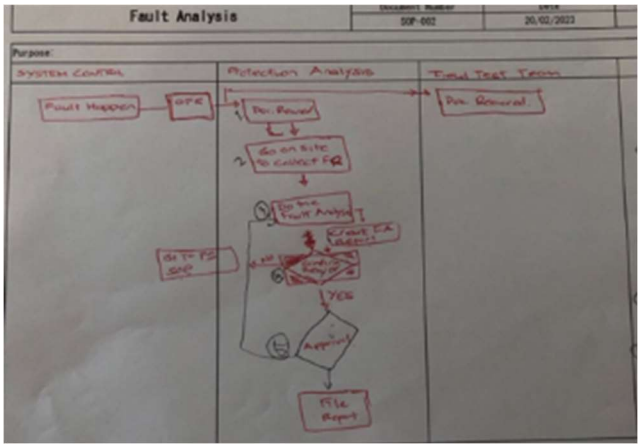
The following online training will be conducted to improve the level of the practical part of the SOPs so that the created SOPs can be effectively utilized.

- Impedance Calculation
- CT saturation study
- Differential relay setting
- Protection coordination of distance relays

* Creation of an Operation Manual will be addressed after the training is conducted.

Activity

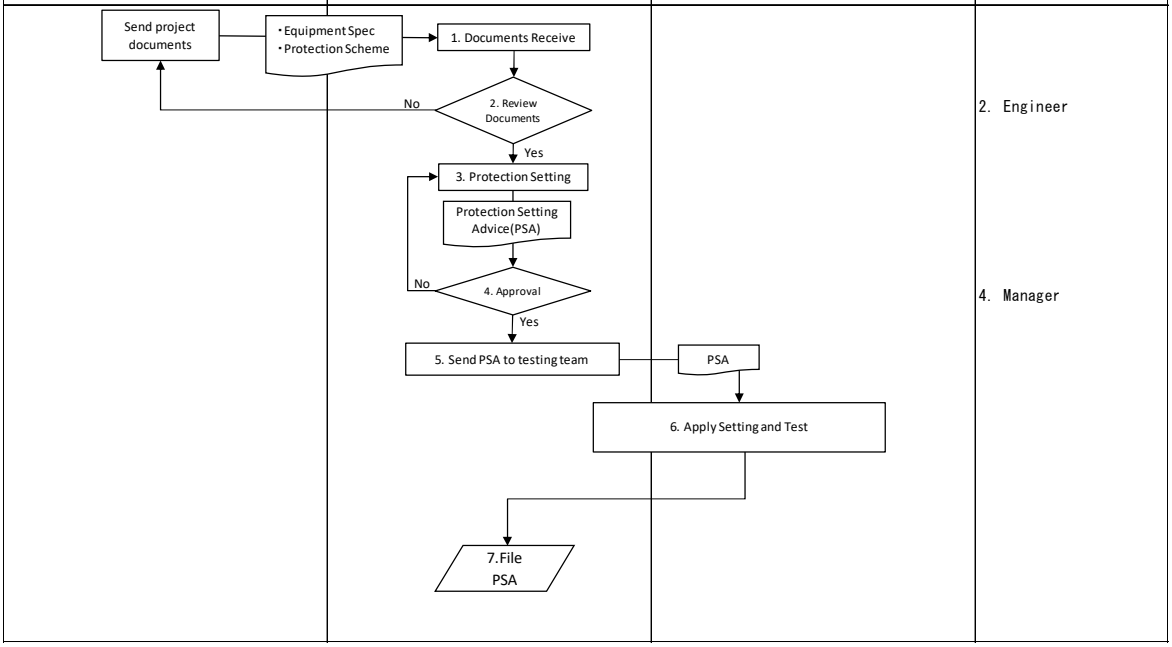




Draft version

Protection Setting For New Project	Document Number	Date	Revision
	SOP-001	2/3/2023	0.4

Purpose: Protection setting for new projects including new grid connection of IPPs



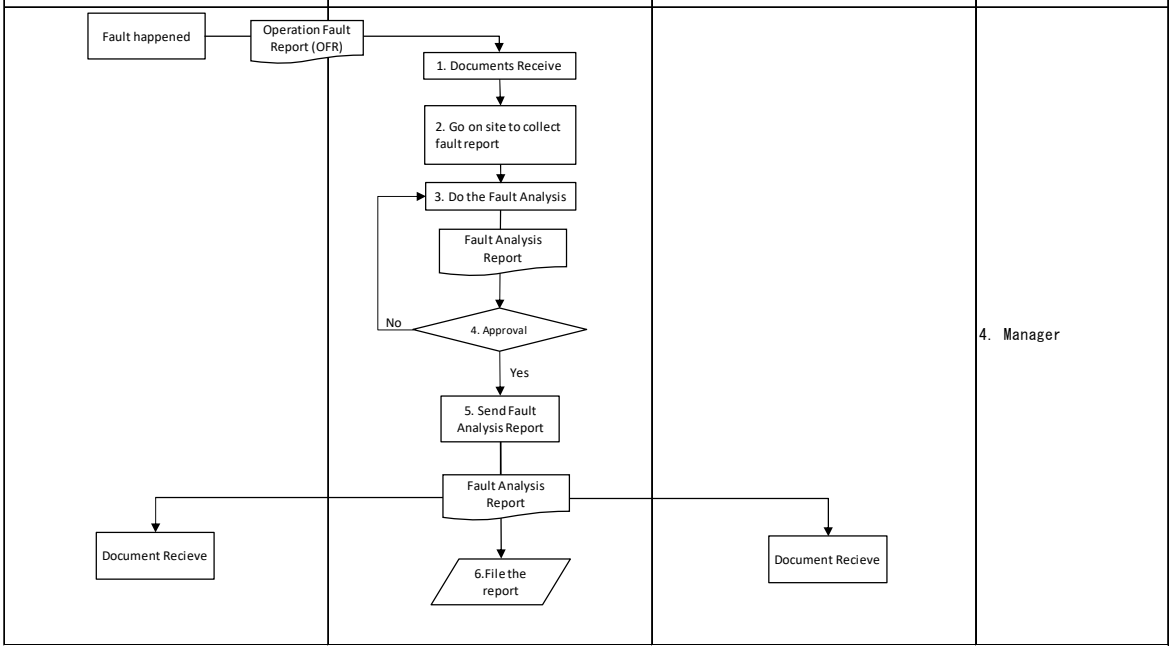
Protection Setting For New Project	Document Number	Date	Revision
	SOP-001	2/3/2023	0.4

Process	Work procedures (work flow/verification/pass/fail criteria)	Special note (reference documents/records/others)
1. Documents Receive	documents are received from project team during meeting.	
2. Check Documents	Confirm protection relay specification to meet requirement standards. After review comment send back to project team. ・CT - Australian Standard(1675-1986) ・VT - Secondary Supply 110V ・CB - Fault Level ・DC - 110V/48V ・Protection relay - Spec sheets, Operation manual ・Protection Schemes - Operation manual ・Equipment rating - Grid Code	Australian Standard(1675-1986) IEC standard IEEE standard GRID CODE Operation Manual
3. Relay Setting	Once the settings is confirmed, we create PSA documents. Calculation and setting is done based on operation manual.	
4. Approval	Send PSA for Manager's Approval. If the Manager doesn't agree, then go back to step 3.	
5. Send PSA to Field Test Team	Send PSA to Field Test Team to apply settings.	
6. Setting and Test	After setting is applied the Field Test Engineer test the equipment with the applied setting. During that time protection engineer is also present to witness the test.Protection Engineer and Field Test Engineer sign of the PSA once everything is confirmed satisfactory.	
7.File PSA	Protection Team will file the PSA. No protection setting will be amended without Protection Engineers approval.	

SOP: Protection Relay Setting

Fault Analysis	Document Number	Date	Revision
	SOP-002	22/02/2023	0.2

Purpose: To do fault analysis on protection operations.



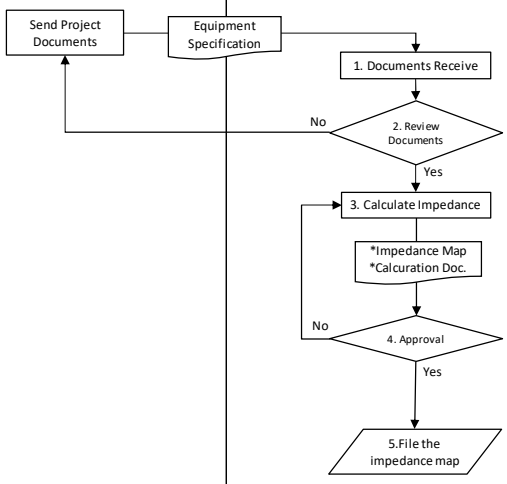
Fault Analysis	Document Number	Date	Revision
	SOP-002	22/02/2023	0.2

Process	Work procedures (work flow/verification/pass/fail criteria)	Special note (reference documents/records/others)
1. Documents Receive	Operation Fault Report (OFR) is sent from the System Control after an outage or blackout.	
2. Go on site to collect fault report	Protection team travels to site to extract fault events from the protection relay, also talk to field officers and request information from IPP.	
3. Do the Fault Analysis	From the information gathered, the protection engineer analysis all the information and does a report.	Past Analysis Reports
4. Approval	The information is then sent to the manager to review and approve.	
5. Send Documents	The approved report is sent to the operations teams in System Control, Transmission and Distribution, and the Generation team.	
6. File Analysis	The approval report is filed for future references.	

SOP: Fault Analysis

Impedance Study	Document Number	Date	Revision
	SOP-003	2/3/2023	0.2

Purpose: To update impedance map

Asse Development / Operation and Maintenance team	Protection Development/ Protection Appication	-	Approval
			4.Manager

Impedance Study	Document Number	Date	Revision
	SOP-003	2/3/2023	0.2

Process	Work procedures (work flow/verification/pass/fail criteria)	Special note (reference documents/records/others)
1. Documents Receive	Receive documents for equipment specification from Asset Development or replaced equipment specs from Operation and Maintenance team. Notes: That this is specifically for Transmission Lines, Transformer and Generator. If documents is from project, Development Engineer will review. If documents is from Operation, Appication Engineer will review.	
2. Review Documents	Documents are received and checked to ensure they meet requirements.	
3. Calculate Impedance	Calculate positive and Zero sequence impedance and update impedance map to last updated date.	
4. Approval	The Manager signs a approves the updated impedance map.	
5. File the impedance map	The impedance map is filed.	

SOP: Impedance Study

WG4

1. Activity Result

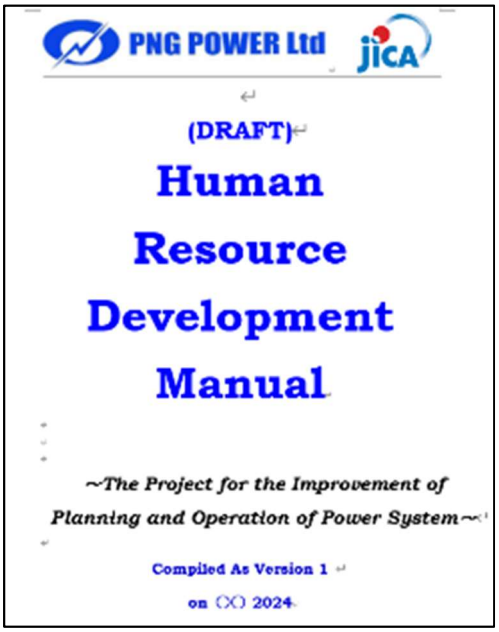
Date	1st 2023.2.16	2nd 2023.2.28
Member	Kevin Kautu Andrew Yuants Andrew Kavanamur	Kevin Kautu, Andrew Yuants, Andrew Kavanamur, Jonah David, Chris Luther, Melvin Angi
Agenda	Reflection and how to proceed	HRD Manual

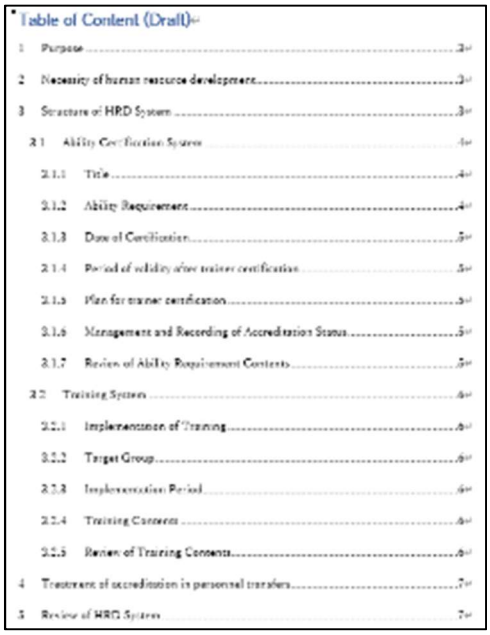
The WG members were briefed on the human resource development system which will be established in this project, especially the contents of the "Ability Certification System" and "Training System," and a common understanding was reaffirmed.

In addition, WG members prepared the cover and table of contents of the "(Draft) Human Resource Development Manual". WG members generally approved the contents of this table.

2. Nsxt Step

- "Ability Certification System" and "Training System"
  - ・The content will be refined with PPL before the next trip.
- HRD Manual
  - ・Based on the table of contents, the contents will be prepared with PPL.
  - ・The management section of this manual will be decided with PPL.
  - ・A draft version of the contents will be prepared before the next trip.





Draft of Cover and Table of Contents of HRD Manual

4. The next schedule

○The next JICA expert trip will be divided into two groups and scheduled from October to November.

○Conduct training in Japan from July to August. JICA will contact you in the future, so please take the necessary actions.

Attachment1 Minutes of the Second JCC

Progress of the training

○ WG1-1 System planning

A total of 6 trainings, 4 on-site and 2 on-line, were given on the concept of power system planning including examples of system analysis, supply and demand planning, and supply and demand adjustment.

In particular, the training focused on the theoretical content behind the system analysis software used for system planning, such as the process of deriving the equation that expresses system stability and the interpretation of the equation, which was difficult to explain in the online training.

Table1 Training of the System planning WG in PNG

Date and Time	Contents	Trainees
2023/2/27 11:00 - 12:00 (PNG time)	Power System Analysis part1 - Concept of Steady-State Stability - Concept of Transient Stability	Benedicta Savage Charlie Enos Haidi Wanya
2023/2/28 15:00 - 16:00 (PNG time)	Power System Analysis part2 - Large-Scale Black Out Caused by System Instability - Black Out Caused by voltage Instability	Benedicta Savage Haidi Wanya
2023/3/1 13:20 - 14:00 (PNG time)	Power System Analysis part3 - System Operation Policy of Kansai Transmission and Distribution - Fence Power Flow Limit for Operation of 500kV Transmission Lines	Benedicta Savage Charlie Enos Haidi Wanya
2023/3/2 14:00 - 15:00 (PNG time)	Power System Analysis part4 - Stability Improvement Using Power Shedding - Stability Improvement Using Static Var Generator (SVG) - System Analysis Methods	Benedicta Savage Charlie Enos Haidi Wanya

Table2 Online Training of the System planning WG

Date and Time	Contents	Trainees
2022/12/1 12:30 - 13:30	Demand and Supply Planning - Power system and System operation	Benedicta Savage Charlie Enos

(JPN time)	- Pursuit of economic efficiency Asset Management System - Kansai's Asset Management System - Other method for Asset Management System	Haidi Wanya
2022/1/24 9:00 - 10:00 (JPN time)	Power System Planning Concept including Example of Power System Analysis - Outline of Power System Planning - Power System Analysis - Example of Power System Analysis by PSSE	Benedicta Savage Charlie Enos Haidi Wanya

○WG1-2 Financial and Economic analysis

During the third mission, we conducted lectures and exercises on how to read and analyze financial statements. After the mission, the exercises continued from November to the end of January of the next year.

During the fourth mission, we conducted lectures and exercises on the concept and method of financial analysis for a project. However, since the trainees were not familiar with the concept, the trainer tried to repeatedly perform exercises to deepen trainees' understanding. These exercises continued from March to the end of May.

Table3. WG1-2 Training of the Financial and Economic WG in PNG

Date and Time	Contents	Trainees
2023/2/20 (Mon) 13:30 - 15:00	There was a lecture on financial analysis for a project. The concepts of technical terms used in analysis such as cash flow, discount rate, and present value (PV) were explained.	Jonah David
2023/2/21 (Tue) 10:00 - 12:00	ditto	Cathy Kutkue, Beda Kuglame
2023/2/21 (Tue) 13:30 - 15:00	ditto	Vera Lama
2023/2/22	The lecture on financial analysis for a	Cathy Kutkue, Beda

(Wed) 10:00 - 12:00	project continued. How to calculate net present value (NPV) and use the Excel functions were explained. This was followed by performance of exercises.	Kuglame
2023/2/22 (Wed) 13:30 - 15:00	ditto	Jonah David, Vera Lama
2023/2/28 (Tue) 10:00 - 12:00	There were lectures on the internal rate of return (IRR), hurdle rate, and the concept of weighted average cost of capital (WACC). They were followed by performance of exercises.	Cathy Kutkue, Beda Kuglame, Jonah David, Vera Lama
2023/3/1 (Wed) 10:00 - 12:00	There were lectures on debt service coverage ratio (DSCR), interest coverage (ICR), debt-to-equity ratio (D/E ratio), and two kinds of IRR (equity IRR and project IRR). They were followed by performance of exercises.	Cathy Kutkue, Beda Kuglame, Jonah David, Vera Lama
2023/3/1 (Wed) 13:30-15:30	ditto	Jonah David
2023/3/2 (Thu) 10:00 - 12:00	The trainees performed exercises on investment analysis.	Cathy Kutkue, Beda Kuglame, Jonah David, Vera Lama

Table4. WG1-2 Online Training of the Financial and Economic WG

Date and Time	Contents	Trainees
2023/1/17 (Tue) 13:30 - 15:00	The trainees performed exercises on analysis of financial statements using those of Energy Fiji Limited and Indonesia's PLN.	Cathy Kutkue, Beda Kuglame, Jonah David
2023/1/18 (Wed) 13:30 - 15:00	ditto	Cathy Kutkue, Beda Kuglame, Vera Lama
2023/1/19	ditto	Beda Kuglame, Vera Lama

(Thu) 13:30 - 15:00		
2023/3/22 (Wed) 13:00 - 15:00	The trainees performed exercises on financial analysis (estimates of WACC and analysis using a simple model).	Cathy Kutkue, Beda Kuglame, Keith Kalama, Jonah David
2023/3/23 (Thu) 10:00 - 12:00	Exercises continued.	Cathy Kutkue, Jonah David
2023/3/23 (Thu) 13:00 - 15:00	Exercises continued.	Beda Kuglame
2023/3/24 (Fri) 10:00 - 11:00	Exercises continued.	Cathy Kutkue
2023/3/24 (Fri) 13:00 - 15:00	Supplemental class for the exercise session of March 22.	Vera Lama
2023/3/ 28 (Tue) 13:00 - 15:00	Supplemental class for the exercise session of March 23.	Keith Kalama
2023/3/31 (Fri) 13:00 - 15:00	ditto	Vera Lama
2023/4/19 (Wed) 10:00 - 11:30	There was a lecture on how to use Goal Seek in Excel.	Cathy Kutkue, Beda Kuglame
2023/4/19 (Wed) 13:00 - 14:30	ditto	Keith Kalama
2023/4/20 (Thu) 10:00-11:30	The trainees performed exercises on project evaluation using IRR and NPV.	Beda Kuglame, Keith Kalama
2023/4/20 (Thu) 13:00 - 14:30	ditto (supplemental class)	Vera Lama
2023/4/21 (Fri) 10:00 - 11:30	Exercises continued.	Beda Kuglame, Keith Kalama
2023/4/21 (Fri) 13:00 - 16:30	ditto	Cathy Kutkue, Vera Lama

2023/4/24 (Mon) 13:00 - 15:00	There was a lecture on how to use Goal Seek in Excel. (Supplemental class)	Jonah David
2023/4/26 (Wed) 13:00 - 15:00	The trainees performed exercises on project evaluation using IRR and NPV. (Supplemental class)	Jonah David
2023/5/24 (Wed) 10:00 - 11:30	There was a lecture on the difference between project and equity IRRs.	Cathy Kutkue, Jonah David
2023/5/24 (Wed) 13:30 - 15:30	ditto	Beda Kuglame, Keith Kalama
2023/5/25 (Thu) 10:00 - 11:30	ditto (Supplemental class)	Vera Lama
2023/5/25 (Thu) 13:30 - 15:30	There was a lecture on how to use Excel and its functions to calculate interest and principal payments. This was followed by performance of exercises.	Beda Kuglame, Keith Kalama, Vera Lama
2023/5/26 (Fri) 10:00 - 12:00	ditto	Cathy Kutkue
2023/5/26 (Fri) 13:00 - 15:00	Exercises continued.	Cathy Kutkue
2023/5/30 (Tue) 10:00 - 12:00	There was a lecture on how to use Excel and its functions to calculate interest and principal payments. This was followed by performance of exercises. (Supplemental class)	Jonah David
2023/5/30 (Tue) 13:30 - 15:30	Exercises continued.	Beda Kuglame, Keith Kalama, Vera Lama
2023/5/31 (Wed) 10:00 - 12:00	Exercises continued. (Supplemental class)	Jonah David
2023/5/31 (Wed)	Exercises continued. (Supplemental class)	Beda Kuglame

13:00 - 14:00		

○WG2-1 Transmission line

On-site training and online training are continued to improve knowledge and improve operations in transmission facility maintenance and asset management in the first year. In addition to maintenance topics such as necessary inspection for each facility and methods for determining facility malfunction, the training also covers the functions and basic design concepts of transmission facilities intending to acquire the checkpoints and sensitivity in inspection and repair work.

Table5. WG2-1 Training of the Transmission line WG in PNG

Date and Time	Contents	Trainees
2023/2/27 13:30-15:30 (PNG Time)	・Patrol / inspection work for transmission lines	Ben Kaum Esorom Passingan Daenne Kilamanu-Naime
2023/2/28 10:30-12:00 (PNG Time)	・Comprehension test	Ben Kaum Esorom Passingan Chris Louger

Table6. WG2-1 Online Training of the Transmission line WG

Date and Time	Contents	Trainees
2022/12/20 13:00-15:00 (PNG Time)	・Commentary on the comprehension test ・Concept of insulation design	Chris Luther Ben Kaum Deanne Kilamanu-Naime
2023/2/2 10:00-12:00 (PNG Time)	・ Method of determining facility malfunction ・Inspection for overhead transmission lines	Chris Luther Ben Kaum Deanne Kilamanu-Naime Esorom Passingan
2023/4/13 10:00-12:00 (PNG Time)	・ Asset management system for transmission lines ・Method for effective use of grid maps	Chris Luther Ben Kaum Esorom Passingan

○WG2-2 Substation

Table8. WG2-2 Training of the Substation WG in PNG

Date and Time	Contents	Trainees
2023.2.20 PM	>The flow of the inspection	Brian Inamo, Simon Robert Rawali Rawali
2023.2.21	>The flow of the inspection >How to search for fault points	Brian Inamo, Simon Robert, Rawali Rawali
2023.2.22 AM	> How to search for fault points	Brian Inamo, Simon Robert, Rawali Rawali
2023.2.27	> Technical Specification and Holistic design philosophy > Relationship between operating temperature and life of transformer	Simon Robert, Tery Neipu, Rawali Rawali
2023.2.28 AM	> Checkpoints in daily patrols and inspections and completion inspections	Simon Deveo, Tery Neipu Simon Robert, Rawali Rawali
2023.3.1 AM	> Survey items and checkpoints when circuit breakers are not operating	Brian Inamo, Tery Neipu Simon Robert, Rawali Rawali Simon Deveo
2023.3.1 PM	> Battery degradation and diagnostic methods > Investigation items and checkpoints in case of transformer OLTC failure	Brian Inamo, Tery Neipu Simon Robert, Rawali Rawali, Simon Deveo
2023.3.2 AM	> Parallel operating conditions and precautions for transformers > Purpose of use of zigzag transformers and how to detect ground fault > Time coordination of protective relay systems (difference between mechanical and digital relays)	Brian Inamo, Tery Neipu Simon Robert

Table9. WG2-2 Online Training of the Substation WG

Date and Time	Contents	Trainees
2022.12.15 AM	> Control Systems and Monitoring and	Simon Robert, Simon Deveo

	Control (SCADA) Systems in the Kansai T&D	Brian Inamo, Rawali Rawali Deanne Kilamanu-Naime*
2022.12.15 PM 2022.12.16 AM	> Concept and outline of preventive maintenance in the Kansai T&D	Simon Deveo, Brian Inamo Deanne Kilamanu-Naime* Rawali Rawali, Simon Robert
2022.12.16 PM	> Internal fault diagnosis of transformer by gas analysis in oil	Simon Deveo Deanne Kilamanu-Naime*
2023.5.19	> Parallel operation of transformers > Principle and usage of leakage current meter for arresters > Principle and usage of DC fault point detector	Simon Deveo, Brian Inamo Simon Robert, Terry Naipu,
2023.6.28 PM	> System of manuals in the Kansai T & D and how to proceed with manual preparation in this project	Simon Deveo, Rawali Rawali, Simon Robert Esorom Passingan*

*Esorom Passingan and Deanne Kilamanu-Naime, who are WG2 -1 members, participated in WG2 -2 training because they are engaged in the development of asset management systems for substations.

○WG3 Protection coordination

For training, lectures were given on Protection Relay Overview and Distance Relay Setting Method. In addition, quizzes were conducted at each training session to check the level of understanding. Based on the results of the quizzes, follow-up training was conducted on-site to improve the level of understanding of subjects. Issues identified during the training will be covered through training in Japan.

Table10. WG3 Training of the Protection coordination WG in PNG

Date and Time	Contents	Trainees
2023 /2 /20 10:00-12:00 （PNG time）	• SOP for relay setting • Impedance	Melvin Angi Michael Akep
2023 /2 /21 14:00-16:00 （PNG time）	• SOP for fault analysis •	Michael Akep
2023 /2 /22 10:00-14:30	• SOP for fault analysis •	Melvin Angi Michael Akep

（PNG time）		
2023 /2 /27 10:00-15:00 （PNG time）	• SOP for Impedance Study • Necessity of Impedance Management	Melvin Angi Michael Akep
2023 /3//1 10:00-12:00 （PNG time）	• Follow-up for online training • Distance relay settling element	Melvin Angi Michael Akep

Table11. WG3 Online Training of the Protection coordination WG

Date and Time	Contents	Trainees
2022/9/14 09:00−10:00 （JPN time）	• Overview of Okinawa's Electric Power System • Protection Relay Overview	Melvin Angi Michael Akep
2022/9/26 09:00-10:30 （JPN time）	• Protection Relay Overview	Melvin Angi Michael Akep
2022/11/18 09:00-10:30 （JPN time）	• Distance Relay Setting part 1	Melvin Angi Michael Akep
2022/12/7 01:00-02:30 （JPN time）	• Distance Relay Setting part 2	Melvin Angi Michael Akep

To CR of JICA PNG Office

Project Monitoring Sheet

Project Title: PROJECT FOR THE IMPROVEMENT OF PLANNING AND OPERATION OF POWER SYSTEM

Version of the Sheet: Ver.4 (Jan. 2024)

Name: Nehemaiah Naris
Title: Project Director

Name: Seiji Ueoka
Title: Chief Advisor / System Planning

Submission Date: 25th January, 2024

PROJECT FOR THE IMPROVEMENT OF PLANNING
AND OPERATION OF POWER SYSTEM
Monitoring Sheet

Table of Contents

ABBREVIATIONS

Symbol	English
C/P	Counterpart
DFAT	Australian's Department of Foreign Affairs and Trade
IPP	Independent Power Producer
JCC	Joint Coordination Committee
KCH	Kumul Consolidated Holdings Limited
KPI	Key Performance Indicators
NEA	National Energy Authority
NSO	National system operation
PDM	Project Design Matrix
PEP	PNG Electrification Partnership
PNG	Papua New Guinea
PO	Plan of Operation
POM	Port Moresby
PPL	Papua New Guinea Power Ltd
PSSE	Power System Simulator for Engineering
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SMEC	SMEC Holdings Limited
SOP	Standard Operating Procedures
STATCOM	Self-commutated Static Var Compensator
WG	Working Group

I. Summary

1. Progress

1-1. Progress of Input

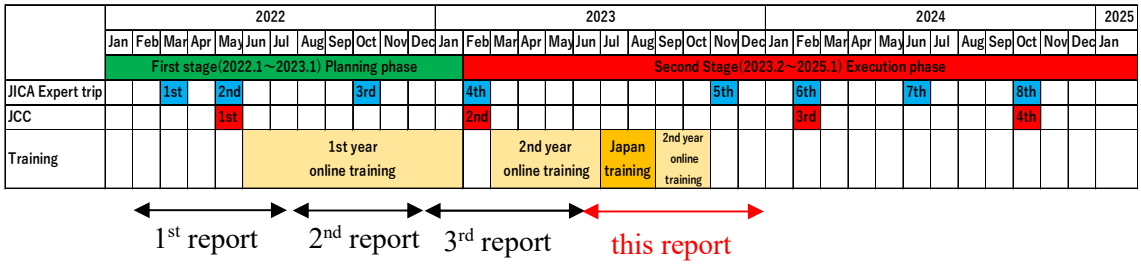


Fig.1 Activity Schedule

A contract for the implementation of this project was signed on 14th January 2022, and the project has started for about three years (until 24th January 2025).

This report describes the results in the second half of the second year (June 2023 to December 2023).

In the second half of the second year, activities were carried out based on the activity plan for the second and third years made in the first year. In addition to conducting training in Japan, completing education for trainer candidates, creating various manuals, providing materials and equipment. Technology transfer based on PDM are progressing almost as planned. The progress of inputs at each dispatch stage is summarized below.

From Japan Side

Training in Japan

A two-week training course in Japan was held in Kansai and Okinawa from the end of July to the beginning of August 2023. During the training in Japan, trainer candidates expanded their knowledge through visits to properly maintained Japanese equipment to gain a sense of the importance of maintenance, and through lectures and discussions by Japanese engineers.

As for the training in Kansai, the morning time focused on activities by working group to deepen knowledge in specialized fields. In the afternoon, we conducted a site visit as a common program and gained a wide range of knowledge outside of own field of work.

Regarding the training in Okinawa, the typhoon made it impossible to conduct face-to-face lectures, practical training, and facility inspections, so the two-day program was changed to an online.

The program, which was common throughout the event, included site visit of the Inagawa substation, Mitsubishi Electric, and Keage Hydro power plant, as well as lectures on human resource development systems and MG sets.

Schedule of training in Japan

	AM	PM
7/24	Tokyo ⇒ Kansai	Orientation
7/25	WG activity	Site visit @ Inagawa S/S
7/26	WG activity	【WG1・3】Site visit @ Mitsubisi Electic 【WG2】Site visit @ Noe Power office
7/27	WG activity	Preparation of presentation
7/28	Site visit @ Keage Hydro power plant	Site visit @ Kinkaku-ji
7/29・7/30	Holiday	
7/31	Return home briefing	Lectures about HR system & MG set
8/1	WG activity（online）	WG activity（online）
8/2	WG activity（online）	WG activity（online）
8/3	WG activity	WG activity
8/4	Presentation	Closing ceremony

Inagawa S/S

Keage Hydro power plant

Presentation

5th dispatch

The fifth dispatch was carried out for approximately four weeks starting at the end of October 2023. During the fifth dispatch, training was conducted and manuals were created. In addition, we made adjustments for the JCC scheduled to be held during the 6th trip, and for the PPL staff who will be training trainer candidates in the third year.

Please refer to the attachment1 for the detailed activity results.

Online WG

From June to October 2023, each WG held an online WG for the purpose of imparting knowledge to C/Ps and gathering information for creating manuals.

Please refer to the attachment2 for the details of the traing.

Delivery of materials and equipment

At the end of July 2023, a bidding session was held for suppliers in conjunction with the provision of equipment and materials, and decided on a priority negotiator. Subsequently, after discussions on the timing of delivery, the contract was concluded on September 19, 2023. With regard to transport, it was found that some items, such as hydraulic compressors, were not in time for the 5th dispatch, so the timing of transport was divided into two occasions: the 5th dispatch and the 7th dispatch (planned around May-June 2024). As for the first delivery, the on-site delivery was completed on November 16, 2023 during the 5th dispatch. On the same day, a handover ceremony was held in PPL Headquaters.

Training using equipment and materials implemented during the 5th dispatch and future plans are described in 1-2 and 1-3.

Table 1-1-1 shows the planned and actual input of these personnel.

Table 1-1-1 Personnel input status

No.	Field of expertise	Total Man/Month(M/M) (M/M of Jun 2023-Dec 2023)	
		In PNG	In Japan
1	Team Leader / System Planning	3.67(0.70)	4.70(1.05)
2	Grid Technology	2.83(0.70)	2.60(0.55)
3	Financial and Economic Analysis	2.57(0.70)	3.05(0.95)
4	Transmission Line	2.77(0.64)	2.83(0.78)
5	Substation	3.50(0.63)	3.68(1.28)
6	Equipment Testing / Evaluation	2.00(0.77)	3.13(0.53)
7	Protection Coordination[1]	3.67(0.70)	3.78(0.93)
8	Human Resource Management / Training Planning	2.30(0.70)	2.40(0.60)
9	Grid Technology(Assistant) / Business Coordination	3.67(0.70)	1.30(0.30)

From PNG side

WG member

21 people were appointed as WG members of this project, and 20 members were dispatched to Japan for training.

Provision of office and WG space

An office space was prepared in the PPL for the 5th dispatch of experts. PNG side also arranged meeting rooms and other facilities necessary for WG activities and cooperated in the smooth implementation of WG activities.

Provision of related documents

The existing PPL materials needed for the preparation of the manual were provided.

1-2. Progress of Activities

The progress of 各成果に対する each activity is described in Table 1-2-1.

Output 1

Table.1.2.1 The progress of each activity (Output 1)

Activities in Project	Activities conducted in the period	Achievement status

[1] Protection coordination: Adjustment of the setting values of protection relays to prevent the spread of power outage by disconnecting only the minimum range in the event of an electrical fault caused by various abnormalities that may occur in the power system.

Design Matrix (PDM)			
1-1	Assess the current capacity of system planning for the transmission line	The results of the baseline survey were explained at the 2nd JCC.	Achieved
1-2	Formulate Working Groups (WG) for (1) system planning and (2) financial and economic analysis	WG1-1 and 1-2 don't change members, and have been progressing WG activities.	Achieved
1-3	Conduct training for trainer candidates on basis on system planning for the transmission line	Lectures on grid analysis, rules for grid operation, the impact of the penetration of renewable energy, etc. were held three times: once in Japan and twice online. In particular, during the training in Japan, we carefully reviewed the theoretical content behind the system analysis software used for system planning. In addition, WG members from PPL deepened their understanding of basic electrical theory by having them solve calculation examples of voltage and current values in a simplified power system as practice problems.	Achieved
1-4	Conduct training for trainer candidates on system simulation using tools such as PSS/E	During the training in Japan, each WG member from PPL actually operated the system analysis software PSS/E and run simulations. As a result of the training, each WG member from PPL was able to acquire basic skills in simulation using system analysis software. We plan to hold lectures on how to operate PSS/E during future trips to improve the abilities of WG members.	Expected to achieve
1-5	Conduct training for trainer	During the training in Japan from July 24 to August 4, we intensively performed	Achieved

	candidates on basis on financial and economic analysis	more complex exercises as the culmination of the past lectures and exercises done until then. In the exercises, we supplementally held a lecture on how to use the if function in Excel that defines judgement conditions in a model. After the training in Japan, we held a total of 16 online training sessions in September and October, and performed all of the remaining exercises. At this point, the training in financial analysis for a project was completed. During the fifth mission, we conducted a total of 22 training sessions for cost-benefit evaluation (i.e., a sort of financial analysis) and economic analysis by applying the ADB guidelines. Since the ADB approach to analysis is unique and differs from the general theory, we performed exercises by comparing both ADB and ordinary procedures for financial analysis. Due to the critical difference of logic between the two, the trainees were slightly confused. But they must have basically understood the ADB approach, because the calculation itself is simple. With the end of the fifth mission, we completed the second year of training.	
1-6	Develop the PPL Official Training Manual for system planning, system simulation, and financial and economic analysis	WG1-1 reconfirmed the draft training manual created so far during the 5th trip and updated it to reflect the latest information on PPL. If the updated training manual draft is approved within PPL, it will be used to train trainers.	Expected to achieve

	through considering systematic human resource development	For WG1-2, all of the materials used for the lectures and exercises up to that time have been compiled in one package of training materials. In addition, we produced a training manual (i.e., a sort of guidance book) for trainers. The term "training manual" as used here includes both the above-mentioned training materials and guidance book. Apart from the training manual, for staff members who wish to join the training, we also produced a syllabus that showed the objectives, contents, and expected outcomes of the training.	
1-7	Support trainers to conduct the training for the engineers based on the training manual	[Not started yet]	Not started yet
1-8	Develop the PPL Official Operational Manual and Standard Operating Procedure (SOP) for system planning, system simulation, financial and economic analysis	WG1-1 created a draft operational manual based on the lecture materials from the training in Japan. Specifically, during the 5th dispatch, we reconfirmed the previous lecture materials with WG members and made appropriate modifications to create a draft PPL operational manual. The main contents include the electrical theory behind system analysis and how to operate system analysis software. For WG1-2, we do not distinguish the training manual and SOP, but instead treat them as comprising a single "training manual," because the characteristics of WG1-2 differ from those of other working groups.	Expected to achieve

1-9	Assess the Least Cost Development Plan based on the operational manual and SOP	During the training in Japan, a two-day lecture was held to give the participants the ability to understand and update the "Papua New Guinea Least Cost Power Development Plan Update December 2020" published by the World Bank. At the beginning of the lecture, WG members from PPL were asked to confirm the plan drawn up by the World Bank. Next, explanations and discussions led by JICA experts deepened each WG member from PPL understanding. As a result of the training, we were able to impart the targeted abilities to WG members from PPL.	Expected to achieve

Output 2

Table.1.2.2 The progress of each activity (Output 2)

Activities in PDM		Activities conducted in the period	Achievement status
2-1	Assess the current capacity and technical, structural, and planning challenges of maintenance for transmission line and substations are assessed and propose measures for these challenges	[WG2-1] We evaluate that WG member's awareness and knowledge of maintenance work is getting improved such as basic design concepts of transmission facilities, suitable way of maintenance and planning of patrol / maintenance for long and short terms through online training and onsite training. Additionally, the required SOPs has been created and used, which includes work flow for maintenance work, documents such as patrol / inspection checklist, malfunction criteria, and planning concept. We evaluated these outcomes will be applied to PPL's maintenance work and makes the quality and efficiency	Achieved

		improved [WG2-2] Training required to solve the problems identified in the first year's survey was conducted. In PPL, visual inspections of substation equipment are carried out, but check sheets do not exist, and they depend on individual experiences. Therefore, some models of the check sheet were proposed by a JICA expert. By utilizing the check sheet, the knowledge was given that the employee can work with the same quality and that it can be utilized in the formulation of the preventive maintenance plan in the future by accumulating the data.	
2-2	Formulate 2 WGs for maintenance for (1) transmission line and (2) substations	(Completed) WG2-1 and 2-2 don't change initial members, and have been progressing WG activities.	Achieved
2-3	Conduct training for trainer candidates on planning of preventive maintenance and asset management	**WG2-1** WG members learned the basic design concepts of transmission facilities such as tower, foundation, conductor and insulator through online training. This training contributes WG members to carry out planning work and maintenance work more appropriately. Additionally, They learned the viewpoints of patrol / maintenance for each transmission facility and safety measurement for power outage work through online training.	Achieved

		WG2-2 In the training in Japan, WG members understood the importance of carrying out maintenance appropriately by inspecting the training centers in Japan, the maintenance office and 500kV substation, etc. In addition, by inspecting what is actually used in the maintenance office for asset management, it was possible to deepen the understanding of C/P. In the fifth dispatch, interview was implemented about situation of developing PPL asset management system and current inspection plan. Training was continued with the aim of improving the knowledge of asset management and improving formulation skill for maintenance plan.	
2-4	Conduct training for trainer candidates on the implementation of preventive maintenance and asset management	**WG2-1** WG members learned the viewpoints of patrol / maintenance for each transmission facility, how to identify the malfunction level, how to use check list on site and record the result and report to Asset management team, through online and onsite training. Additionally, they learned how to use the tools and measurement instruments procured during the 2nd years through onsite training. **WG2-2** Since PPL aims at the introduction of preventive maintenance, lectures on the structure and operation principle of transformer and circuit breaker were given as an improvement of knowledge	Expected to achieve

		for inspection of substation equipment. In addition, a checklist was proposed from JICA experts for the patrol inspection, and trained using actual equipment at the substation. As equipment and materials were provided to improve PPL maintenance skills, training was conducted using them.	
2-5	Develop the PPL Official Training Manuals for maintenance for transmission line and substations considering systematic human resource development	**WG2-1** The training manual consists of materials that were used through online and onsite training described in 2-3 and 2-4. Its draft version is going to be completed this February. WG2-2 As in the past, a draft of training manual was prepared and conducted the training using it. The draft will be discussed with C/P as appropriate, to be finalized.	Expected to achieve
2-6	Support the trainers to conduct the training for the engineers based on the training manual	**WG2-1 & WG2-2** [Not started yet]	Not started yet
2-7	Develop the PPL Official Manual and Standard Operating Procedure (SOP) for transmission line and substations	**WG2-1** Base on the data and information through 1st and 2nd year's WG activities and some requests from WG members, the creation of Operation manual and the related SOPs has been carried out and draft version is going to be completed this February. **WG2-2** A draft of the manual was prepared by JICA experts, and during the fifth dispatch, PPL's maintenance workflow, the items and frequency of periodic	Expected to achieve

		inspections, and other informaton required for the preparation of the manual were interviewed. On the basis of them, the draft will be revised again by the JICA experts, and aimed to completion. ・JICA experts prepared and suggested SOP for training of inspection, and also training of supplied equipment and materials. SOP was also trained about how to create, as PPL should create it by themselves in the future.	
2-8	Support PPL to implement the maintenance of transmission line and substation based on the approved PPL Official Operational Manual and SOP	**WG2-1 & WG2-2** [Not started yet]	Expected to achieve

Output 3

Table.1.2.3 The progress of each activity (Output 3)

Activities in PDM		Activities conducted in the period	Achievement status
3-1	Assess the current capacity and technical, structural, and planning challenges of protection coordination and propose the measures for these challenges	Completed; The results of the baseline survey were explained at the JCC.	Achieved
3-2	Formulate WG for protection coordination	Completed; No personnel changes in WG3.	Achieved

3-3	Conduct training to improve capacity of protection coordination setting for candidate trainers	The following practical training was conducted during the 5th trip. (1) Impedance calculation (2) CT study (3) Distance relay setting In addition, it was confirmed that appropriate values were input to the distance relays at a substation. In the training in Japan, Japanese technology was introduced, software used in relay setting calculation was introduced, and lectures were given on fault analysis items and analysis methods in power system. All technology transfer to C/P was completed with the completion of practical training in the 5th trip.	Achieved
3-4	Develop the PPL Official Training Manual for protection coordination considering systematic human resource development	The following training manuals have been developed until now. We are currently waiting for feedback from C/P superiors. 01_Overview of Protection Relay 02_Distance Relay setting Part 1 03_Distance Relay setting Part2 04_Diff. Relay setting 05_CT Study 06_Calculation of Impedance(Underground) 07_Calculation of Impedance (Overhead) 08_Fault Analysis	Expected to achieve
3-5	Support trainers candidate to conduct the training for the rest of engineers based on the PPL Official Training Manual	(Issue)PPL has only two protection relay engineers, and there is no one to train currently. (Countermeasures) (1) The two newly hired engineers will be trained. (2) Currently confirming with Kevin, PPL project manager, who else is eligible to take the course.	Not started yet
3-6	Develop the PPL	The workflows were reviewed with the	Expected to achieve

	Official Operational Manual and Standard Operating Procedure (SOP) for protection coordination.	C/P and we prepared the following three SOPs (draft versions) and an operational manual for the relay setting. Currently, we are waiting for feedback from the C/P superiors. 01_SOP_Relay Setting 02_SOP_Fault Analysis 03_SOP_Impedance Study	
3-7	Support PPL to modify the setting, for the protection coordination based on the operational manual and SOP	Review the distance relay settling based on manuals that have been prepared.	Expected to achieve

Output 4

Table.1.2.4 The progress of each activity (Output 4)

Activities in PDM		Activities conducted in the period	Achievement status
4-1	Assess the current system for human resource development	The results of the baseline survey were explained at the 2nd JCC.	Achieved
4-2	Develop the PPL Official system of human resource development	We prepared a draft of contents of human resource development manual for engineers, [2] incorporating the needs of C/Ps. It will be confirmed at the 3rd JCC.	Expected to achieve

1-3. Achievement of Output

Output 1

"Capacity of system planning for the transmission line is improved", the following initiatives were implemented.

[2] Engineer: Office-based workers who are in charge of system planning, inspection planning, asset management, and protection coordination, et

【WG1-1】

During web training, training in Japan, and the 5th trip, we provided lectures on system planning, prepared manuals, and provided education on system analysis software. During the training in Japan, we not only gave WG members from PPL basic skills in power system analysis using the power system analysis software PSS/E, but also provided the ability to understand and update the "Papua New Guinea Least Cost Power Development Plan Update December 2020" published by the World Bank.

In the future, in addition to training trainer candidates using the manuals we have created, we will provide additional training that has been strongly requested by PPL, such as how to operate the system analysis software PSS/E.

【WG1-2】

With the completion of the fifth mission, we have completed all of the training sessions for the first-generation trainees.

As we allocated enough time for training to understand how to read financial statements and make a financial analysis for a project, the trainee capacity-building should be regarded as having been achieved. In light of the current situation, however, chances to use the acquired knowledge and skills in the daily work are limited. The trainees will properly respond each time by referring to the training materials provided in the training.

As the new trainers for the third-year training, we nominated three persons from the group of first-generation trainees. They also need to further strengthen their capacity to serve as trainers, and are expected not only to continue to review the training materials but also to apply gained skills and knowledge to solve real problems arising in the day-to-day operation in parallel with teaching new trainees..

Output 2

“Capacity of maintenance for transmission line and substation is improved”, a survey of the current situation was conducted, and challenges were identified in three areas: people, organization, and equipment. In addition, in the WG at the baseline survey, we shared the challenges and improvement points of the PPL.

WG2-1

The outcomes of WG2-1 activities in 2nd year is as follows;

JICA expert established training menus based on the survey results on current circumstances and issues that maintenance team was facing, and carried out the technical transfer to PPL’s WG members through online and onsite training

For instance, JICA expert proposed the appropriate methods of implementing patrol / inspection, reporting the results and maintenance planning, and PPL’s WG members has been deepening the knowledge and know-how on that.

Consequently, their skills and abilities are evaluated as getting improved.

As for required manuals, not only the training manual which consists of materials that were used actually in online and onsite training, but also the operation manual which specifies the appropriate method of maintenance and planning work, and the related SOPs such as patrol / inspection checklist and work flow, has been prepared.
The draft version is going to be completed this February.

In the final year, WG 2-1 including JICA expert and PPL's member will achieve the goals which means the completion of fully technical transfers and establishment of manuals.

WG2-2

Details of implementation in W2-2 and how to proceed in the future are as follows.

・Lectures on giving knowledge of basic knowledge (structure, operating principle, inspection items, etc.) of substation equipment required for preventive maintenance, and also lectures on items of inspection, implementation methods and abnormality judgment were provided.

・Basic knowledge was provided on equipment and materials supplied for the improvement of maintenance capacity, and training was conducted using actual equipment. As the transport of some equipment and materials will be the seventh dispatch (planned for May-June 2024), training for the relevant items will continue to be conducted.

・In the fifth dispatch, as for the Operational Manual, the draft was created by collection from C/P about the work flow of the inspection plan and other required information. In the future, the draft will be completed with discussion of the inspection items and cycles of substation equipment with C/P.

・Training manuals and SOP were trained using drafts in various training sessions, and C/P and discussions were held on how to improve them.

・As for assistance of developing the asset management system in PPL, an inspection of the maintenance office in the Kansai Electric Power Transmission and Distribution was carried out in the training in Japan. Through actual system demonstrations and discussions with the staff members, the knowledge of C/P was able to be deepen. In addition, as for reports of equipment inspection and failures, the operational manual will be created so that trend management can be carried out regarding suggestion of report formats and management method.

Output 3

"Capacity of protection coordination is improved", the following actions have been taken.

[WG3]

During the 5th trip's on-site training, impedance calculations and relay setting were conducted using PPL's power system parameters to ensure that past trainings could be

applied in practice. Furthermore, we confirmed that the appropriate values were input to the protection relays installed in the substations. The transfer of technology to C/P was completed with the completion of practical training during the 5th trip.

As for the three manuals (training manual, SOP, and operational manual) that have been prepared, the draft versions were completed and requested to be reviewed by the PPL's superiors for approval in June 2024.

Human Resource Development

・We prepared a draft of contents of human resource development manual which will serve as the framework for the trainer certification system and training system, incorporating the needs of CPs.

・We confirmed the department which is in charge of this manual.

・This manual was approved by C/P as a preliminary step to get approval at the 3rd JCC.

1-4. Achievement of Project Purpose

As for the Project Purpose, when we achieve the Output 1-3 as described in 1-3, the Project Purpose "PPL can properly implement system planning for the transmission line and maintenance for transmission line and substations on its own ." will be achieved.

In order to achieve the project purpose, activities are being carried out in accordance with the activity plan approved at the 2nd JCC. Technology transfer to trainer candidates has been completed, and in the third year trainer candidates will train other PPL staff to check their understanding and revise the manual. We aim to achieve the project purpose by creating a system that allows sustainable education within PPL.

The evaluation results based on the DAC evaluation criteria are as follows.

A. Relevance

In Development Strategic Plan (2010-2030) and Vision 2050, the PNG government has indicated its policy to increase the electrification rate to 70% by 2030. In order to achieve this goal, further expansion of electric power facilities is required, and there is an urgent need to improve the capacity of human resources engaged in the electric power business. The capacity building of instructors and the preparation of manuals are consistent with this goal.

B. Coherence

The other donors' assistance has focused on supporting the development of facilities and has not provided assistance for improving the maintenance capacity of transmission facilities. By improving PPL's maintenance capacity through this project, facilities constructed with the support of other donors can be properly maintained and used for a long period of time.

The project is consistent because of the synergistic effects expected to improve PPL's power quality.

C. Effectiveness

Project purpose is clearly stated in the PDM, and these goals were set based on the results of the capacity assessment in the first year.

The Project Purpose is appropriate as a goal to achieve the Overall Goal. And the outputs to achieve the project goals are also clearly described and the project is effective.

D. Efficiency

The activities required to produce the outputs of this project are described in the PO. The PO will continue to be staffed with the right people to carry out the necessary activities, and the project is highly efficient.

E. Impact

Through this project, the capacity of system planning for the transmission line and maintenance for transmission lines and substations has improved, and further improvement is expected as education continues to be provided within PPL. By improving the overall capacity of PPL, it is expected that the quality of power in PNG will improve and contribute to society as a whole.

F. Sustainability

The creation of manuals and the introduction of a human resource development structure and training system that meets PPL's needs are expected to ensure a sustainable human resource development system. The draft manuals and the draft of the human resource development system and training system have been completed, and they are planned to be revised during the third year of activities.

1-5. Changes of Risks and Actions for Mitigation

Following factors are considered to become obstacles for the smooth implementation of the Project.

(1) Inadequate assignment of C/P

If the adequate C/P will not be assigned at the proper time and necessary numbers, activities of the technology transfer could not be carried out on schedule.

In the third year, we are planning training from trainer candidates to PPL staff. If it is not possible to secure PPL staff for the third year of training, it may not be possible to confirm the level of understanding of trainer candidates and the effectiveness of the draft manuals.

(2) Inadequacy of working environment and necessary equipment

Proper working environment and equipment will be indispensable for implementing the Project on schedule.
Lack of proper working environment and equipment would be obstacles for the smooth implementation of the Project.

(3) Shortage of budgetary allocation
In order to carry out the Project on schedule, necessary budget should be prepared in adequate time. If the necessary budget would not be allocated on time, we cannot expect the Project running smoothly.

As the above-mentioned risks may occur, we are taking the following measures to reduce risks.

Table 1-5-1. Risk items

No.	Risk Factor	Countermeasures for Mitigation	Results
1	Assignment of C/P	During the fifth dispatch, consultants requested the PPL project manager to select PPL staff who would train trainer candidates in the third year. In addition, even after returning to Japan, the selection status is confirmed via email.	We plan to secure the necessary personnel on the PPL side by the third year activities.
2	Office Space and Working Environment	The expert team requested the office space to PNG side in the kickoff meeting in March 2022. PNG side provided the office space with air condition to the expert team.	No problems occurred so far now
3	Shortage of budgetary allocation	In order to secure the necessary budget, experts and project managers frequently exchange schedules regarding technology transfer.	No problems occurred so far now

1-6. Progress of Actions undertaken by JICA

(1) Conducted WG activities on the 5th trip.
(2) Conducted online training.
(3) Conducted training in Japan.
(4) Materials and equipment were provided.

1-7. Progress of Actions undertaken by Gov. of PNG

(1) To provide the expert team office space with necessary equipment
(2) To provide meeting rooms for WG activity
(3) WG members participated in WG activities and online training.
(4) To cooperate in collecting various data necessary for technical cooperation.
(5) Personnel were dispatched to Japan for training.

1-8. Progress of Environmental and Social Considerations (if Applicable)

No relevant matters

1-9. Progress of Considerations on Gender/Peace Building/Poverty Reduction (if applicable)

Five women are participating as WG members.

1-10. Other remarkable/considerable issues related/affect to the project (such as other JICA`s projects, activities of counterparts, other donors, private sectors, NGOs etc.)

No relevant matters

2. Delay of Work Schedule and/or Problems (if any)

2-1. Detail

The overall schedule is as originally planned. However, as it takes time to procure some of the equipment, training using some of the equipment remains to be implemented.

2-2. Cause

Because it would take time to procure some of the materials and equipment that we decided to provide after consultation with the PPL side.

2-3. Action to be taken

During the 7th dispatch, education will be carried out using the remaining provided materials and equipment.

2-4. Roles of Responsible Persons/Organization (JICA, Gov. of PNG, etc.)

No relevant matters

3. Modification of the Project Implementation Plan

3-1. PDM

Ver1 : Obtained approval at the 1st JCC in May 2022.
Ver2 : Obtained approval at the 2nd JCC in February 2023.

3-2. PO

Obtained approval at the 2nd JCC in February 2023.

3-3. Other modification on detailed implementation plan

No change

4. Current Activities of Gov. of PNG to secure Project Sustainability after its Completion

Based on the manuals and training plans created in this project, the engineers trained in this project will continue to provide training.

II. Project Monitoring Sheet I & II

1） Project Monitoring Sheet I (Revision of Project Design Matrix)

2） Project Monitoring Sheet II (Revision of Plan of Operation)

Nov 28, 2023

The Project for the Improvement of Planning and Operation of Power System

5th Mission Report

Kansai Transmission and Distribution, Inc.
NEWJEC Inc.
SeED Okinawa LLC

1. Purpose of this dispatch

① Conducting a training and making manuals
② Confirmation of training targets in the third year
③ Coordination for the next JCC
④ Delivery of materials and equipment

2. Schedule

WG1・3・4：30th Oct ～16th Nov
WG2：13th Nov ～ 28th Nov

3. Activity of 5th mission

① Conducting a training and making manuals

During this trip, each working group conducted training for trainer candidates and created a manual. Details are explained in the report materials from each working group mentioned below.

② Confirmation of training targets in the third year

We had a meeting with Mr. Kevin regarding PPL engineers who will receive training from trainer candidates in the third year. Regarding the number of students, PPL will select candidates from WG1-1: 2 people, WG1-2: 3 to 4 people, and WG3: 2 people.

③ Coordination for the next JCC

We made adjustments regarding the 3rd JCC scheduled to be held in February 2024. The venue will be arranged by PPL, and the date and time will be informed to PPL after consulting with JICA
Regarding participants, KCH and DNPM are expected to be invited same as last meeting in addition to JICA, PPL, and Embassy of Japan.

④ Delivery of materials and equipment

Materials and equipment which is used for maintenance were provided to PPL. A ceremony was held to coincide with the delivery of equipment.

4. Activity of each WGs

WG1-1

1 Formulation of Manuals

1.1 Training Manual

WG members reconfirmed the materials used in face-to-face training, training in Japan, and web training. We reviewed the structure of each material to make it suitable for educational activities at PPL, and added wording in some parts to make it more in line with PPL's business practices. In particular, in the introduction, we worked to understand the current situation and create materials dedicated to the current state of the PPL transmission system.

Table1: Documents of Training Manual

No.	Document Name
0	Introduction
1	Basic knowledge of power system planning
2	Concept of Power System Planning
3	Supply and Demand Planning
4	Supply and Demand Control
5	Frequency control in interconnection system
6	Asset Management System
7	Influence and Challenges on Power Grid Operation of Renewable Energy

1.2 Operational Manual

Currently, the power source (IPP) interconnection has the greatest impact on the formation of PPL facilities. Due to insufficient consideration and failure to follow appropriate procedures for power interconnection, facilities have not been constructed in accordance with the grid code. Therefore, in the Operational Manual, we focused on this business process and held a discussion on a draft manual that defines procedures within PPL when interconnecting the grid.

Based on the draft manual that the consultant had formulated based on previous interviews with PPL engineers and the PNG grid code, we exchanged opinions on each internal business flow that is divided into each item of the grid code. We revised the draft manual to reflect the actual situation of PPL.

There were several cases in which information was not shared with the engineering department during the grid interconnection planning stage, but was shared with the engineering department after equipment specifications had been determined. In this manual, we have devised a system in which the opinions of the engineering department are reflected in equipment specification decisions by establishing internal business rules that ensure that information is shared with the engineering department from the planning stage. Additionally, in the current grid interconnection procedures, there were cases in which the documents stipulated by the PNG Grid Code were not created by PPL, so this PPL internal manual clearly stipulates the format of each document and the need to issue it. And WG members have put in place internal rules to ensure that procedures are carried out in accordance with the PNG Grid Code.

After the WG members revised the draft manual, we explained it to Maira, the GM of Business Development, and received his comments.

1.3 Standard Operating Procedure (SOP)

Technical matters related to grid analysis are created as SOPs, with emphasis on technical considerations at the grid interconnection planning stage in the Operational Manual. The members reviewed materials related to system analysis theory and how to use PSSE software, which were used in the training in Japan. The quality of the materials was improved by adding a table of contents and revising the layout.

Two kinds of grid analysis software are used within PPL: PSSE is used by Strategic, which

handles technical studies before grid connection, and Power Factory is used by NSO, which handles daily power dispatch. After discussing the unification of analysis software with the support of USAID, it was confirmed that USAID recommended that PPL unify to Power Factory. In response to USAID's recommendation, PPL transferred one Power Factory license from NSO to Starategic Department, but no clear efforts have been made to unify power system analysis software within PPL.

Table2: Documents of Standard Operating Procedure (SOP)

No.	Document Name
1	System analysis theory
2	Power System Analysis Using PSSE

Fig1: Formulation of manuals in WG1-1

2 Site-visit for Moitaka Substation

We visited the Moitaka substation, which is going to connect the 132kV transmission line from the newly constructed Edevu hydropower plant. By connecting the Edevu power plant, 54MW of supply capacity will be added to the POM system, ensuring sufficient power generation capacity for the POM system.

Although this is a newly constructed substation, there were cases where the equipment was not placed in consideration of maintenance aspects, and cases where maintenance equipment was not prepared, so consultants gave the WG members who accompanied advice on points of concern.

Fig2: Site-visit for Moitaka Substation

3 Information collection

3.1 Situation of POM gird

In the POM system, there was a lack of a supply source of reactive power Q, and voltage drop was a problem. For this reason, PPL had installed a new STATCOM at the Boroko substation, but it had malfunctioned and stopped, making it difficult to maintain proper voltage in the POM system. During this trip, we confirmed that the STATCOM had been repaired and was operating normally, and that it is contributing to the stabilization of the POM system by maintaining the proper voltage of the STATCOM.

In addition, the POM system also lacked active power P, and frequency drop was a problem. In the near future, PPL expects to be able to deal with this problem by securing enough power supply through the new connection of the Edevu hydropower plant.

As a result, in the POM system, the imbalance between supply and demand of active power P and reactive power Q has been improved, and system stabilization can be expected.

3.2 Grid code revision discussion in progress

The revision to the existing grid code are being discussed. PPL and IPP are currently in the process of confirming their opinions.

4 Activity history

It was carried out as shown in the table below.

5 Future work

PPL working group members will reflect additional revised opinions in the materials by December 2023 and complete the work of compiling the manuals. We would like to report that the formulation of manuals has been completed at the next JCC (Joint Coordinating Committee) scheduled for around February 2024. From then on, the main activity is going to trial training from candidate trainers to other engineers.

Table3: Activity history of WG1-1 during the 5th trip

Date/Time	Venue	Activity	Participant
2023/11/01 10:00-12:00 (PNG time)	T & D Meeting Room, PPL 3F	- Explanation of purpose of travel - Discussion on draft operational manual	Benedicta Savage Haidi Wanya
2023/11/02 10:00-12:00 (PNG time)	T & D Meeting Room, PPL 3F	- Discussion on draft operational manual	Benedicta Savage Charlie Enos Haidi Wanya
2023/11/03 10:00-12:00 (PNG time)	T & D Meeting Room, PPL 3F	- Discussion regarding PPL overview materials used in training manuals	Benedicta Savage Charlie Enos Haidi Wanya
2023/11/06 10:00-12:00 (PNG time)	T & D Meeting Room, PPL 3F	- Discussion regarding PPL overview materials used in training manuals	Benedicta Savage Haidi Wanya
2023/11/07 10:00-12:00 (PNG time)	T & D Meeting Room, PPL 3F	- Explaining the contents of the training manuals and confirming revisions	Benedicta Savage Charlie Enos Haidi Wanya
2023/11/08 10:00-12:00 (PNG time)	Moitaka Substation	- Site-visit for substation to which IPP (Edevu Hydro Power) connects	Benedicta Savage Charlie Enos Haidi Wanya
2023/11/09 14:00-16:00 (PNG time)	T & D Meeting Room, PPL 3F	- Explaining the contents of the training manuals and confirming revisions	Benedicta Savage Haidi Wanya
2023/11/10 10:00-12:00 (PNG time)	T & D Meeting Room, PPL 3F	- Explaining the contents of the training manuals and confirming revisions	Haidi Wanya

WG1-2

1. Lecture on the ADB guidelines for financial analysis and exercise

The leader lectured on the Asian Development Bank (ADB) guidelines for financial analysis. The ADB approach to analysis is unique and differs from the general theory as follows:

- The guidelines use the term "cost-benefit evaluation" for financial analysis of a project. However, in individual ADB reports, the term "financial analysis" is still used.
- In general, financial analysis is performed in "nominal terms," but the ADB performs it in "real terms." Although the ADB's theory is unusual, this might be because the ADB wants to keep consistency between financial analysis and economic analysis, which is performed in real terms.

As an exercise, the trainees performed financial analyses in accordance with both ordinary and ADB procedures

Since the two procedures stand on completely different sets of analytical logic, the trainees were slightly confused. But they must have basically understood the ADB approach, because the calculation itself is simple.

By contrast, the procedure for ordinary analysis, which the trainees learnt in the JICA technical assistance, is more complicated. In particular, when the analysis had to take into account several variables, such as cost escalation caused by inflation, the grace period for loan payment, and increase in power demand, the trainees had difficulty compiling an Excel model.

2. Lecture on ADB guidelines for economic analysis and exercise

The leader lectured on the logic and calculation method of economic analysis while referring to the ADB guidelines.

The guidelines are well designed. They would be the best textbook which is currently available, but are a little difficult for ordinary people to read and understand.

Following the lecture, the trainees performed exercises in economic analysis in accordance with the guidelines.

It is not easy for the trainees to concretely grasp the concept of economic analysis. For example, they could not perfectly understand the difference between shadow prices and market prices (i.e., tariffs). It is indeed true that the definition of "shadow price" is slightly vague. The logic of the calculation of a shadow price varies from analyst to analyst.

Unlike the ordinary procedure, on one hand, the ADB's financial analysis is based on the logic that the net gain of cash flows is calculated by deducting inputs (costs) from outputs (revenue). On the other hand, economic analysis is based on a similar logic that the net gain of benefits is calculated by deducting inputs (costs) from outputs (benefits). It seems that the term "revenue" is merely replaced with "benefits." Therefore, both analyses have a superficial similarity, and beginners are often confused.

3. Training materials, training manual, and syllabus

In the third year, three of the current trainees will be the next trainers.

The leader explained the contents of the three documents (i.e., training materials, training manual, and syllabus) and requested the trainees to check them.

The leader will hold a Zoom meeting next January, and receive their comments and revise the documents if necessary.

4. Next step

Basically, the training in the second year has been completed through the fifth mission.

The third year of the training will start from the next mission, and the three new trainers will train new trainees.

Table. Schedule for the WG1-2

Date		Participants				
		Cathy Kutkue	Beda Kuglame	Keith Kalama	Vera Lama	David Jonah
Lecture on the ADB guidelines for financial analysis						
October 31 (Tue) Afternoon class	10:00-12:00		✓	✓		
November 1 (Wed) Morning class	10:00-12:00	✓				
Afternoon class	15:30-17:00				✓	
November 10 （Thu)) Morning class	10:00-12:00					✓
Exercise in the ADB guidelines for financial analysis						
November 2 (Thu) Morning class	10:00-12:00	✓				
Afternoon class	14:00-16:00			✓	✓	
November 3 (Fri) Morning class	10:00-13:00	✓				
Afternoon class	13:00-16:00		✓	✓	✓	
November 6 (Mon) Morning class	10:00-12:00	✓	✓			
Afternoon class	14:00-16:00		✓	✓		
November 7 (Tue) Morning class	10:00-12:00		✓	✓		
Afternoon class	14:00-16:00		✓	✓	✓	
November 8 (Wed) Morning class	10:00-12:00	✓	✓			
November 9 (Thu) Morning class	10:00-12:00		✓			
November 15 (Wed) Morning class	10:00-12:00					✓
Afternoon class	14:00-16:30					✓
Lecture on economic analysis						
November 9 (Thu) Afternoon class	14:00-16:00	✓	✓	✓	✓	✓
Exercise in economic analysis						
November 10 (Fri) Afternoon class	14:00-17:00	✓	✓	✓	✓	✓
November 13 (Mon) Morning class	10:00-12:00				✓	✓
Afternoon class	14:00-16:30	✓	✓	✓		
November 14 (Tue) Morning class	10:00-11:00	✓	✓	✓		
Discussion on training manual, training materials and syllabus						
November 14 日 (Tue)	14:00-15:00	✓	✓	✓	✓	✓


Photo. WG1-2 Class during the fifth mission

WG2-1

1. Training activity

1.1 Share of Pre-draft Training Manual

JICA consultant provided WG members with Pre-draft training manual. It consists of the previous online and face-to-face training materials shown in Table 1

Table1: Configuration of Pre-draft Training Manual (Under consideration)

No.	Candidate contents
1	Basic concept of Tower and Foundation design
2	Basic concept of Conductor and Ground wire design, and method of calculating span sag
3	Basic concept of Insulation design
4	Outline of maintenance work for transmission facilities
5	Method of patrol / inspection and repair / monitoring management for malfunctioned facilities
6	Malfunction rank criteria for transmission facilities
7	Asset data management for transmission facilities
8	Planning of regular patrol / inspection work

WG members were asked to go it over by themselves and agreed. The future online training will deal with exercises or tests for previous trainings in accordance with their requests.

1.2 Implementation of training

The following trainings were implemented.

(1) Trial of patrol / inspection on site

JICA consultant has considered the updated patrol /inspection checklist and reporting form which detected malfunctions are filled out. In order to enhance the ability of patrol / inspection for transmission facilities and evaluate the created documents, on site trial was implemented at L541 No.2 tower. As a result, It was confirmed that current documents met all of required items and cautious point to manage facilities conditions properly. Minor revision points will be modified in accordance with feedbacks after this trial.

(2) Application of procured tools and measurement

As some tools and measurements were delivered to PPL during this trip, the proper ways of using these items were lectured to WG members. Especially, laser measurement can be carried in patrol / inspection work and enable to measure many kinds of distance such as line span length and tower or tree height. WG members used it actually on site and realized its effectiveness and accuracy.

(3) Safety management

Safety management shall be top priority and it's crucial to enhance the consciousness of safety for every worker. Based on current circumstances on transmission maintenance team and work flow, JICA consultant lectured the preferable and realistic safety management in PPL. It contains treatment of insulation items and safety work procedure under planned power outage conditions. WG member had same opinions with consultant and commented to try applying additional management such as regular calibration test for an earthing pole.


Photo. WG2-1 On site training


Photo. WG2-1 technical training

2. Formulation of Operation Manual and SOPs

2-1 Operation manual

JICA consultant has been preparing operation manual. It would consist of several chapters shown in Table 2.

Table2: Configuration of operation manuals (Under consideration)

Chapter No.	Contents of section
1	General
2	Demarcation
3	Implementation of work
4	Management of equipment
5	Dealing with failure power outage
6	Management of equipment specification

A large number of information related was gathered through the discussion with WG2-1 and WG2-2 members. The main discussion points are shown in Table 3

Table3: Main discussion points regarding operation manual

Chapter No.	Main Discussion points
1	Existence of law or guideline related to maintenance work
2	Maintenance Demarcation between transmission team and substation team, transmission team and generation side (PPL own and IPP)
3	Current work flow of creating long term maintenance planning and approval procedure when start operation and modification
4	Method of current tools and equipment management Company rules for using specific tools and dangerous items
5	Current work flow of obtaining planned power outage and emergency work
6	Current circumstances on asset data management such as inspection results and replacement plan

Furthermore, future schedule was proposed and agreed among WG2 members.

2-2 SOP documents

The discussion on SOP documents has been proceeded through previous trips and online meeting. JICA consultant proposed the following draft SOP documents in this trip. The proposed documents and feedbacks from WG members are described below;

(1) Inspection and planning cycle

JICA consultant proposed the suitable patrol / inspection cycle in POM grid as every 2 years, based on GIS data which shows tower locations. WG member agreed with our proposal from the perspective of prevention from severe accidents, but the necessity of reconsidering the total number of daily patrol / inspection sections was confirmed because counted total tower number was different from actual one.

From now on, JICA consultant will do the above. Whereas, WG members will consider the increase of patrol car because the scarcity of patrol car is leading the inefficiency of maintenance work.

The required information on Ramu grid will be provided soon and same consideration will be carried out.

(2) The type of patrol / inspection

The proposal consists of three types of patrol / inspection, which are regular, specific and emergency. It was agreed.

(3) Criteria of malfunction rank and repair timing

The proposal is classified into three ranks. It was agreed, but more malfunction sample pictures must be reflected to create effective criteria. Therefore, updating will be carried out.

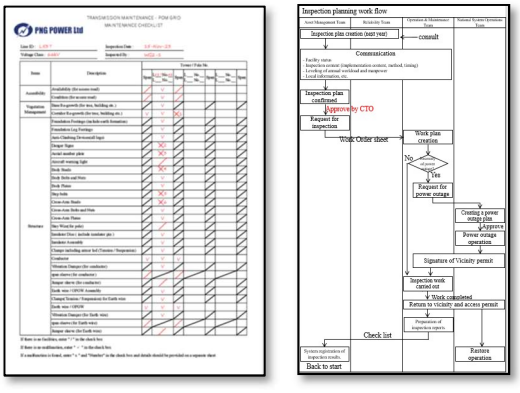
(4) Patrol / inspection documents

It's described in 1.2 (1).

(5) Work flow of patrol / inspection in transmission maintenance team

In order to make it realize to implement patrol / inspection work with SOP documents, the preferable work flow was proposed. It includes the timing of reporting the result to asset management team and approval procedure to prepare daily work plan and patrol / inspection reports between team manager and actual workers and so on. It was agreed.

Photo. Discussion on operation manual



SOP documents

3. Activity history

It was carried out as shown in the table below.

4. Future work

The preparation of operation manual will be accelerated in accordance with gathered information in this trip. The draft version will be formulated by next February.

Online training will be carried on reflecting on WG members requests toward next training when WG members are in charge of trainer. Training manuals will be updated and aimed to finalize by then.

A part of SOP documents will be modified analyzing the additional data, and incorporated into operation manual.

Date/Time	Venue	Activity	Participant
2023/11/14 10:00-15:00 (PNG time)	Procurement Room	- Share of activity schedule and outline - Share of pre-draft ver. training manual and go over previous training contents	Chris Luther, Ben Kaum Deanne Kilamanu-Naime
2023/11/15 10:00-15:00 (PNG time)	Procurement Room, L541#2 /L542#1	- Review of patrol / inspection method with checklist, malfunction drawing and result report - On-site training of patrol / inspection with the above documents	Chris Luther, Ben Kaum Deanne Kilamanu-Naime
2023/11/16 13:30-16:00 (PNG time)	Procurement Room	- Gather information toward formulation of operation manual (Day 1)	Chris Luther, Ben Kaum Deanne Kilamanu-Naime
2023/11/17 10:00-15:00 (PNG time)	Procurement Room	- Training of how to use rope and pulleys - SOPs discussion on patrol / inspection documents	Chris Luther, Ben Kaum Deanne Kilamanu-Naime
2023/11/20 10:00-15:00 (PNG time)	Strategy planning room	- Training of effective method of long term patrol / inspection planning - SOPs discussion on patrol / inspection types, cycle, criteria of malfunction rank and repair timing - Work flow of maintenance work in Transmission team	Chris Luther, Ben Kaum Esorom Passingan Deanne Kilamanu-Naime
2023/11/21 10:00-15:30 (PNG time)	T&D room	- Gather information toward formulation of operation manual (Day 2)	Chris Luther, Ben Kaum Esorom Passingan Deanne Kilamanu-Naime
2023/11/22 10:00-15:00 (PNG time)	L401#9	- On-site training of how to use a laser measurement	Chris Luther, Ben Kaum Esorom Passingan Deanne Kilamanu-Naime
2023/11/23 10:00-15:00 (PNG time)	Procurement Room	- Training of how to calculate segment of line span and tensile force using values measured by laser measurement - Training of preferable safety management for transmission work	Chris Luther, Ben Kaum Esorom Passingan Deanne Kilamanu-Naime
2023/11/24 10:00-12:00 (PNG time)	Procurement Room	- Discussion about trainer and trainee in next training - Wrap up of WG activities	Chris Luther, Ben Kaum Esorom Passingan Deanne Kilamanu-Naime

Table 4: Activity history of WG2-1 during the 5th trip

WG2-2

During this trip, WG2-2 conducted the following.

1. Technology transfer

As part of the technology transfer, on-the-job training was conducted on the equipment and materials provided and on patrol inspections.

1.1 Provided equipment and materials training

Equipment with oil leaks and rusting has been observed at PPL, and small animal measures for control boxes and other equipment have not been implemented. This time, materials such as gaskets, caulking and putty were provided to solve these problems. In the training, lectures were given on the basic knowledge and use of these materials in classroom sessions, and training was also conducted using actual materials.

In the lectures, tips and tricks for use, which can easily be handed down to the individual, were documented and know-how on their use was imparted, and the WG members were asked to impart this know-how when they become trainers in the future. He also introduced examples of accidents caused by rust and small animal infestation, and stressed the importance of not leaving defects unattended. After the lecture, the WG members were encouraged to replace these materials on a regular basis.

1.2 Visual inspection training

A classroom lecture was given on safety measures, inspection items and criteria for patrol inspections. As PPL has not conducted patrol inspections using check sheets, a patrol check sheet was prepared and proposed by JICA experts. The WG members were requested to prepare check sheets for each substation.

On 23 November, a mock visual inspection was conducted at Boroko substation using the proposed checksheet. The WG members deepened their knowledge by explaining the checkpoints and other points that were discussed in the classroom lecture on the actual equipment. As the checklist proposed by the JICA expert was a draft, opinions were collected from the WG members on the sheet, including points to be improved. The checksheet was revised to reflect the opinions received and will be shared again. It was also agreed that the WG members would prepare a checklist for each substation owned by PPL. Through this training, WG members recognized the importance of keeping records using checksheet.




Draft patrol inspection checksheet (lower section)

2. Formulation of manuals

2.1 Operation manual

During this trip, information was mainly collected for the preparation of an operations manual. Discussions were held by the members of WG2-1 and WG2-2 and a lot of information was obtained. The main topics of discussion were as follows

- Work flow for conducting periodic inspections.
- Work flow and response methods in the event of accidents and failures.
- Responsibility demarcation points for power plants and transmission and substation facilities, as well as for transmission and substation facilities.
- Status of development of asset management systems (MEX).
- Methods of operation of operation manuals (flow at the time of establishment or modification).
- Security measures for transmission and substation facilities.
- Inspection items and frequency for substation facilities.
- Existence or non-existence of abnormal ranks for accidental failures.
- Methods for updating equipment specification data when substation equipment is newly built, replaced or retired.

2.2 Training manuals

For the training manual, the lecture material prepared through previous trainings will be compiled, but opinions were collected from WG members on points for improvement. The opinions will continue to be collected and revised as appropriate.

2.3 Standard Operating Procedure (SOP)

SOP (work flow, items, decision criteria, etc.) for patrol inspections were prepared and proposed to the WG members, and opinions were collected on points to be improved. Continue to collect opinions and revise as appropriate.

3. Future work

- A draft version of the Operations Manual will be prepared based on the information obtained during this walkthrough. The SOPs will also be amended as appropriate and incorporated into the Operations Manual.
- Complete the training manual through discussions with WG members.
- Conduct online training, etc., as appropriate, to train current WG members as trainers.

WG2 Equipment testing /Evaluation

1 Provision of Equipment and Materials

1.1 Implementation of the first provision

The first provision of equipment and materials was implemented on 16th November, 2023. The items are shown in Table 1, and photographs are shown in Figure 1.

Table 1: The items of the first provision

No	Item	Specifications	Quantity
1	Battery Tester	HIOKI, BT-3554-52	3
2	Insulation Oil Acidity Tester	Musashi Intech	1
3	Consumables for Insulation Oil Acidity Tester	Musashi Intech	1
4	Gas Leak Detectors	Asada, TEK-Mate(LB001)	2
5	DC Earth Fault Locator	KEHUI, ZDT-300	1
6	Gasket	ESCO, EA351NE-3B	1
7	Rubber Sheet	KUREHA ERASTOMER, CB260NE	1
8	Sponge Packing	SHINOHARA Electric, PDR-3-10T(20m)	1
9	Packing Cutter	KANAZAWA-TEKKO, K-330	1
10	Packing Punching Punch Set	HHH, 3HP17	1
11	Caulking (epoxy-based)	DEVCON AQ, DV16115	4
12	Caulking (silicone-based)	KONISHI, 55778	2
13	Caulking Gun	TAJIMA, CNV-V	1
14	Electrical Sealing Putty	INABA, JAPPY B-02G	2
15	Grease	KYODO YUSHI, Multemp SC-S (2.5Kg/can)	1
16	Laser Rangefinders	LESER TECH, TruPulse 200L	2
17	Cremona Rope	NAGOYA-SEIKO (200m/pc)	3
18	Single Pulley	ESCO, EA987HA-175A	9
19	Polyester Southern Cross Rope	NAROC (200m/pc)	2
20	Oil Tester	Chongquing Zhongneng Oil Purifier Manufacturer Co., Ltd, Ⅱ-J-Ⅱ Transformer Oil BDV Tester for 80kV	1

Figure 1: The equipment and materials

The consultant inspected the items using a check sheet, explained the details to Mr. Simo (General Manager T&D), and completed the delivery to PPL by receiving a signature on the receipt certificate.

On the same day, a handover ceremony was held at PPL headquaters, inviting the media. The situation is shown in Figure 2.

Figure 2: Handover ceremony

1.2 Future work

The equipment and materials provided at this time will be temporarily stored at the Southern/NGI Regional Office with the cooperation of Mr. Chris (Regional Manager). The second (final) supply of the remaining materials and equipment will be implemented during the training period around May or June next year. From then on, with the cooperation of PPL, the provided materials and equipment will be placed at each Maintenance Office.

2 Training

2.1 Training by using the equipment and materials

Training was conducted for working group members by using the equipment and materials provided at this time. Specifically, we explained how to measure and judge by using battery testers, DC circuit ground fault detector, oil tester and oil acid value measurement kit using PPL's facilities.

The training situation are shown in Figures 3 and 4.

Figurer3: DC circuit ground fault detection

Figure4: Oil acid value measurement

2.2 Future work

Some equipment and materials will be provided during the training period from May or June next year, so training for WG members will be conducted next year. The contents of the training conducted at this time and the content to be implemented next year will be the content of the training that will be conducted from May or June next year by WG members to other staff.

3 Creation of Manuals

3.1 Operational Manual

WG2 member considers the Operational Manual to be the rules that define the flow of maintenance work. The content is planned to specify the flow of responses to equipment abnormalities. In order to create this, in addition to hearing from WG members about the current PPL's responsibilities and work flow, we also held discussions on how to define areas that are currently not clearly defined. Figure 5 shows the discussion with the working group members.

Figure 5: Discussion about the Operational Manual with WG members

3.2 Standard Operating Procedure (SOP)

Regarding the maintenance items specified in the Operational Manual, we are considering attaching SOPs to each of them as instructions that give an image of the work contents. This time, the consultant created a sample SOP using photos of actual training sessions, provided an image of the content to the working group members, and then explained

the key points in creating it. Figure 6 shows an image of the SOP sample. In addition, regarding maintenance items that are not covered in this project, we taught that it is important for PPL to prepare samples and satisfy SOPs in order to maintain maintenance quality.

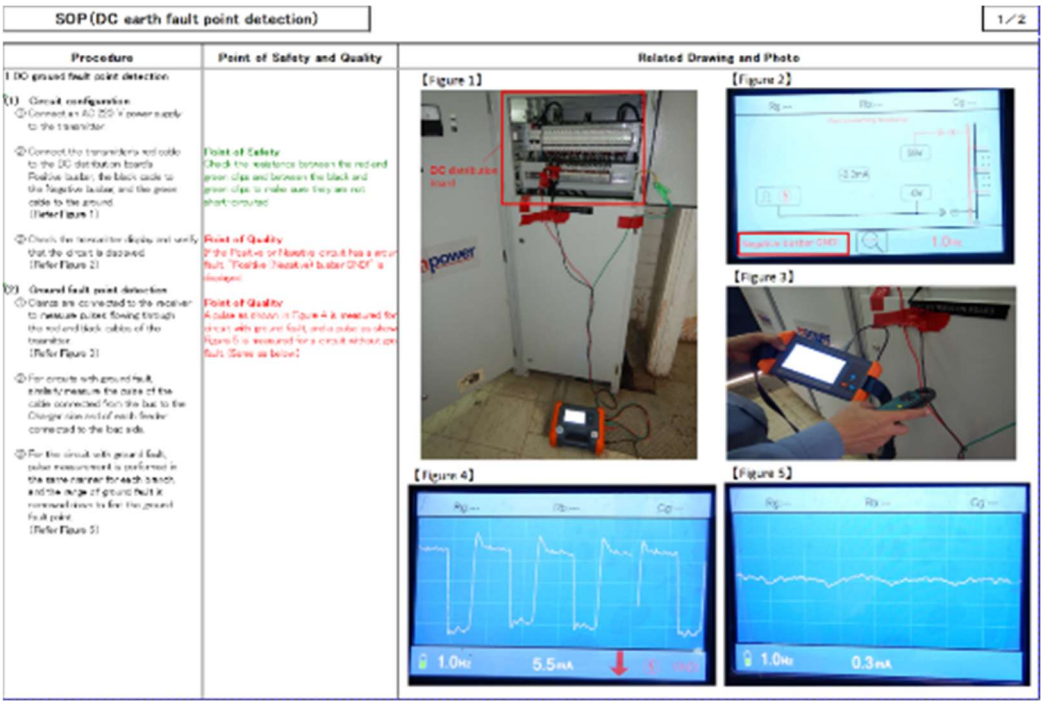


Figure 6: Image of the SOP sample created this time

3.3 Future work

Regarding the Training Manual, we will review the structure based on the lecture materials that have been given so far so that it will contribute to PPL's educational activities. Regarding the Operational Manual, the contents of the draft will be revised based on the content discussed this time. Concerning SOP, we will continue to create the content of the training and attach it to the Operational Manual. The draft of these manuals is scheduled to be submitted to the JCC in February 2023, so we will proceed with the work with this in mind.

4 Activity history

Because Equipment testing/Evaluation team worked primarily in conjunction with WG 2 -2, the activity history is included in WG 2 -2.

5. WG2-2 Activities in the 5th mission (Including Equipment Testing/Evaluation)

The performance of WG2-2 activities during this mission is as follows;

Date & time	Room	Contents	Attendees
2023/11/14 11:00-12:00 13:30-15:00 (PNG time)	Procurement Room, PPL BF	-Kick-off meeting -Desk lecture on tests to determine the degradation of transformer insulating oil	S. Deveo S. Robert B. Inamo T. Naipu R. Rawali
2023/11/15 10:00-12:00 14:00-16:00 (PNG time)	Procurement Room, PPL BF	-Provided equipment and materials training (classroom) ▪ Overview of packing and gaskets ▪ How to install gasket ▪ About Door gasket ▪ Prevent of small animals ▪ About visual inspection	S. Deveo S. Robert B. Inamo T. Naipu R. Rawali
2023/11/16 10:00-12:00 13:30-16:00	Procurement Room, PPL BF	-Discussion on draft operations manual (jointly with WG2-1)	S. Deveo S. Robert T. Naipu R. Rawali (WG2-2 only)
2023/11/17 10:00-12:00 14:00-15:00	Boroko substation, PPL	- Training on provided measuring equipment (on site) ▪ Battery tester ▪ DC grounding probe	S. Deveo S. Robert T. Naipu R. Rawali
2023/11/20 10:00-12:00 14:00-15:30	Corporate Service Room, PPL, 2F	-Lecture on how to use the patrol inspection check sheet (classroom) -Practical training on creating SOPs (classroom) -Paper test regarding tests to determine the degradation of transformer insulating oil (classroom)	S. Deveo S. Robert T. Naipu R. Rawali
2023/11/21 10:00-12:00 13:30-15:30	T&D Room, PPL, 3F	-Discussion on draft operations manual (jointly with WG2-1)	S. Deveo S. Robert T. Naipu R. Rawal (WG2-2 only)
2023/11/22 10:00-12:00 13:30-15:00	Workshop, PPL	-Provided measuring equipment training ▪ Insulating oil pressure testers ▪ Insulation oil acid value testers -Training on materials to be supplied ▪ Putty, caulking and gaskets	S. Deveo S. Robert T. Naipu R. Rawal
2023/11/23 10:00-12:00	Boroko substation, PPL	-Visual inspection training (on site)	S. Robert T. Naipu R. Rawali
2023/11/24 10:00-12:00 13:30-14:00	T&D Room, PPL, 3F	-Operations manual discussion (substation part) -Trainee selection discussion -Wrap-up meetings	S. Robert R. Rawali

WG3

During this trip, WG3 conducted the following.

1. Outline of Activities

- Period: November 1 to November 14, 2023
- Place: PPL National System Operation
- Attendees: Mr. Melvin Angi, Mr. Michael Akep

2. Technology Transfer

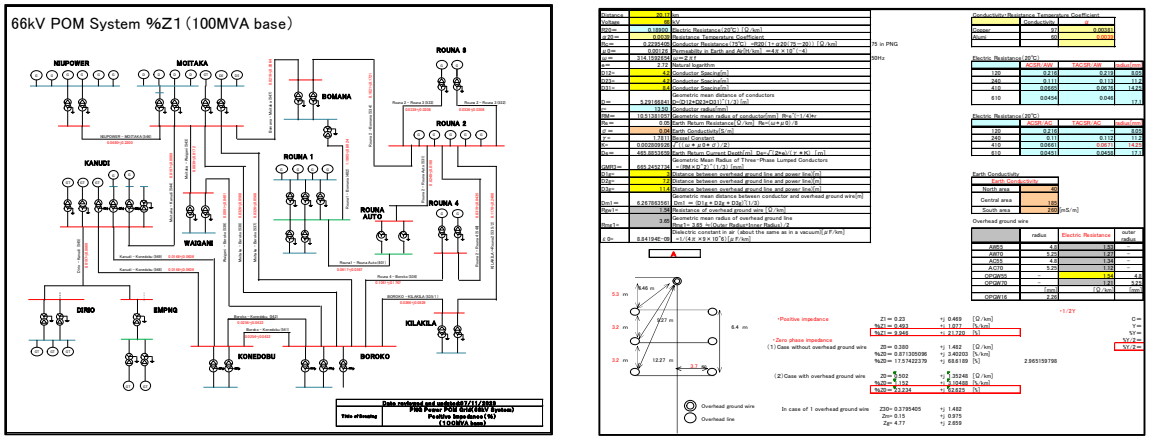
The following practical training was conducted as technology transfer, and the content of the training was reflected in the operational manual so that it can continue to be practiced in the future.

- **Impedance Calculation**

We explained how to use the calculation spread sheet and trained to be able to perform the calculations in practice. Although it was planned to conduct calculations using PPL's transmission line parameters, it became difficult to conduct the calculations because the drawings of the tower were not properly managed.

PPL currently obtains impedance by actual measurement test, but in the future, they will utilize the calculation sheet while comparing the measured and calculated values.

For the impedance map, the transmission line portion was completed. It was confirmed that transformer constants will be included for the next step.



Impedance Map (Left), Calculation Spread Sheet (Right)

- **CT Saturation Study**

Explanations were given on how to utilize the spread sheet as well as impedance calculations. In addition, CT saturation study installed on PPL's transmission line (544) was conducted. The results of the study confirmed that an appropriate CT ratio was selected and that there was no possibility of CT saturation.

- **Distance Relay Setting**

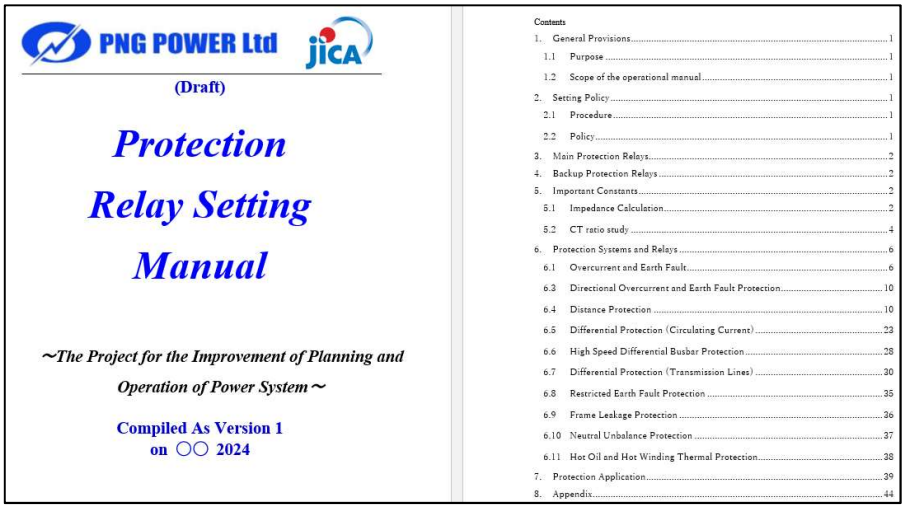
We checked the distance relay installed on the transmission line (544) at the Moitaka substation. Two types of distance relays are used in PPL: MicomP543 and ToshibaGRZ100.

Each has a different setting method, but both were found to be properly calculated. We also visited the substation and confirmed that the appropriate values were input to the distance relay itself.

3. Manuals

During this trip, an operational manual was developed.

- The protection team had an operational manual that was established in March 1977, and it was becoming out of date.
- Through WG activities, items to be included in the Operational Manual were organized and a draft version was prepared.
- Three manuals (1) Training Manual, (2) SOP, and (3) Operational Manual were sent to Mr. Ivan (General Manager) and Ms. Benedicta (Manager) for review.


PNG POWER Ltd JICA

(Draft)

Protection Relay Setting Manual

~The Project for the Improvement of Planning and Operation of Power System~

Compiled As Version 1
on ○○ 2024

Contents

Operational Manual (cover and table of contents)

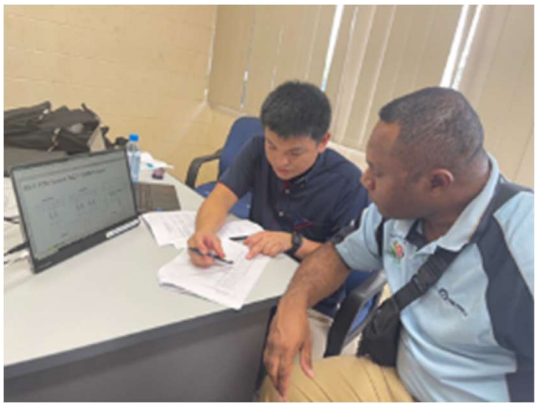
4. For the Next step

- Add transformer constants to the impedance map.
- Based on feedback from managers, the manuals will be revised.

5. WG3 activities conducted during this trip

The following table shows the results of the activities.

Date & time	Room	Contents	Attendees
2023/11/01 10:00-12:00 (PNG time)	NSO Room, PPL B1	- Explanation of the purpose of this trip - Discussion on the draft Operational Manual - Impedance calculation practices	Melvin Angi
2023/11/02 14:00-16:30 (PNG time)	NSO Room, PPL B1	- Impedance calculation practices	Melvin Angi、 Michael Akep
2023/11/03 10:00-12:00 (PNG time)	NSO Room, PPL B1	- Impedance calculation practices - CT Study	Melvin Angi、 Michael Akep
2023/11/06 10:00-12:00 14:00-16:00 (PNG time)	NSO Room, PPL B1	- Impedance calculation practices - CT Study	Melvin Angi、 Michael Akep
2023/11/07 14:00-16:00 (PNG time)	NSO Room, PPL B1	- How to use impedance map - Distance relay setting practices	Melvin Angi、 Michael Akep
2023/11/08 10:00-12:00 (PNG time)	Moitaka Substation	- Site visit of substations to be interconnected by IPP (Edevu Hydro Power) - Check the setting value of the distance relay unit	Melvin Angi、 Michael Akep
2023/11/09 14:00-16:30 (PNG time)	NSO Room, PPL B1	- Distance relay setting practices - Creating operational manuals	Melvin Angi、 Michael Akep
2023/11/10 14:00-16:30 (PNG time)	NSO Room, PPL B1	- Creating operational manuals	Melvin Angi、 Michael Akep
2023/11/14 11:30-12:00 (PNG time)	NSO Room, PPL B1	- Briefing on the manuals to Mr. Ivan	Ivan Pekaea

WG 3 Activities

WG4

WG4 activities conducted in this trip are below.

1. HRD manual

In this trip, the draft of HRD manual is verified by PPL. Through WG activities, main points we discussed are below.

（1） Practical Work Experience

As a requirement of trainer certification, trainer and assistant trainer should have practical work experience at least 7years, 5 years respectively. The reason for this requirement is based on ideas with developing enough skill and confidence as becoming a trainer or assistant trainer. In addition, because the reason for requirement of taking lecture for trainee is that they should be allowed to take a lecture after their incoming employee training, at least 2 years working in PPL is set as a requirement for trainee.

（2） Rule of trainer certification expiration

To maintain the quality of trainers, incumbent trainers need to conduct a training at least 1 time every single year. This is based on PPL's idea that they want to maintain an enough quality of trainer to provide appropriate training sustainably.

（3） Monitoring of situation of trainer certification

To be able to manage the status the number of certificated members and taking members of training, we created a trainer recording ledger as an attachment. Trainer activities can be tracked using this ledger, so that it is helpful for not being expired trainer certification. In addition, trainer activity is included in one of the factors in KPI.

（4） Incentive

To prevent from expiration of trainer certification since trainer forget to conduct their trainer activities, trainers need to conduct training positively. Therefore, as an incentive, PPL can set an allowance according to an existing training policy by themselves after this project. This incentive is not needed to be written in this HRD manual.

2.Seriese of Attachment

Series of attachments of HRD manual are confirmed by PPL.

1. Application for trainer, assistant trainer, trainee
2. Trainer Checklist
3. Trainer recording ledger
4. KPI Form

Date	Room	Discussion Contents	Participants
2023/11/01 14:00-16:00 (PNG time)	Procurement Room	1. - Review of the past 2. - Draft HRD manual	Andrew.Y, Andrew.K
2023/11/02 10:00-11:30 (PNG time)	Procurement Room	3. Confirmation of practical working experience in each WG	Andrew.Y, Chris Luther, Melvin Angi
2023/11/08 15:00-16:30 (PNG time)	Procurement Room	4. Approval Procedures for Trainer Certification 5. Procedures for conducting training	Kevin.K, Andrew.K
2023/11/09 14:00-16:00 (PNG time)	Procurement Room	6. Incentives for maintaining trainer certification. 7. Monitoring of certification status	Kevin.K, Andrew.Y, Andrew.K
2023/11/15 10:00-12:00 (PNG time)	Procurement Room	1. Approval of a set of documents related to the draft. 2. Sharing of activities for the next trip	Michael. P, Andrew.K

4.Future Activity

The draft of HRD Manual and related materials have been approved by PPL as of this trip. In the third year, each WG will conduct training based on this draft and revise it as the final version. We will give a presentation at JCC in February that this draft has been confirmed by PPL.


Photo: WG4 activities

Progress of the training

○ WG1-1 System planning

Lectures on grid analysis, rules for grid operation, the impact of the penetration of renewable energy, etc. were held three times in total, once in training in Japan and three times online.

In addition, during the training in Japan, WG members from PPL confirmed the actual state of grid interconnection operations at PPL, acquired basic skills in power system analysis using the power system analysis software PSS/E. And WG members from PPL acquired the ability to understand and update the "Papua New Guinea Least Cost Power Development Plan Update December 2020" published by the World Bank.

Table1 Training of the System planning WG in PNG

Date and Time	Contents	Trainees
2023/7/25 9:30 - 12:00 (JPN time)	(Discussion) Actual status of grid interconnection work - Grid cord of PNG - Work flow of PPL	Benedicta Savage Charlie Enos Haidi Wanya
2023/7/26 9:30 - 12:00 (JPN time)	(Lecture) System analysis theory - Concept of stability - Synchronous Stability - Voltage Stability - Per-Unit method - Δ-Y transform - Exercises	Benedicta Savage Charlie Enos Haidi Wanya
2023/7/27 9:30 - 12:00 (JPN time)	(Exercises) Power System Analysis using PSS/E - Load Flow Calculation - Dynamic Stability Simulation - Short Circuit Current Calculation	Benedicta Savage Charlie Enos Haidi Wanya
2023/8/1 9:30 - 12:00 13:00 - 16:00 (JPN time)	Assess least cost development plan part1 - Executive Summary - Background	Benedicta Savage Charlie Enos Haidi Wanya
2023/8/2 9:30 - 12:00 13:30 - 16:00	Assess least cost development plan part2 - Updated Least-cost Generation Expansion Study	Benedicta Savage Charlie Enos Haidi Wanya

(JPN time)	- Main Findings and Recommendations	
2023/8/3 10:30 - 12:00 13:00 - 16:00 (JPN time)	Assess least cost development plan part3 - Major Assumptions for Updating the Least-cost Generation Expansion Study - Load Assumptions Used for the Least-cost Transmission Expansion Study - Transmission Investment Projects	Benedicta Savage Charlie Enos Haidi Wanya

Table2 Online Training of the System planning WG

Date and Time	Contents	Trainees
2023/4/26 10:00 - 11:00 (JPN time)	Supply and Demand Control - Power Demand Curve - Supply and Demand Control - Next Day Plan - Frequency Control	Benedicta Savage Charlie Enos Haidi Wanya
2023/6/2 13:15 - 14:15 (JPN time)	Operation rule in Central and Western interconnection system - Control method - Interconnection between companies - Frequency Quality - Cross-regional Coordination - Quality Evaluation	Benedicta Savage Charlie Enos Haidi Wanya
2023/10/10 9:00 - 10:00 (JPN time)	Influence and Challenges on Power Grid Operation with High Penetration of Renewable Energy - Issues and current situation of reverse current - Equipment measures - How to identify the reverse current - Flow chart of the measure	Benedicta Savage Charlie Enos Haidi Wanya

○WG1-2 Financial and Economic analysis

We proceeded with the exercises in financial analysis for a project during the training in Japan, and enhanced the trainees' capacity so that they would be able to compile more complex models. After the training in Japan, we got the remaining exercises done by online training in September and October and finalized the training in financial analysis for a

project.

During the fifth mission, we conducted lectures on and exercises in cost-benefit evaluation (i.e., a sort of financial analysis) and economic analyses in accordance with the guidelines of the Asian Development Bank (ADB).

Since the ADB approach to analysis is unique and differs from the general theory, we performed exercises by comparing both ADB and ordinary procedures for financial analysis. Due to the critical difference of logic between the two, the trainees were slightly confused. But they must have basically understood the ADB approach, because the calculation itself is simple.

With regard to economic analysis, the ADB guidelines are well organized, and we conducted lectures and exercises based on them.

The training in the second year was finally completed with the end of the fifth mission in November.

With regards to the preparation of manuals, all of the materials used for the lectures and exercises up to that time have been compiled in one package of training materials.

In addition, we produced a training manual (i.e., a sort of guidance book) for trainers.

Apart from the training manual, for staff members who wish to join the training, we also produced a syllabus that showed the objectives, contents, and expected outcomes of the training.

Table3. WG1-2 Training in Economic and Financial Analysis in Japan

Date and Time	Contents	Trainees
2023/7/24 (Mon) 15:00 - 18:00	Briefing about the training schedule	David Jonah Keith Kamala Beda Kuglame Cathy Kutkue Vera Lama
2023/7/25 (Tue) 9:00 - 12:00	Exercise in financial analysis for a project	
2023/7/26 (Wed) 9:00 - 12:00	ditto	
2023/7/27 (Thu) 9:00 - 12:00	How to use the if function Exercise in financial analysis for a project by using the if function	
2023/7/31 (Mon)	Briefing about the report on the training in Japan	

13:00 - 15:00		
2023/8/1 (Tue) 13:00 - 16:00	Report writing	
2023/8/2 (Wed) 13:45 - 16:00	Compilation of the report	
2023/8/3 (Wed) 13:30-16:30	Exercise in financial analysis for a project using multiple if functions to judge complex premises.	

Table 4. WG1-2 Training in Economic and Financial Analysis in PNG

Date and Time	Contents	Trainees
2023/10/31 (Tue) 10:00 - 12:00	Lecture on the ADB guidelines for financial analysis	Keith Kamala Beda Kuglame
2023/11/1 (Wed) 10:00 - 12:00	ditto	Cathy Kutkue
15:30 - 17:00	ditto	Vera Lama
2023/11/2 (Thu) 10:00 - 12:00	Exercise in financial analysis in accordance with the ADB guidelines	Cathy Kutkue
14:00 - 16:00	ditto	Keith Kamala Vera Lama
2023/11/3 (Fri) 10:00 - 13:00	ditto	Cathy Kutkue
13:00 - 16:00	ditto	Keith Kamala Beda Kuglame Vera Lama
2023/11/6 (Mon) 10:00 - 12:00	ditto	Beda Kuglame Cathy Kutkue
14:00 - 16:00	ditto	Keith Kamala Beda Kuglame
2023/11/7 (Tue)	ditto	Keith Kamala Beda Kuglame

10:00 - 12:00		
14:00 - 16:00	ditto	Keith Kamala Beda Kuglame Vera Lama
2023/11/8 (Wed) 10:00 - 12:00	ditto	Beda Kuglame Cathy Kutkue
2023/11/9 (Thu) 10:00 - 12:00	ditto	Beda Kuglame
14:00 - 16:00	Lecture on the ADB guidelines for economic analysis	David Jonah Keith Kamala Beda Kuglame Cathy Kutkue Vera Lama
2023/11/10 (Fri) 10:00 - 12:00	Lecture on the ADB guidelines for financial analysis	David Jonah
14:00 - 17:00	Exercise in economic analysis in accordance with the ADB guidelines	David Jonah Keith Kamala Beda Kuglame Cathy Kutkue Vera Lama
2023/11/13 (Mon) 10:00 - 12:00	ditto	David Jonah Vera Lama
14:00 - 16:30	ditto	Keith Kamala Beda Kuglame Cathy Kutkue
2023/11/14 (Tue) 10:00 - 11:00	ditto	Keith Kamala Beda Kuglame Cathy Kutkue
14:00 - 15:00	Explanation of the training manual, training materials, and syllabus	David Jonah Keith Kamala Beda Kuglame Cathy Kutkue

		Vera Lama
2023/11/15 (Wed) 10:00 - 12:00	Exercise in financial analysis in accordance with the ADB guidelines	David Jonah
14:00 - 16:30	ditto	David Jonah

Table 5. WG1-2 Online Training in Economic and Financial Analysis

Date and Time	Contents	Trainees
2023/6/13 (Tue) 10:00 - 12:00	Exercise in calculations of project and equity IRRs for real-estate and infrastructure projects as examples	Cathy Kutkue
13:00 - 15:00	ditto	Keith Kamala Beda Kuglame
2023/6/14 (Wed) 10:00 - 12:00	ditto	Keith Kamala Beda Kuglame
13:00 - 15:00	ditto	Cathy Kutku
2023/6/15 (Thu) 13:00 - 15:00	ditto	Keith Kalama
2023/6/20 (Tue) 13:30 - 15:30	ditto	Vera Lama
2023/6/22 (Thu) 12:00 - 14:00	ditto	Jonah David
14:00 - 16:00	ditto	Vera Lama
2023/7/17 (Mon) 13:00 - 15:00	ditto	David Jonah
2023/9/13 (Wed) 10:00 - 12:00	Exercise in financial analysis	Beda Kuglame Cathy Kutkue
13:30 - 15:30	ditto	Keith Kamala Vera Lama
2023/9/14	ditto	Beda Kuglame

(Thu) 10:00 - 12:00		
2023/9/21 (Thu) 10:00 - 12:00	ditto	Vera Lama
13:00 - 15:00	ditto	Beda Kuglame
2023/9/22 (Fri) 10:00 - 12:00	ditto	Cathy Kutkue
2023/9/25 (Mon) 10:00 - 12:00	ditto	Beda Kuglame
13:00 - 15:00	ditto	Keith Kamala
2023/9/28 (Wed) 10:00 - 12:40	ditto	Cathy Kutkue
13:00 - 15:00	ditto	Beda Kuglame
2023/9/29 (Thu) 10:00 - 12:00	ditto	Keith Kamala
13:00 - 15:00	ditto	Cathy Kutkue
2023/10/2 (Mon) 10:00 - 12:00	ditto	Vera Lama
2023/10/6 (Fri) 14:00 - 17:00	ditto	Keith Kamala
2023/10/9 (Mon) 13:00 - 16:30	ditto	Keith Kamala
2023/10/18 (Wed) 13:30 - 15:30	ditto	Vera Lama

○WG2-1 Transmission line

On-site training and online training are continued to improve knowledge and improve

operations in transmission facility maintenance and asset management in the first year. In addition to maintenance topics such as necessary inspection for each facility and methods for determining facility malfunction, the training also covers the functions and basic design concepts of transmission facilities and safety measurements under power outage work intending to acquire the checkpoints and sensitivity in inspection and repair work. The training dealing with ropes and laser measurements procured in 2nd year.

Table6. WG2-1 Training of the Transmission line WG in PNG

Date and Time	Contents	Trainees
2023/7/25 9:00-12:00 （JST）	・Witness for the training of new employee （Training center in Kansai T&D）	Chris Luther Ben Kaum Esorom Passingan
2023/7/25 14:00-16:00 （JST）	・Technical survey to 500kV transmission line (Inagawa substation in Kansai T&D)	Chris Luther Ben Kaum Esorom Passingan
2023/7/26 10:00-11:30 （JST）	・Witness to 275kV transmission line upgrading project. （Shin-Kakogawa transmission line construction site）	Chris Luther Ben Kaum Esorom Passingan
2023/7/26 13:30-16:30 （JST）	・Witness to maintenance center for transmission and substation facilities. （Noe maintenance center in Kansai T&D）	Chris Luther Ben Kaum Esorom Passingan
2023/7/27 10:00-12:00 （JST）	・Learning of calculation method of conductor tensile force and sag of line span (Headquarters in Kansai T&D)	Chris Luther Ben Kaum Esorom Passingan
2023/8/3 10:00-12:00 （JST）	-Learning of appropriate methods of patrol / inspection （JICA Okinawa office）	Chris Luther Ben Kaum Esorom Passingan
2023/11/14 10:00-15:00 (PNG time)	- Share of activity schedule and outline Share of pre-draft ver. training manual and go over previous training contents	Chris Luther, Ben Kaum Deanne Kilamanu-Naime
2023/11/15 10:00-15:00 (PNG time)	- Review of patrol / inspection method with checklist, malfunction drawing and result report On-site training of patrol / inspection with the above documents	Chris Luther, Ben Kaum Deanne Kilamanu-Naime
2023/11/17	- Training of how to use rope and pulleys	Chris Luther,

10:00-15:00 (PNG time)	SOPs discussion on patrol / inspection documents	Ben Kaum Deanne Kilamanu-Naime
2023/11/20 10:00-15:00 (PNG time)	- Training of effective method of long term patrol / inspection planning	Chris Luther, Ben Kaum Esorom Passingan Deanne Kilamanu-Naime
2023/11/22 10:00-15:00 (PNG time)	On-site training of how to use a laser measurement	Chris Luther, Ben Kaum Esorom Passingan Deanne Kilamanu-Naime
2023/11/23 10:00-15:00 (PNG time)	- Training of how to calculate segment of line span and tensile force using values measured by laser measurement Training of preferable safety management for transmission work	Chris Luther, Ben Kaum Esorom Passingan Deanne Kilamanu-Naime

Table7. WG2-1 Online Training of the Transmission line WG

Date and Time	Contents	Trainees
2023/6/21 10:00-12:00 (PNG time)	Learning of calculation method of conductor tensile force and sag of line span	Chris Luther Ben Kaum Esorom Passingan
2023/6/28 10:00-12:00 (PNG time)	Learning of Checkpoints of tower design documents to apply to maintenance work	Chris Luther Ben Kaum Esorom Passingan
2023/9/21 10:00-12:00 (PNG time)	Learning of using calculation program	Chris Luther Ben Kaum Esorom Passingan

○WG2-2 Substation

Training was continued with the aim of improving knowledge of substation equipment maintenance work and asset management, as well as maintenance plan formulation skills. During the fifth trip, materials and equipment were provided, and training was conducted on basic knowledge, how to use them, and how to judge data. Additionally, since PPL aims to introduce systematic preventive maintenance, training for patrol inspections (items, points of focus, judgment criteria, etc.) was conducted. And also training was

carried out about how to create SOPs with the aim of creating by themselves in the future.

Table8. WG2-2 Training of the Substation WG in PNG

Date and Time	Contents	Trainees
2023/11/14 11:00-15:00 (PNG time)	-Kick-off meeting -Desk lecture on tests to determine the degradation of transformer insulating oil	S. Deveo, S. Robert,B. Inamo, T. Naipu,, R. Rawali
2023/11/15 10:00-16:00 (PNG time)	-Provided equipment and materials training (classroom) ▪ Overview of packing and gaskets ▪ How to install gasket ▪ About Door gasket ▪ Prevention of small animals ▪ About visual inspection ▪ Inspection items, checkpoints, and judgment criteria	S. Deveo, S. Robert,B. Inamo, T. Naipu,, R. Rawali
2023/11/17 10:00-15:00 (PNG time)	- Training on provided measuring equipment (on site) ▪ Battery tester ▪ DC grounding fault locator	S. Deveo, S. Robert,T. Naipu, R. Rawali
2023/11/20 10:00-15:30 (PNG time)	-Lecture on how to use the patrol inspection check sheet (classroom) -Practical training on creating SOPs (classroom) -Paper test regarding tests to determine the degradation of transformer insulating oil (classroom)	S. Deveo, S. Robert,T. Naipu, R. Rawali
2023/11/22 10:00-15:00 (PNG time)	-Training on provided measuring equipment ▪ Insulating oil tester ▪ Insulation oil acid value tester -Training on provided materials ▪ Putty, caulking and gaskets	S. Deveo, S. Robert,T. Naipu, R. Rawali

2023/11/23 10:00-12:00 (PNG time)	-Visual inspection training (on site)	S.Robert, T. Naipu, R. Rawali

○WG3 Protection coordination

During the 5th trip's on-site training, impedance calculations and relay setting were conducted using PPL's power system parameters to ensure that past trainings could be applied in practice. Furthermore, we confirmed that the appropriate values were input to the protection relays installed in the substations. The transfer of technology to C/P was completed with the completion of practical training during the 5th trip.

Table9. WG3 Training of the Protection coordination WG in PNG

Date and Time	Contents	Trainees
2023 /11 /1 10:00-12:00 PNG time	・Impedance Calculation Practice - (Overhead power lines)	Melvin Angi
2023 /11 /2 14:00-16:30 PNG time	・Impedance Calculation Practice - (Overhead power lines)	Melvin Angi Michael Akep
2023 /11/3 10:00-12:00 PNG time	・Impedance Calculation Practice -(Overhead power lines) ・Various factors required for CT ratio study	Melvin Angi Michael Akep
2023 /11 /6 10:00-12:00 PNG time	・Various factors required for Impedance Calculation -(Overhead power lines)	Melvin Angi Michael Akep
2023 /11 /6 14:00-16:00 PNG time	・CT ratio study Practice	Melvin Angi Michael Akep
2023 /11 /7 14:00-16:00 PNG time	・How to Use Impedance Map ・Distance Relay Setting Practice	Melvin Angi Michael Akep
2023 /11 /9 14:00-16:30 PNG time	・Distance Relay Setting Practice	Melvin Angi Michael Akep

Table10. WG3 Training of the Protection coordination WG in Japan

Date and Time	Contents	Trainees
2023/7/25 09:30-12:00 JPN time	・CT Ratio Study	Melvin Angi Michael Akep
2023/7/26 09:30-12:00 JPN time	・Impedance Calculation - (Underground power lines)	Melvin Angi Michael Akep
2023/7/27 09:30-12:00 JPN time	・Fault Analysis	Melvin Angi Michael Akep
2023/8/1 09:30-11:30 JPN time	・Power System Overview of Okinawa Electric Power Co.	Melvin Angi Michael Akep
2023/8/1 13:30-15:30 JPN time	・Overview of load dispatching center	Melvin Angi Michael Akep
2023/8/2 09:30-11:30 JPN time	・Overview of Power System Stabilizing Controller	Melvin Angi Michael Akep
2023/8/2 14:00-15:00 JPN time	・Mega Solar Demonstration Study	Melvin Angi Michael Akep
2023/8/3 09:30-11:30 JPN time	・Relay Setting Simulation	Melvin Angi Michael Akep

Table11. WG3 Online Training of the Protection coordination WG

Date and Time	Contents	Trainees
2023/10/20 13:00-14:00 JPN time	・Impedance Calculation Practice - (Overhead power lines)	Melvin Angi Michael Akep
2023/10/20 14:00-15:30 JPN time	・Differential Relay Setting	Melvin Angi Michael Akep

To CR of JICA PNG Office

Project Monitoring Sheet

Project Title: PROJECT FOR THE IMPROVEMENT OF PLANNING AND OPERATION OF POWER SYSTEM

Version of the Sheet: Ver.4 (July. 2024)

Name: Nehemaiah Naris
Title: Project Director

Name: Seiji Ueoka
Title: Chief Advisor / System Planning

Submission Date: 3rd July, 2024

PROJECT FOR THE IMPROVEMENT OF PLANNING
AND OPERATION OF POWER SYSTEM
Monitoring Sheet

Table of Contents

ABBREVIATIONS

Symbol	English
C/P	Counterpart
DFAT	Australian's Department of Foreign Affairs and Trade
IPP	Independent Power Producer
JCC	Joint Coordination Committee
KCH	Kumul Consolidated Holdings Limited
KPI	Key Performance Indicators
NEA	National Energy Authority
NSO	National system operation
PDM	Project Design Matrix
PEP	PNG Electrification Partnership
PNG	Papua New Guinea
PO	Plan of Operation
POM	Port Moresby
PPL	Papua New Guinea Power Ltd
PSSE	Power System Simulator for Engineering
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SMEC	SMEC Holdings Limited
SOP	Standard Operating Procedures
STATCOM	Self-commutated Static Var Compensator
WG	Working Group

I. Summary

1. Progress

1-1. Progress of Input

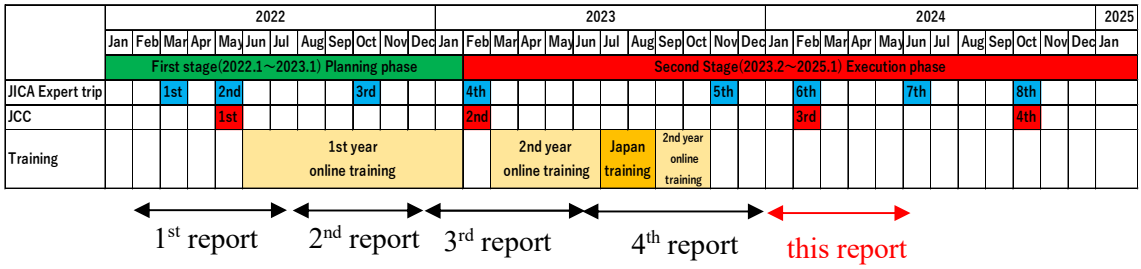


Fig.1 Activity Schedule

A contract for the implementation of this project was signed on 14th January 2022, and the project has started for about three years (until 24th January 2025).

This report describes the results in the first half of the third year (January 2024 to May 2024).

In the first half of the third year, the results of the activities up to the second year and the activity plan for the third year will be explained at the 3rd JCC.

In line with the third-year activity plan approved by the JCC, we began training from trainer candidates to PPL staff and revised various manuals.

The progress of inputs at each dispatch stage is summarized below.

From Japan Side

6th Dispatch

The sixth dispatch was conducted for approximately three weeks starting in mid-February 2024. During the 6th dispatch, the 3rd JCC was held, and the activity plan for the 3rd year was explained and approved. In addition, we made arrangements for the workshops scheduled to be held during the 7th trip, as well as the PPL staff who will be training trainer candidates in the third year. Please refer to the attachment1 for the detailed activity results.

WG activity

Training was conducted and a manual was created during the 6th dispatch. In addition, some working groups conducted online training..

Delivery of materials and equipment

During the 6th trip, coordination on site was carried out for the provision during the next trip. After that, during the 7th trip, which is currently underway, the 2nd provision of the equipment and materials was completed on May 31st.

Table 1-1-1 shows the planned and actual input of these personnel.

Table 1-1-1 Personnel input status

No.	Field of expertise	Total Man/Month(M/M) (M/M of Jan 2024-May 2024)	
		In PNG	In Japan
1	Team Leader / System Planning	4.27(0.60)	5.50(0.80)
2	Grid Technology	2.83(0.00)	2.80(0.20)
3	Financial and Economic Analysis	3.17(0.60)	3.30(0.25)
4	Transmission Line	2.97(0.20)	3.63(0.80)
5	Substation	3.50(0.00)	4.83(1.15)
6	Equipment Testing / Evaluation	2.67(0.67)	3.93(0.80)
7	Protection Coordination[1]	3.67(0.00)	4.98(1.20)
8	Human Resource Management / Training Planning	2.90(0.60)	2.60(0.20)
9	Grid Technology(Assistant) / Business Coordination	4.27(0.60)	1.60(0.30)

From PNG side

Host of 3rd JCC

The 3rd JCC was held, and attendances discussed the project's activity plan, etc.

WG member

21 people were appointed as WG members of this project, and 20 members were dispatched to Japan for training.

Provision of office and WG space

An office space was prepared in the PPL for the 5th dispatch of experts. PNG side also arranged meeting rooms and other facilities necessary for WG activities and cooperated in the smooth implementation of WG activities.

Provision of related documents

The existing PPL materials needed for the preparation of the manual were provided.

[1] Protection coordination: Adjustment of the setting values of protection relays to prevent the spread of power outage by disconnecting only the minimum range in the event of an electrical fault caused by various abnormalities that may occur in the power system.

1-2. Progress of Activities

The progress of each activity is described in Table 1-2-1.

Output 1

Table.1.2.1 The progress of each activity (Output 1)

Activities in Project Design Matrix (PDM)		Activities conducted in the period	Achievement status
1-1	Assess the current capacity of system planning for the transmission line	The results of the baseline survey were explained at the 2nd JCC.	Achieved
1-2	Formulate Working Groups (WG) for (1) system planning and (2) financial and economic analysis	No change in WG1-1, but one trainee withdrew from WG1-2 due to another assignment for a different training program.	Achieved
1-3	Conduct training for trainer candidates on basis on system planning for the transmission line	Lectures on grid analysis, rules for grid operation, the impact of the penetration of renewable energy, etc. were held three times: once in Japan and twice online. In particular, during the training in Japan, we carefully reviewed the theoretical content behind the system analysis software used for system planning. In addition, WG members from PPL deepened their understanding of basic electrical theory by having them solve calculation examples of voltage and current values in a simplified power system as practice problems.	Achieved
1-4	Conduct training for trainer candidates on system simulation using tools such as PSS/E	During the training in Japan the 6th dispatch of experts, each WG member from PPL actually operated the system analysis software PSS/E and run simulations. As a result of the training, each WG member from PPL was able to acquire	Expected to achieve

		basic skills in simulation using system analysis software. We plan to hold lectures on how to operate PSS/E during the 7th dispatch of experts to improve the abilities of WG members.	
1-5	Conduct training for trainer candidates on basis on financial and economic analysis	During the sixth mission, the third-year training started. Three staff were assigned for new trainers, and five staff were nominated by the PPL as new trainees (these numbers changed to two trainers and four trainees due to the withdrawal of two persons). The training manual and materials were compiled during the fifth mission. Using those materials, the new trainers teach the new trainees. Although new trainees have little experience of economic and financial analysis for a project, their capacity to acquire new knowledge in the training is high because they have basic knowledge of economics or accounting. After the mission, the online training started at a pace of two hours a session, two sessions a week, and eight sessions a month.	Expected to achieve
1-6	Develop the PPL Official Training Manual for system planning, system simulation, and financial and economic analysis through considering systematic human resource	WG1-1 created the training manual. It will be used to train trainers. For WG1-2, all of the materials used for the lectures and exercises up to the fifth mission have been compiled in one package of training materials. In addition, we produced a training manual (i.e., a sort of guidance book) for trainers. The term “training manual” as used here	Expected to achieve

	development	includes both the above-mentioned training materials and guidance book. Apart from the training manual, for staff members who wish to join the training, we also produced a syllabus that showed the objectives, contents, and expected outcomes of the training. These three documents were distributed to the new trainers during the sixth mission, and will be necessarily revised during the third-year training.	
1-7	Support trainers to conduct the training for the engineers based on the training manual	WG1-1 Scheduled to be implemented during the 7th trip starting from July WG1-2 Implemented during the 6th trip. Support for PPL training is being provided online.	Expected to achieve
1-8	Develop the PPL Official Operational Manual and Standard Operating Procedure (SOP) for system planning, system simulation, financial and economic analysis	WG1-1 created an operational manual based on the lecture materials from the training in Japan. For WG1-2, we do not distinguish the training manual and SOP, but instead treat them as comprising a single "training manual," because the characteristics of WG1-2 differ from those of other working groups. (As a side note, the training manual consists of two parts, i.e., the main body and materials.)	Expected to achieve
1-9	Assess the Least Cost Development Plan based on the operational manual and SOP	During the training in Japan, a two-day lecture was held to give the participants the ability to understand and update the "Papua New Guinea Least Cost Power Development Plan Update December 2020" published by the World Bank.	Expected to achieve

		In the 7th dispatch, WG1-1 plans to give a lecture on the standards for power transmission facilities, based on Japanese examples.	

Output 2

Table.1.2.2 The progress of each activity (Output 2)

Activities in PDM		Activities conducted in the period	Achievement status
2-1	Assess the current capacity and technical, structural, and planning challenges of maintenance for transmission line and substations are assessed and propose measures for these challenges	[WG2-1] We evaluate that WG member's awareness and knowledge of maintenance work is getting improved such as basic design concepts of transmission facilities, suitable way of maintenance and planning of patrol / maintenance for long and short terms through online training and onsite training. Additionally, the required SOPs has been created and used, which includes work flow for maintenance work, documents such as patrol / inspection checklist, malfunction criteria, and planning concept. We evaluated these outcomes will be applied to PPL's maintenance work and makes the quality and efficiency improved [WG2-2] Training required to solve the problems identified in the first year's survey was conducted. In PPL, visual inspections of substation equipment are carried out, but check sheets do not exist, and they depend on individual experiences. Therefore, some models of the check sheet were proposed by a JICA	Achieved

		expert. By utilizing the check sheet, the knowledge was given that the employee can work with the same quality and that it can be utilized in the formulation of the preventive maintenance plan in the future by accumulating the data.	
2-2	Formulate 2 WGs for maintenance for (1) transmission line and (2) substations	(Completed) WG2-1 and 2-2 don't change initial members, and have been progressing WG activities.	Achieved
2-3	Conduct training for trainer candidates on planning of preventive maintenance and asset management	**WG2-1** WG members learned the basic design concepts of transmission facilities such as tower, foundation, conductor and insulator through online training. This training contributes WG members to carry out planning work and maintenance work more appropriately. Additionally, They learned the viewpoints of patrol / maintenance for each transmission facility and safety measurement for power outage work through online training. **WG2-2** In the training in Japan, WG members understood the importance of carrying out maintenance appropriately by inspecting the training centers in Japan, the maintenance office and 500kV substation, etc. In addition, by inspecting what is actually used in the maintenance office for asset management, it was possible to deepen the understanding of C/P.	Achieved

		In the fifth dispatch, interview was implemented about situation of developing PPL asset management system and current inspection plan. Training was continued with the aim of improving the knowledge of asset management and improving formulation skill for maintenance plan.	
2-4	Conduct training for trainer candidates on the implementation of preventive maintenance and asset management	**WG2-1** We conducted the online training about how to considering the patrol and inspection cycle and management system of transmission line facilities as maintenance method. During the 7th trip, the compression tools, engine winch and ladder for tension tower were provided to PPL. The training using this equipment will be conducted. **WG2-2** ・In order to improve PPL's capacity to maintain and manage substation equipment, a lecture was given on the concept of inspection criteria. ・During the 7th trip, the second half of the equipment to improve PPL's maintenance capacity will be provided, and training using this equipment will be conducted.	Expected to achieve
2-5	Develop the PPL Official Training Manuals for maintenance for transmission line and substations considering	**WG2-1** The training manual consists of materials that were used through online and onsite training described in 2-3 and 2-4. We aim to complete them while discussing with PPL. **WG2-2**	Expected to achieve

	systematic human resource development	A training manual was created based on the materials used in the training described in 2.3 and 2.4. A draft version was submitted to PPL during the 6th trip.	
2-6	Support the trainers to conduct the training for the engineers based on the training manual	**WG2-1 & WG2-2** By PPL, six candidates were selected for WG2-1 and five candidates were selected for WG2-2.	Expected to achieve
2-7	Develop the PPL Official Manual and Standard Operating Procedure (SOP) for transmission line and substations	**WG2-1** Base on the data and information through 1st and 2nd year's WG activities and some requests from WG members, the creation of Operation manual and the related SOPs were carried out and draft version were submitted to PPL. **WG2-2** ・A draft manual was prepared by JICA experts and submitted to PPL during the 6th trip.	Expected to achieve
2-8	Support PPL to implement the maintenance of transmission line and substation based on the approved PPL Official Operational Manual and SOP	**WG2-1 & WG2-2** [Not started yet]	Expected to achieve

Output 3

Table.1.2.3 The progress of each activity (Output 3)

Activities in PDM		Activities conducted in the period	Achievement status
3-1	Assess the current capacity and technical, structural, and planning challenges of	The results of the baseline survey were explained at the 2nd JCC.	Achieved

	protection coordination and propose the measures for these challenges		
3-2	Formulate WG for protection coordination	No personnel changes in WG3.	Achieved
3-3	Conduct training to improve capacity of protection coordination setting for candidate trainers	All technology transfer to candidate trainers has been completed with the completion of practical training (conducted during the 5th trip).	Achieved
3-4	Develop the PPL Official Training Manual for protection coordination considering systematic human resource development	The following training manuals have been developed until now and currently waiting for feedback from C/P supervisors. 01_Overview of Protection Relay 02_Distance Relay setting Part 1 03_Distance Relay setting Part2 04_Diff. Relay setting 05_CT Study 06_Calculation of Impedance(Underground) 07_Calculation of Impedance (Overhead) 08_Fault Analysis	Expected to achieve
3-5	Support trainers candidate to conduct the training for the rest of engineers based on the PPL Official Training Manual	Not implemented. Training will be conducted at the next trip (July 2024) from the candidate instructors. Training will be provided to the two engineers selected at the JCC (held in February 2024).	Expected to achieve
3-6	Develop the PPL Official Operational Manual and Standard Operating Procedure (SOP)	The workflows were reviewed with the C/P and we prepared the following three SOPs (draft versions) and an operational manual for the relay setting and currently, waiting for feedback from the C/P	Expected to achieve

	for protection coordination.	supervisors. 01_SOP_Relay Setting 02_SOP_Fault Analysis 03_SOP_Impedance Study	
3-7	Support PPL to modify the setting, for the protection coordination based on the operational manual and SOP	Based on the manuals prepared, the distance relay settling calculations for the POM system were conducted. During the next trip (July 2024), calculated values will be compared with the local setting values to confirm that the values are correct.	Expected to achieve

Output 4

Table.1.2.4 The progress of each activity (Output 4)

Activities in PDM		Activities conducted in the period	Achievement status
4-1	Assess the current system for human resource development	The results of the baseline survey were explained at the 2nd JCC.	Achieved
4-2	Develop the PPL Official system of human resource development	We established a draft of contents of human resource development manual for engineers, [2] incorporating the needs of C/Ps. It was approved by PPL at the 3rd JCC.	Expected to achieve

1-3. Achievement of Output

Output 1

"Capacity of system planning for the transmission line is improved", the following initiatives were implemented.

【WG1-1】

Over web training, training in Japan, and the 5th trip, we provided lectures on system

[2] Engineer: Office-based workers who are in charge of system planning, inspection planning, asset management, and protection coordination, et

planning, prepared manuals, and provided education on system analysis software. During the training in Japan, we not only gave WG members from PPL basic skills in power system analysis using the power system analysis software PSS/E, but also provided the ability to understand and update the "Papua New Guinea Least Cost Power Development Plan Update December 2020" published by the World Bank.

From now on, we train trainer candidates using the manuals we have created. And we will provide additional training that has been strongly requested by PPL, such as how to conduct the system analysis software PSS/E and construction standards for power transmission facilities.

【WG1-2】

The third-year training started during the sixth mission. The training is at present carried out in the structure of two new trainers, four new trainees, and the WG leader.

It is expected to be completed by the end of September. After the mission, the online training started in March, and half of the training was completed by the end of May.

Since the new trainees are equipped with basic economic or accounting knowledge, they are fast learners and the training is progressing smoothly.

In addition, the training provides a good chance for the new trainers to learn techniques for teaching trainees well. The two trainers are actively engaged in the training.

Output 2

"Capacity of maintenance for transmission line and substation is improved", a survey of the current situation was conducted, and challenges were identified in three areas: people, organization, and equipment. In addition, in the WG at the baseline survey, we shared the challenges and improvement points of the PPL.

WG2-1

The outcomes of WG2-1 activities in 2nd year is as follows;

JICA expert established training menus based on the survey results on current circumstances and issues that maintenance team was facing, and carried out the technical transfer to PPL's WG members through online and onsite training

For instance, JICA expert proposed the appropriate methods of implementing patrol / inspection, reporting the results and maintenance planning, and PPL's WG members has been deepening the knowledge and know-how on that.

Consequently, their skills and abilities are evaluated as getting improved.

As for required manuals, not only the training manual which consists of materials that were used actually in online and onsite training, but also the operation manual which specifies the appropriate method of maintenance and planning work, and the related SOPs such as patrol / inspection checklist and work flow, has been prepared.

The draft version is going to be completed this February.

In the final year, WG 2-1 including JICA expert and PPL's member will achieve the goals which means the completion of fully technical transfers and establishment of manuals.

WG2-2

Details of implementation in W2-2 and how to proceed in the future are as follows.

・Lectures on giving knowledge of basic knowledge (structure, operating principle, inspection items, etc.) of substation equipment required for preventive maintenance, and also lectures on items of inspection, implementation methods and abnormality judgment were provided.

・Basic knowledge was provided on equipment and materials supplied for the improvement of maintenance capacity, and training was conducted using actual equipment. As the transport of some equipment and materials will be the seventh dispatch (planned for May-June 2024), training for the relevant items will continue to be conducted.

・In the fifth dispatch, as for the Operational Manual, the draft was created by collection from C/P about the work flow of the inspection plan and other required information. In the future, the draft will be completed with discussion of the inspection items and cycles of substation equipment with C/P.

・Training manuals and SOP were trained using drafts in various training sessions, and C/P and discussions were held on how to improve them.

・As for assistance of developing the asset management system in PPL, an inspection of the maintenance office in the Kansai Electric Power Transmission and Distribution was carried out in the training in Japan. Through actual system demonstrations and discussions with the staff members, the knowledge of C/P was able to be deepen. In addition, as for reports of equipment inspection and failures, the operational manual will be created so that trend management can be carried out regarding suggestion of report formats and management method.

Output 3

"Capacity of protection coordination is improved", the following actions have been taken.

[WG3]

Based on the revision requests from the WG members and their supervisors, an update of the manual's attachments and the impedance map of the POM system was conducted (updates: addition of transformer (28 units) specifications, addition of transmission line (22 lines) distances, and the list of impedance). In addition, distance relay setting calculations for the POM system were performed based on the manual prepared (model: Micom P543, 40 devices).

Human Resource Development

・A draft of contents of human resource development manual was approved by PPL at 3rd JCC.

・ We had a discussion to set a method of keeping trainers and engineers' skills even after this project.

・We had a discussion to set a method to make this HRD system work sustainably.

1-4. Achievement of Project Purpose

As for the Project Purpose, when we achieve the Output 1-3 as described in 1-3, the Project Purpose "PPL can properly implement system planning for the transmission line and maintenance for transmission line and substations on its own ." will be achieved.

In order to achieve the project purpose, activities are being carried out in accordance with the activity plan approved at the 2nd JCC. Technology transfer to trainer candidates has been completed, and in the third year trainer candidates will train other PPL staff to check their understanding and revise the manual. We aim to achieve the project purpose by creating a system that allows sustainable education within PPL.

The evaluation results based on the DAC evaluation criteria are as follows.

A. Relevance

In Development Strategic Plan (2010-2030) and Vision 2050, the PNG government has indicated its policy to increase the electrification rate to 70% by 2030. In order to achieve this goal, further expansion of electric power facilities is required, and there is an urgent need to improve the capacity of human resources engaged in the electric power business. The capacity building of instructors and the preparation of manuals are consistent with this goal.

B. Coherence

The other donors' assistance has focused on supporting the development of facilities and has not provided assistance for improving the maintenance capacity of transmission facilities. By improving PPL's maintenance capacity through this project, facilities constructed with the support of other donors can be properly maintained and used for a long period of time.

The project is consistent because of the synergistic effects expected to improve PPL's power quality.

C. Effectiveness

Project purpose is clearly stated in the PDM, and these goals were set based on the results of the capacity assessment in the first year.

The Project Purpose is appropriate as a goal to achieve the Overall Goal. And the outputs to

achieve the project goals are also clearly described and the project is effective.

D. Efficiency

The activities required to produce the outputs of this project are described in the PO. The PO will continue to be staffed with the right people to carry out the necessary activities, and the project is highly efficient.

E. Impact

Through this project, the capacity of system planning for the transmission line and maintenance for transmission lines and substations has improved, and further improvement is expected as education continues to be provided within PPL. By improving the overall capacity of PPL, it is expected that the quality of power in PNG will improve and contribute to society as a whole.

F. Sustainability

The creation of manuals and the introduction of a human resource development structure and training system that meets PPL's needs are expected to ensure a sustainable human resource development system. The draft manuals and the draft of the human resource development system and training system have been completed, and they are planned to be revised during the third year of activities.

1-5. Changes of Risks and Actions for Mitigation

Following factors are considered to become obstacles for the smooth implementation of the Project.

(1) Inadequate assignment of C/P

If the adequate C/P will not be assigned at the proper time and necessary numbers, activities of the technology transfer could not be carried out on schedule.

(2) Inadequacy of working environment and necessary equipment

Proper working environment and equipment will be indispensable for implementing the Project on schedule.

Lack of proper working environment and equipment would be obstacles for the smooth implementation of the Project.

During the fifth dispatch, we were able to secure the work space necessary for our activities by dividing the travel periods of the Japanese experts. The seventh dispatch is also being handled by dividing the travel periods for Japanese experts.

(3) Shortage of budgetary allocation

In order to carry out the Project on schedule, necessary budget should be prepared in adequate time. If the necessary budget would not be allocated on time, we cannot expect the Project running smoothly.

As the above-mentioned risks may occur, we are taking the following measures to reduce risks.

Table 1-5-1. Risk items

No.	Risk Factor	Countermeasures for Mitigation	Results
1	Assignment of C/P	During the sixth dispatch, consultants confirmed with the PPL project manager to select PPL staff who would train trainer candidates in the third year. In addition, even after returning to Japan, the selection status is confirmed via email.	PPL has secured the necessary personnel and technology transfer is currently underway in each working group.
2	Assignment of Japanese Expert	As for the contents and method of technology transfer were discussed and confirmed in the Work Plan in May 2022. And this Work Plan was agreed between JICA and PNG side in the first JCC held on 27th May 2022. Base on the schedule in the Work Plan, the expert team was dispatched	No problems occurred so far now
3	Management of Scheduling and Implementation	The expert team and Project Manager exchange views frequently mainly about the schedule of the technology transfer.	No problems occurred so far now
4	Share of Information	Regarding the daily job management, the expert team discuss with the Project Manager and the progress of the project is reported in the JCC and shared among the related people.	No problems occurred so far now
5	Office Space and Working Environment	The expert team requested the office space to PNG side in the kickoff meeting in March 2022. PNG side provided the office space with air condition to the expert team. The meeting rooms required for WG activities are also provided within the PPL head office.	No problems occurred so far now

1-6. Progress of Actions undertaken by JICA

(1) Conducted WG activities.

(2) JICA Experts explained the results of the second year's activities and the activity plan for the third year at the 3rd JCC(February 27, 2024).

(3) Delivery materials and equipment.

1-7. Progress of Actions undertaken by Gov. of PNG

(1) Hosted the 3rd JCC.

(2) Provided the expert team office space with necessary equipment

(3) Provided meeting rooms for WG activity

(4) WG members participated in WG activities and online training.

(5) To cooperate in collecting various data necessary for technical cooperation

1-8. Progress of Environmental and Social Considerations (if Applicable)

No relevant matters

1-9. Progress of Considerations on Gender/Peace Building/Poverty Reduction (if applicable)

Five women are participating as WG members.

1-10. Other remarkable/considerable issues related/affect to the project (such as other JICA`s projects, activities of counterparts, other donors, private sectors, NGOs etc.)

No relevant matters

2. Delay of Work Schedule and/or Problems (if any)

2-1. Detail

The overall schedule is as originally planned. Provision of some materials and equipment that had been delayed was completed on May 31, 2024. Education on the provided materials and equipment will be conducted in June 2024.

2-2. Cause

Because it would take time to procure some of the materials and equipment that we decided to provide after consultation with the PPL side.

2-3. Action to be taken

During the 7th dispatch, education will be carried out using the remaining provided materials

and equipment.

2-4. Roles of Responsible Persons/Organization (JICA, Gov. of PNG, etc.)

No relevant matters

3. Modification of the Project Implementation Plan

3-1. PDM

Ver1： Obtained approval at the 1st JCC in May 2022.

Ver2： Obtained approval at the 2nd JCC in February 2023.

3-2. PO

Obtained approval at the 2nd JCC in February 2023.

3-3. Other modification on detailed implementation plan

No change

4. Current Activities of Gov. of PNG to secure Project Sustainability after its Completion

Based on the manuals and training plans created in this project, the engineers trained in this project will continue to provide training.

II. Project Monitoring Sheet I & II

1） Project Monitoring Sheet I (Revision of Project Design Matrix)

Project Monitoring Sheet I （Revision of Project Design Matrix）

Project Title: The Project for the Improvement of Planning and Operation of Power System
Implementing Agency: PNG Power Ltd
Target Group: Engineers in PPL
Period of Project: March 2022 to March 2025

Version 2
May,2024

Project Site: N/A　　**Model Site:** N/A

Narrative Summary	Objectively Verifiable Indicators (Rev)	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
The quality and reliability of electricity is improved.	By 2029, 50% reduction of total blackouts in 3 main grids caused by inadequate maintenance of PPL's transmission, substation, and protection coordination equipment compare to in 2021.	Data from PPL		Not Achieved yet	
	The 15 Year Power Development Plan is executed with necessary budget and physical work.	Data from PPL		Not Achieved yet	
	The number of faults resulting from the lack of maintenance and asset management decreases by 50% by 2029.	Data from PPL		Not Achieved yet	
	PPL can conduct review and protection coordination on 50% of the existing distance relays by 2029.	Data from PPL		Not Achieved yet	
	New engineers assigned to the relevant department receive training within one year and always secure 10 trainers.	Data from PPL		Not Achieved yet	
Project Purpose					
PPL can properly implement system planning for the transmission line and maintenance for transmission line and substations on its own.	Capacity for revising and proposing grid plan based on simulation and, financial and economic analysis is equipped with PPL.	Report from Japanese experts/Data from PPL	PPL continues commitment to the Project by securing budget allocation as well as assignment of personnel for post- Project activity.	In progress. WG members from PPL acquired basic skills in simulation using system analysis software.	
	The maintenance for transmission line and substations, and asset management are regularly implemented in accordance with manuals.	Report from Japanese experts/Data from PPL		In progress. A draft version of the inspection items/frequency, inspection plan flow, etc. was prepared in the operation manual to enable periodic maintenance.	
	The setting for protection coordination is regularly confirmed in accordance with manuals.	Report from Japanese experts/Data from PPL		In progress. Training on protection relay was provided to WG members and SOPs, operational mannuals, and training manuals were prepared.	
	Various Training are conducted by 10 trainers produced by the Project and improving trainees skill and knowledge effectively based on the established human resource development system.	Report from Japanese experts/Data from PPL		In progress. The draft of human resource development system was established and is being refined for the final version.	
Outputs					
Capacity of system planning for the transmission line is improved.	Knowledge for system planning, simulation, and financial and economic analysis is improved.	Exam results (Pre-exam and Post-exam)	Necessary budget is secured.	In progress. The results of the baseline survey were explained at the 2nd JCC.	
	5 of engineers who completed training gained sufficient knowledge and skills.	Report from Japanese experts		In progress. Lerctures during trips to PNG , the on-line traingings and the training in Japan were conducted.	
	Least Cost Development Plan is verified by PPL.	Report from Japanese experts		In progress. A lecture was held to give the participants the ability to understand and update the "Papua New Guinea Least Cost Power Development Plan Update December 2020" published by the World Bank.	
Capacity of maintenance for transmission line and substation is improved	Knowledge for maintenance of transmission line and substation, and asset management is improved.	Exam results (Pre-exam and Post-exam)		In progress. Based on the results of the first year's survey, training was conducted to improve knowledge of maintenance and asset management.	
	10 of engineers and technicians who completed training gained sufficient knowledge and skills.	Report from Japanese experts Questionarre for staff in charge.		In progress. Based on the questionnaire, training was provided in the second year to compensate for missing knowledge and skills.The training of instructors for TOT, which is scheduled to be implemented in the third year, was also conducted.	
	Asset management and preventive maintenance are implemented by PPL at least once based on the manuals developed by the Project.	Report from Japanese experts Questionarre for staff in charge.		Not Achieved yet	
Capacity of protection coordination is improved	Knowledge for protection coordination is improved.	Exam results (Pre-exam and Post-exam)		In progress. The results of the baseline survey were explained at the 2nd JCC.Training in Japan and practical training in the field were conducted, and education for trainers was completed.	
	2 new engineers to be recruited who completed training gained sufficient knowledge and skills.	Report from Japanese experts		In progress. Training manuals were prepared for the training of two new engineers.	
	The setting of protection coordination is confirmed by PPL at least once.	Report from Japanese experts		In progress. The lecture of setting of protection coordination was conducted.	
Sustainable system for human resource development is established	Qualified 10 of Trainers and 17 Engineers are produced, based on the established human resource development system by the end of the Project.			In progress. The draft of human resource development system was established and is being refined for the final version.	

Activities	Inputs		Important Assumption		
	The Japanese Side	The PNG Side			
1-1 : The current capacity of system planning for the transmission line is assessed. 1-2 : 2 Working Groups (WG) for (1) system planning and (2) financial and economic analysis are formulated. 1-3 : Training for trainer candidates on basis on system planning for the transmission line is conducted. 1-4 : Training for trainer candidates on system simulation using tools such as PSS/E is conducted. 1-5 : Training for trainer candidates on financial and economic analysis is conducted. 1-6 : The training manuals for system planning, system simulation, and financial and economic analysis are formulated through considering systematic human resource development. Manuals are officially approved by PPL. 1-7 : Based on the training manual, the training for the engineers is implemented by trainers. 1-8 : The operational manual and Standard Operating Procedure (SOP) for system planning, system simulation, financial and economic analysis are formulated, and the manual and SOP are officially approved by PPL. 1-9 : Based on the operational manual and SOP, the Least Cost Development Plan is verified by PPL. 2-1: The current capacity and technical, structural, and planning challenges of maintenance for transmission line and substations are assessed. Measures for these challenges are proposed. 2-2:2 WGs for maintenance for (1) transmission line and (2) substations are formulated. 2-3:Training for trainer candidates on planning of preventive maintenance and asset management is implemented. 2-4:Training for trainer candidates on the implementation of preventive maintenance and asset management is implemented. 2-5: The training manuals for maintenance for transmission line and substations are formulated considering systematic human resource development. Manuals are officially approved by PPL. 2-6 : Based on the training manual, the training for the engineers is conducted by the trainers. 2-7 : The operational manual and Standard Operating Procedure (SOP) for transmission line and substations are formulated. 2-8: Based on the operational manual and SOP, PPL implements the maintenance of transmission line and substation.The manuals and SOP are officially approved by PPL. 3-1: The current capacity and technical, structural, and planning challenges of protection coordination is assessed.The measures for these challenges are proposed. 3-2: WG for protection coordination is formulated. 3-3:Training to improve capacity of protection coordination setting is implemented for candidate trainers. 3-4 : The training manual for protection coordination is formulated considering systematic human resource development. The manual is officially approved by PPL. 3-5 : Based on the training manual, the training for the rest of engineers is implemented by trainers candidate. 3-6 : The operational manual and Standard Operating Procedure (SOP) for protection coordination are formulated. 3-7 : Based on the operational manual and SOP, the setting for the protection coordination is modified by PPL.The manuals and SOP are officially approved by PPL. 4-1 : The current system for human resource development is assessed and workable system is proposed. 4-2 : Sustainable system for human resource development is established, and officially approved by PPL.	1. Short-term Experts a. Chief advisor/System planning b. Grid technology c. Financial and economical analysis d. Transmission line (maintenance) e. Substation (maintenance) f. Equipment Testing/ Evaluation g. Protection coordination h. Human resource management / traing planning i. Grid technology asistant / Business coordination 2. Equipment 3. Trainings a. Training online b. Training in Japan c. Training in PNG	1. Office place for Japanese experts 2. Utility 3. Counterpart personnel 4. all expenses for PPL staffs (salaries, in-country transportation, allowance, etc.) 5. Tax exemption 6. Customs clearance for equipment 7. Cost for JCC avenue 8. Expenses necessary for the transportation within PNG of the equipment as well as for the installation, operation and maintenance thereof.	**Pre-Conditions** 1. Political, security, COVID-19 situation etc do not detriorate significantly. 2. Input from PNG and JICA is iplemnted in timely manner. 3. Necessary budget for implementation of project is secured during the project. **<Issues and countermesures>**	

2） Project Monitoring Sheet II (Revision of Plan of Operation)

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 2

Dec,2023

Project Title: The Project for the Improvement of Planning and Operation of Power System

Inputs		Year	2022				2023				2024				2025	Remarks	Monitoring: Issue	Monitoring: Solution
			I	II	III	IV	I	II	III	IV	I	II	III	IV	I			
Expert																		
Short - Term (Visiting) Expets		Plan / Actual	To be assigned by JICA															
Long - Term (Resident) Experts		Plan / Actual																
Equipment		Plan / Actual																
Training online		Plan / Actual																
Training in Japan		Plan / Actual																
In-country/Third country Training		Plan / Actual																

Activities			Year	1st Year				2nd Year				3rd Year				4th Year	Responsible Organization		Achievements	Issue & Countermeasures
	Sub-Activities (Original)	Sub-Activities (Revision 23/2/2023)		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	Japan	GOPNG		
Output 1:																				
1.1	The current capacity of system planning for the transmission line is assessed.	Assess the current capacity of system planning for the transmission line	Plan / Actual																The results of the baseline survey were explained at the 2nd JCC.	
1.2	2 Working Groups (WG) for system planning and financial and economic analysis are formulated.	Formulate Working Groups (WG) for (1) system planning and (2) financial and economic analysis	Plan / Actual																In JCC held at 27th May 2022, members of WG1-1 and WG1-2 have been formulated. We confirmed members at second trip and established contact systems.	
1.3	Training for trainer candidates on basis on system planning for the transmission line is conducted.	Conduct training for trainer candidates on basis on system planning for the transmission line	Plan / Actual																Lectures on grid analysis, rules for grid operation, the impact of the penetration of renewable energy, etc. were held three times: once in Japan and twice online. In particular, during the training in Japan, we carefully reviewed the theoretical content behind the system analysis software used for system planning. In addition, WG members from PPL deepened their understanding of basic electrical theory by having them solve calculation examples of voltage and current values in a simplified power system as practice problems.	
1.4	Training for trainer candidates on system simulation using tools such as PSS/E is conducted.	Conduct training for trainer candidates on system simulation using tools such as PSS/E	Plan / Actual																During the training in Japan, and 6th trip to PNG each WG member from PPL actually operated the system analysis software PSS/E and run simulations. As a result of the training, each WG member from PPL was able to acquire basic skills in simulation using system analysis software. We plan to hold lectures on how to operate PSS/E during 7th trip to improve the abilities of WG members. (Main acquired skills) -Load flow analysis -Short circuit analysis -Dynamic stability analysis	
1.5	Training for trainer candidates on financial and economic analysis is conducted.	Conduct training for trainer candidates on financial and economic analysis	Plan / Actual																During the third mission, we conducted a total of eight lecture sessions including supplementary classes in four days. The subjects of these lessons were: (i) how to read financial statements, (ii) the structure of the statements, (iii) indicators used in financial statement analysis, and (iv) the method of analytical calculation. As the online training between the third and fourth missions, we conducted a total of seven exercise sessions in seven days in November and three sessions in three days in January. The exercise is aimed at strengthening the members' capacity to fully understand theories by having them calculate various financial indicators by themselves. In the exercise, individual members evaluated the financial performance of the PPL, Solomon Islands Electricity Authority and Tonga Power Limited using financial indicators. In addition, they contemplated problems in business operation suggested by the financial indicators. During the fourth mission, we conducted a total of nine lecture and exercise sessions in seven days. The subject of these lessons was financial analysis for a project. As the online training after the fourth mission, we conducted a total of seven lecture and exercise sessions in five days in March, eight sessions in five days in April, and ten sessions in five days in May.	
1.6	The training manual for system planning, system simulation, and financial and economic analysis is formulated considering systematic human resource development and the manuals is officially approved by PPL.	Develop the PPL Official Training Manual for system planning, system simulation, and financial and economic analysis through considering systematic human resource development.	Plan / Actual																WG1-1 created the training manual. It will be used to train trainers. For WG1-2 , we prepared and distributed to the members textbooks (pdf files) on matters including financial statements, financial statement analysis, financial analysis for a project, and use of the Excel functions for financial analysis. In addition, we prepared and distributed six kinds of exercise books (pdf files) and answer sheets (Excel files). WG1-2	
1.7	Based on the training manual, the training for the rest of engineers is implemented by trainers.	Support trainers to conduct the training for the engineers based on the training manual.	Plan / Actual																	
1.8	The operational manual and Standard Operating Procedure (SOP) for system planning, system simulation, financial and economic analysis are formulated, and the manual and SOP are officially approved by PPL.	Develop the PPL Official Operational Manual and Standard Operating Procedure (SOP) for system planning, system simulation, financial and economic analysis.	Plan / Actual																WG1-1 created a perational manual based on the lecture materials. It will be used to train trainers. For WG1-2 , we have begun to compile a draft training manual based on the outcomes of the lectures and exercises up to now.	
1.9	Based on the operational manual and SOP, PPL verifies the Least Cost Development Plan.	Assess the Least Cost Development Plan based on the operational manual and SOP.	Plan / Actual																During the training in Japan, a two-day lecture was held to give the participants the ability to understand and update the "Papua New Guinea Least Cost Power Development Plan Update December 2020" published by the World Bank.As a result of the training, we were able to impart the targeted abilities to WG members from PPL. WG1-1 started formulating a reference book for construction of transmission facilities after 6th trip.	

2.1	The current capacity and technical, structural, and planning challenges of maintenance for transmission line and substations are assessed. Measures for these challenges are proposed	Assess the current capacity and technical, structural, and planning challenges of maintenance for transmission line and substations are assessed and propose measures for these challenges.	Plan Actual		[WG2-1] We evaluate that WG member's awareness and knowledge of maintenance work is getting improved such as basic design concepts of transmission facilities, suitable way of maintenance and planning of patrol / maintenance for long and short terms through online training and onsite training. [WG2-2] Training required to solve the problems identified in the first year's survey was conducted. In PPL, visual inspections of substation equipment are carried out, but check sheets do not exist, and they depend on individual experiences. Therefore, some models of the check sheet were proposed by a JICA expert. By utilizing the check sheet, the knowledge was given that the employee can work with the same quality and that it can be utilized in the formulation of the preventive maintenance plan in the future by accumulating the data.	
2.2	2 WGs for maintenance for (1) transmission line and (2) substations are formulated.	Formulate 2 WGs for maintenance for (1) transmission line and (2) substations.	Plan Actual		WG2-1 and 2-2 don't change initial members, and have been progressing WG activities.	
2.3	Training for trainer candidates on planning of preventive maintenance and asset management is implemented.	Conduct training for trainer candidates on planning of preventive maintenance and asset management.	Plan Actual		WG2-1 Before the third visit, the on-line training was carried out once regarding preventive maintenance works. In addition, the contents of last lecture were reviewed and basic design concepts of transmission facilities are lectured newly during the third visit. The difficulties of online meeting As C/P makes few remarks and it is difficult to check the level of understanding for each C/P, it is necessary to follow up on the contents of the training when visiting in PPL. In addition, as each C/P is busy with his/her works and there are many unexpected works, it takes time and changes to arrange the meeting date and time. WG2-2 In the training in Japan, WG members understood the importance of carrying out maintenance appropriately by inspecting the training centers in Japan, the maintenance office and 500kV substation, etc. In addition, by inspecting what is actually used in the maintenance office for asset management, it was possible to deepen the understanding of C/P. In the fifth dispatch, interview was implemented about situation of developing PPL asset management system and current inspection plan. Training was continued with the aim of improving the knowledge of asset management and improving formulation skill for maintenance plan.	
2.4	Training for trainer candidates on the implementation of preventive maintenance and asset management is implemented.	Conduct training for trainer candidates on the implementation of preventive maintenance and asset management.	Plan Actual		WG2-1 WG members learned the basic design concepts of transmission facilities such as tower, foundation, conductor and insulator through online training. This training contributes WG members to carry out planning work and maintenance work more appropriately. Additionally, They learned the viewpoints of patrol / maintenance for each transmission facility and safety measurement for power outage work through online training. WG2-2 ・In order to improve PPL's capacity to maintain and manage substation equipment, a lecture was given on the concept of inspection criteria. ・During the 7th trip, the second half of the equipment to improve PPL's maintenance capacity will be provided, and training using this equipment will be conducted.	
2.5	The training manual for maintenance for transmission line and substations is formulated considering systematic human resource development and the manuals is officially approved by PPL.	Develop the PPL Official Training Manuals for maintenance for transmission line and substations considering systematic human resource development.	Plan Actual		WG2-1 The lectures on the basics of transmission line maintenance have been given to C/P, and further materials have been prepared, establishing systematically grasping the level of understanding for each C/P and their requests. The draft version will be completed this Feburary. WG2-2 A training manual was created based on the materials used in the training described in 2.3 and 2.4. A draft version was submitted to PPL during the 6th trip.	
2.6	Based on the training manual, the training for the engineers is conducted by the trainers.	Support the trainers to conduct the training for the engineers based on the training manual.	Plan Actual		WG2-1 & WG2-2 Not started yet	
2.7	The operational manual and Standard Operating Procedure (SOP) for transmission line and substations are formulated.	Develop the PPL Official Operational Manual and Standard Operating Procedure (SOP) for transmission line and substations.	Plan Actual		WG2-1 Based on the data and information through 1st and 2nd year's WG activities and some requests from WG members, the creation of Operation manual and the related SOPs has been carried out and draft version is going to be completed this February WG2-2 A draft manual was prepared by JICA experts and submitted to PPL during the 6th trip.	
2.8	Based on the operational manual and SOP, PPL implements the maintenance of transmission line and substation, and the manuals and SOP are officially approved by PPL.	Support PPL to implement the maintenance of transmission line and substation based on the approved PPL Official Operational Manual and SOP.	Plan Actual		"WG2-1 & WG2-2 Not started yet"	

No.	Output	Activities	Plan/Actual	Remarks	Issue	Solution
Output 3:						
3.1	The current capacity and technical, structural, and planning challenges of protection coordination is assessed.The measures for these challenges are proposed.	Assess the current capacity and technical, structural, and planning challenges of protection coordination and propose the measures for these challenges.	Plan		Achieved; The results of the baseline survey were explained at the JCC.	
			Actual			
3.2	WG for protection coordination is formulated.	Formulate WG for protection coordination.	Plan		Achieved; no personnel changes in WG3.	
			Actual			
3.3	Training to improve capacity of protection coordination setting is implemented for candidate trainers.	Conduct training to improve capacity of protection coordination setting for candidate trainers.	Plan		Achieved; All technology transfer to candidate trainers has been completed with the completion of practical training (conducted during the 5th trip).	
			Actual			
3.4	The training manual for protection coordination is formulated considering systematic human resource development and the manuals is officially approved by PPL.	Develop the PPL Official Training Manual for protection coordination considering systematic human resource development.	Plan		The following training manuals have been developed until now and currently waiting for feedback from C/P supervisors. 01_Overview of Protection Relay 02_Distance Relay setting Part 1 03_Distance Relay setting Part2 04_Diff. Relay setting 05_CT Study 06_Calculation of Impedance(Underground) 07_Calculation of Impedance (Overhead) 08_Fault Analysis	
			Actual			
3.5	Based on the training manual, the training for the rest of engineers is implemented by candidate trainers.	Support trainers candidate to conduct the training for the rest of engineers based on the PPL Official Training Manual.	Plan		Not implemented; Training will be conducted at the next trip (July 2024) from the candidate instructors. Training will be provided to the two engineers selected at the JCC (held in February 2024).	
			Actual			
3.6	The operational manual and Standard operating Procedure (SOP) for protection coordination are formulated.	Develop the PPL Official Operational Manual and Standard Operating Procedure (SOP) for protection coordination.	Plan		The workflows were reviewed with the C/P and we prepared the following three SOPs (draft versions) and an operational manual for the relay setting and currently, waiting for feedback from the C/P supervisors. 01_SOP_Relay Setting 02_SOP_Fault Analysis 03_SOP_Impedance Study	
			Actual			
3.7	Based on the operational manual and SOP, PPL modifies the setting for the protection coordination, and the manuals and SOP is officially approved by PPL.	Support PPL to modify the setting for the protection coordination based on the operational manual and SOP.	Plan		Based on the manuals prepared, the distance relay settling calculations for the POM system were conducted. During the next trip (July 2024), calculated values will be compared with the local setting values to confirm that the values are correct.	
			Actual			
Output 4:						
4.1	The current system for human resource development is assessed and workable system is proposed.	Assess the current system for human resource development.	Plan		Achieved:The results of the baseline survey were explained at the 2nd JCC.	
			Actual			
4.2	Sustainable system for human resource development is established.	Develop the PPL Official system of human resource development.	Plan		We prepared a draft of contents of human resource development manual for engineers, incorporating the needs of C/Ps. The contents was approved by PPL at the 3rd JCC. The draft version will be refined through test operations in 3rd year and confirmed as a final version at the 4th JCC.	
			Actual			

Duration / Phasing	
	Plan
	Actual

Monitoring Plan	Year	1st Year				2nd Year				3rd Year				4th Year	Remarks	Issue	Solution
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I			
Monitoring																	
Joint Coordinating Committee	Plan / Actual																
Set-up the Detailed Plan of Operation	Plan / Actual																
Submission of Monitoring Sheet	Plan / Actual																
Monitoring Mission from Japan	Plan / Actual																
Post Monitoring	Plan / Actual														Three years after project completion		
Reports/Documents																	
Inception Report	Plan / Actual															2022.5 Work plan submitted	
Progress Report	Plan / Actual																
Project Completion Report	Plan / Actual																
Public Relations																	
	Plan / Actual																
	Plan / Actual																

Feb 29, 2024

The Project for the Improvement of Planning and Operation of Power System

6th Mission Report

Kansai Transmission and Distribution, Inc.
NEWJEC Inc.
SeED Okinawa LLC

1. Purpose of this dispatch

① Holding the 3rd JCC
② Conducting a WG
③ Coordination regarding the provision of materials and equipment for the next trip
④ Coordination regarding the next trip

2. Schedule

15th Feb～29th Feb

3. Activity of 6th mission

① Holding the 3rd JCC

The third JCC was held on February 27 at Gateway Hotel, and the 3rd year's action plans were approved. And in the meeting, we discussed how PPL secure the budget to sustain the effects of this project even after the project was completed, and whether the HRD system created this time matched well with PPL's existing HRD system.
See Attachment 1 for details.

② Conducting a WG

As a 3rd year activity, each working group carried out activities. (Details on later pages.)

③ Coordination regarding the provision of materials and equipment for the next trip

In the next trip (under adjustment in June-July 2024), the second (final) provision of equipment and materials will be scheduled. Therefore, adjustment was made regarding schedule, delivery method, etc. with related members in this trip. Details will be described later.

④ Coordination regarding the next trip

4-1. Workshop
In preparation for holding the workshop during next trip, we requested PPL to secure a venue and announce to related department that they should participate in workshop. In addition, in preparation for holding the workshop, we requested to share the manual with the relevant departments.

4-2. Training of Trainers
In preparation for implementing the training during next trip, we requested to make an announcement to trainees to participate training and announce their supervisor.

4. Next trip plan

On the next trip, members other than WG1-2 are scheduled.

I. Trip period

・First half (WG2) : From early June to late June(Scheduled for about 4 weeks)

・Second half (WG1-1/3/4) : From early July to late July(Scheduled for about 3 weeks)

II. Activity contents

i. Training of Trainers

PPL trainer candidates provide training to PPL engineers. And, JICA experts check the training and provide advice to trainer candidates as appropriate. In addition, we will also check with the trainees to confirm if there are any points in the training manual that are difficult to understand and improve the manual.

ii. Workshop

Workshops will be held to explain the contents of the created manual to PPL staff in related departments. General Manager and other staffs from relevant departments will be in attendance, and we will explain contents of the manuals we have created. Workshops will be held at each WG.

5. Activity of each WGs

WG1-1

1 PSSE training

During last trip, we received a request from PPL for further training on PSSE, so this time we gave lectures on how to use PSSE.

We reviewed the method of making a system model and analyzing power flow, which we conducted training in Japan. In addition, we conducted analyzes on short-circuit accidents and dynamic stability. Through this training, WG members were able to acquire basic model creation and analysis methods.

It was agreed that when creating a POM grid model at PSSE in the future, it would be based on the POM grid model created in the past (around 2019). We agreed PPL to check if there were any changes that needed to be made from past models.

2 Activity history

It was carried out as shown in the table below.

3 Future work

During the next trip (around July), WG members will be a trainer and give lectures to PPL engineers. Through the lectures, we will confirm the point for improvement in the training manual and whether trainers are correctly understanding the content.

We will also hold a workshop to explain the contents of the manual created through this project to PPL engineers other than WG members, and hear their opinions for improvement.

Date/Time	Venue	Activity	Participant
2024/2/19 14:00-15:30 (PNG time)	Property Room PPL 2F	- Explanation of overview of 3rd JCC - Explanation of activity plans for this trip	Benedicta Savage Charlie Enos Haidi Wanya
2024/2/21 10:00-12:00 (PNG time)	Finance Room, PPL 1F	- Training on PSSE (Power flow analysis, Short circuit current analysis)	Benedicta Savage Charlie Enos Haidi Wanya
2024/2/23 10:00-12:00 (PNG time)	Finance Room, PPL 3F	- Training on PSSE (Power flow analysis, Short circuit current analysis, Dynamic stability analysis) - Information collection for creating POM system model	Benedicta Savage Charlie Enos Haidi Wanya
2024/2/28 14:00-15:00 (PNG time)	Strategy Room, PPL 2F	- Discussion regarding next trip schedule and content	Benedicta Savage Charlie Enos Haidi Wanya

WG1-2

1. Commencement of the third-year training

(1) Trainers and trainees

Five new trainees were nominated: Ngayam David, Belinda Amo, Lilian Amu, Samuel Saulep, and Lisoh Masu. Of them, Samuel Saulep belongs to the transmission division, and the others, the strategic division. All of them have an economic or accounting background; no engineers are participating this year.

Three staff from the previous-year trainees were nominated as trainers: Keith Kalama, Beda Kuglame, and Cathy Kutkue. However, Keith Kalama may leave his trainer position, because he is going to take a university class in line with the official job.

(2) Training schedule

We created an annual schedule for the third-year training. The frequency of the training is two sessions a week, with a maximum of two hours per session. Given this pace of the class, the whole training is expected to be completed by October.

The WG leader attended the training in person during the mission, but will join the class online using Zoom from March. His role in the third year is not a trainer but an adviser.

During the mission, we held one session for trainee orientation and six sessions (six days) for lecture and exercise.

2. Training materials

Training manuals have already been prepared, but the contents will be revised as necessary through the third-year training.

3. Next step

After the mission, the new trainers will continue the training. The WG leader will join and assist them online using Zoom as needed.

Table. Schedule for the WG1-2 and trainee attendance rate

Time and date	Trainer			Trainee				
	Cathy Kutkue	Beda Kuglame	Keith Kalama	Ngayam David	Belinda Amo	Lilian Amu	Samuel Saulep	Lisoh Masu
2/16 (Fri) 10:00-11:30	✓	✓	✓					
2/19 (Mon) 11:00-12:00	✓	✓						
13:30-15:30	✓	✓						
2/20 (Tue) 10:00-10:30		✓						
14:00-15:30	✓	✓		✓		✓		✓
2/21 (Wed) 10:30-11:15		✓						
14:00-16:00	✓	✓		✓	✓	✓	✓	✓
2/22 (Thu) 14:00-16:00	✓	✓		✓	✓	✓	✓	✓
2/23 (Fri) 13:30-15:30	✓	✓			✓	✓	✓	✓
2/28 (Wed) 10:00-11:30	✓			✓				
2/28 (Wed) 14:00-16:00	✓	✓		✓	✓	✓	✓	✓
2/29 (Thu) 13:30-15:30	✓	✓		✓	✓	✓	✓	✓

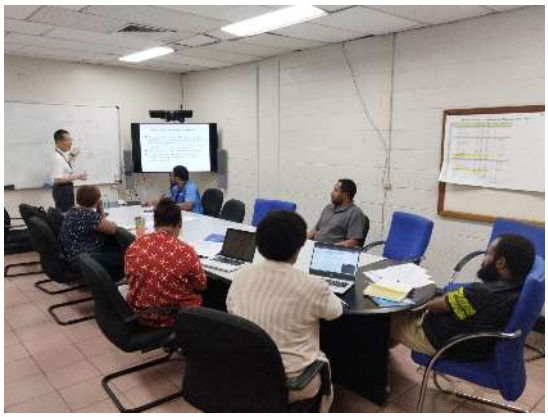



Photo. WG1-2 class during the sixth mission

WG2

1. Organization and Outline of Activities in the 6th trip

In the 6th trip, WG2 representative from Mr. Katsuki participated in the equipment evaluation/testing, and preliminary interviews were held to explain the details of JCC, including future schedules, and to discuss detailed Operational Manual. In addition, an on-line combined WG was conducted jointly with WG2-2 for two days. Furthermore, since the second (final) provision of equipment in the next trip (under adjustment in June-July 2024) will be scheduled, adjustment was made with related members regarding schedules, delivery methods, etc.

2. Discussion on the next year's plan

1.1 How to select next year's trainee and train

In next year, the present WG members will be as instructors and train new personnel as trainee. As for WG2, assignment of 6 and 5 Trainee from WG2-1 and 2-2 respectively will be planned. Since the departments of the trainee will be T&D and Asset Management, the final confirmation on assignees and the timing and contents of training was made with Mr. Simo (General Manager Transmission & Distribution) and Ms. Vera (General Manager Asset Management) which are responsible for each department.

2.2 How to proceed toward the finalization of Operational Manual

In the 3rd JCC, drafts of Operational Manual and the others will be submitted, and in next year, detailed discussions and revisions toward the finalization will be planned in next year. Operational Manual of WG2 defines the workflow (how to plan, implement, record and analyze the outcome) of the work related to maintenance, and the main related departments are T&D and Asset Management. Accordingly, the schedule and procedure together with the contents of 2.1 was confirmed with Mr. Simo and Ms. Vera. We explained them that in next trip Work Shop will be held with discussion for revision of Operational Manual, and that asked them to attend it.

2.3 Interviews for detailed Operational Manual discussion

As mentioned in 2.2, after the 3rd JCC, discussions to match Operational Manual to workflows in PPL will be proceeded. The present drafts are rough version which are reflected the organizational structure and division of roles of PPL that was surveyed in the past based on the outlines of maintenance in Kansai TD. As a springboard for this drafts, the content will be revised so that the actual work in PPL will be flowed. In this opportunity, the items which seemed to be necessary for further interviews in the draft preparation stage were listed up, and the survey was implemented as much as the time permitted. Specifically, discussions were held on the division of roles and flows related to the plan and implementation of power outage for work, and the division of roles and flows related to the replenishment of consumables and equipment and materials. The situation is shown in Figure.1.

Figure.1: Discussion on Operational Manual

3. Implementation of on-line WG (WG2-2 and equipment testing/evaluation)

In this trip, the combined on-line WG as shown in Table.1, was carried out jointly in WG2-2 and equipment testing/evaluation. The situation is shown in Figure.2.

Table.1: Contents of on-line combined WG for the 6th Trip

Date and time	Room	Item	Participants
2024/2/28 10:00-12:00 14:00-16:00 (PNG time)	Property Room & On-line	・Concept of criteria for inspection of substation facilities at Kansai ・Discussion on Operational Manual	S. Deveo S. Robert B. Inamo T. Naipu R. Rawali
2024/2/29 10:00-12:00 14:00-16:00 (PNG time)	Property Room & On-line	・EIC and partial discharge detection using measuring instruments ・Mobile Equipment ・Accumulation of data and response against defects ・Review of maintenance frequency (Introduction of examples in Kansai)	S. Deveo S. Robert B. Inamo T. Naipu R. Rawali

Figure.2: Situation of WG

4. Coordination for the 2nd provision of equipment and materials

In the next trip (under adjustment in June-July 2024), the second (final) provision of equipment and materials will be scheduled. Therefore, adjustment was made regarding schedule, delivery method, etc. with related members in this trip. Specifically, confirmation for shipping schedule, customs procedures and local storage methods was made with Pacific International Limited which will be responsible for transportation of equipment and materials. And confirmation for the rough schedule, arrangement and storage space was made with Mr. Chris who is Regional Manager of PPL Southern Regional office where will be for storage. In the future, the detailed delivery date and arrangement will be adjusted.

Figure.3: Storage space and Mr. Chris at PPL Southern Regional Office

WG4

WG4 activities conducted in this trip are below.

1. HRD manual

The draft manual and related documents have been approved by the PPL at the 3rd JCC meeting. The main topics discussed through the WG activities were below.

① The way to maintain the quality of trainers and engineers after this project.

As JICA experts will leave after this project, there is a concern that the quality of trainers and engineers may decline over time. Therefore, the following ways were taken.

<For trainers>
Trainers must conduct training at least once a year. HRGM will approve the training.
＜For engineers>
Engineers actively utilize the knowledge and skills acquired in training in their daily work. Supervisors check whether the knowledge and skills acquired are being used effectively.

PPL also check every year whether the above ways contribute effectively to maintain their quality.

② Issuing certificates of course completion to trainees

In order to get trainee motivated, certificates are issued to them on completion of the training. However, trainer's certificate as a paper is not issued to trainers, as there is concern that they may use it for recruitment.

③ Submission of reports after the implementation of training

In order to monitor the implementation of training by trainers, the trainers shall submit a report to the HRGM after the training has been conducted.

Date	Room	Discussion Contents	Participants
2024/2/16 14:00-15:00 (PNG time)	Kavanamur's desk	– Contents about HRD for JCC – WG activity in this trip	Andrew.K
2024/2/19 11:00-12:00 (PNG time)	CTO's Room	– Contents about HRD for JCC – The quality of trainers after the project	Mark Greenaway, Kevin Kautu, Andrew.K Michael Pasi
2024/2/22 14:00-15:15 (PNG time)	NSO Room	– The quality of trainers and engineers after the project	Kevin Kautu, Andrew.K Michael Pasi, Jonah David, Chris Luther, Melvin Angi
2024/2/28 10:00-11:00 (PNG time)	HRGM's Room	– The quality of trainers and engineers after the project – The way to report after providing training	AlexsonMalga Andrew.Y, Andrew.K

2.Future Activity

Since the draft version has been approved at this JCC meeting, it will be improved through trial operation in the third year and completed as the final version.

The WG4 members will continue to exchange opinions and take action to ensure more appropriate operation of the overall HRD system.

Photo: WG activities

Progress of the training

○ WG1-1 System planning

As PPL requested further training on PSS/E during the 5th trip, we gave a lecture on how to use PSS/E again during the 6th trip. The training was conducted in Japan, and the methods of phylogenetic modeling and power flow analysis were explained. In addition to reviewing the methods of system modeling and power flow analysis that were conducted in the Japan training, WG members were asked to conduct short-circuit accident analysis and dynamic stability analysis, which could not be conducted in the Japan training. Through this training, basic modeling and analysis methods were acquired.

It was also agreed that the model of POM system created in the past (around 2019) will be used as a basis for the modeling of POM system in PSS/E in the future. The PSS/E agreed to base the model on the POM grid model developed in the past (circa 2019). The PPL will confirm any necessary changes from the past model.

Table1 Training of the System planning WG in PNG

Date and Time	Venue	Activity	Participant
2024/2/19 14:00-15:30 (PNG time)	Property Room PPL 2F	- Overview of the 3rd JCC - Explanation of WG activities during this trip	Benedicta Savage Charlie Enos Haidi Wanya
2024/2/19 14:00-15:30 (PNG time)	Property Room PPL 2F	- Training on PSS/E (power flow analysis, short-circuit accident analysis)	Benedicta Savage Charlie Enos Haidi Wanya
2024/2/19 14:00-15:30 (PNG time)	Property Room PPL 2F	- Training on PSS/E (power flow analysis, short-circuit accident analysis, dynamic stability) - Discussion on how to make the system mode for POM	Benedicta Savage Charlie Enos Haidi Wanya
2024/2/19 14:00-15:30 (PNG time)	Property Room PPL 2F	- Discussion on timing and implementation of next trip	Benedicta Savage Charlie Enos Haidi Wanya

○WG1-2 Financial and Economic analysis

The third-year training started during the sixth mission.

Five staff (Ngayam David, Belinda Amo, Lilian Amu, Samuel Saulep, and Lisoh Masu) were nominated as new trainees by the PPL, and three former trainees (Keith Kalama, Beda Kuglame, and Cathy Kutkue) were assigned to be new trainers. However, Ngayam David withdrew from the training due to another assignment for a different training program, and Keith Kalama also withdrew due to university studies.

We made a schedule for the third-year training, and started the training at a pace of two hours a session, two sessions a week, and eight sessions a month.

Meanwhile, the training manual, training materials, and syllabus were compiled during the fifth mission. These materials will be necessarily revised during the period of the third-year training.

After the mission, the online training also started in March, and half of the training was completed by the end of May.

Table 2. WG1-2 Training in Economic and Financial Analysis in PNG

Date and Time	Contents	Participants
2024/2/16 (Fri) 10:00 - 11:30	Explanation of the overall schedule for the third-year training, and exchange of opinions	Cathy Kutkue, Beda Kuglame, Keith Kamala
2024/2/19 (Mon) 11:00 - 15:30	Exchange of opinions about the procedure for conducting the training (lunch break from noon to 13:30)	Cathy Kutkue, Beda Kuglame
2024/2/20 (Tue) 10:00 - 10:30	Discussion on the orientation for trainees	Beda Kuglame
14:00 - 15:30	Implementation of the orientation	David Ngayam, Belinda Amo, Lilian Amu, Beda Kuglame, Cathy Kutkue
2024/2/21 (Wed) 10:30 - 11:15	Discussion on how to conduct lectures	Beda Kuglame
14:00 - 16:00	Lecture on financial statements	Ngayam David, Belinda Amo, Lilian Amu, Samuel Saulep, Lisoh Masu, Beda Kuglame, Cathy Kutkue
2024/2/22 (Thu)	ditto	Ngayam David, Belinda

14:00 - 16:00		Amo, Lilian Amu, Samuel Saulep, Lisoh Masu, Beda Kuglame, Cathy Kutkue
2024/2/23 (Fri) 13:30 - 15:30	Lecture on financial statement analysis	Belinda Amo, Lilian Amu, Samuel Saulep, Lisoh Masu, Beda Kuglame, Cathy Kutkue
2024/2/28 (Tue) 10:00 - 11:30	ditto	Ngayam David, Beda Kuglame
14:00 - 15:00		Ngayam David, Belinda Amo, Lilian Amu, Samuel Saulep, Lisoh Masu, Beda Kuglame, Cathy Kutkue
2024/2/29 (Wed) 13:30 - 15:30	ditto	Ngayam David, Belinda Amo, Lilian Amu, Samuel Saulep, Lisoh Masu, Beda Kuglame, Cathy Kutkue

Table 3. WG1-2 Online Training in Economic and Financial Analysis

Date and Time	Contents	Participants
2024/3/6 (Wed) 10:00 - 12:00	Exercise in financial statement analysis of various power companies	Cathy Kutku, Beda Kuglame, Belinda Amo, Lilian Amu, Lisoh Masu
2024/3/8 (Fri) 13:30 - 15:30	ditto	Beda Kuglame, Belinda Amo、Lilian Amu, Samuel Saulep
2024/3/11 (Mon) 13:30 - 15:30	ditto	Beda Kuglame, Belinda Amo、Lilian Amu, Samuel Saulep
2024/3/12 (Tue) 13:30 - 14:30	ditto	Cathy Kutkue, Beda Kuglame, Belinda Amo、Lilian Amu, Samuel Saulep
2024/3/15 (Fri) 10:00 - 12:00	ditto (supplemental session)	Beda Kuglame, Lisoh Masu
2024/3/19 (Tue)	ditto	Cathy Kutkue, Beda

13:30 - 15:30		Kuglame, Belinda Amo, Lisoh Masu
2024/3/20 (Wed)	ditto (supplemental session)	Beda Kuglame, Lilian Amu, Samuel Saulep
2024/3/22 (Fri) 10:00 - 12:00	Lecture on financial analysis for a project	Cathy Kutkue, Beda Kuglame, Lilian Amu, Lisoh Masu, Samuel Saulep
2024/3/25 (Mon) 13:30 - 15:30	ditto (supplemental session)	Cathy Kutkue, Beda Kuglame, Belinda Amo
2024/3/26 (Tue) 13:30 - 15:30	Exercise in financial analysis for a project	Cathy Kutkue, Beda Kuglame, Belinda Amo, Lilian Amu, Lisoh Masu
2024/3/28 (Thu) 10:00 - 12:00	ditto (supplemental session)	Cathy Kutkue, Beda Kuglame, Samuel Saulep
2024/4/9 (Tues) 13:30 - 15:30	ditto	Cathy Kutkue, Beda Kuglame, Lilian Amu, Lisoh Masu
2024/4/11 (Thu) 13:30 - 15:30	ditto (supplemental session)	Beda Kuglame, Lilian Amu, Lisoh Masu
2024/4/17 (Wed) 10:00 - 15:30	Ditto (lunch break from noon to 13:30)	Cathy Kutkue, Beda Kuglame, Belinda Amo, Samuel Saulep
2024/4/22 (Mon) 13:30 - 15:30	ditto	Cathy Kutkue, Beda Kuglame, Belinda Amo, Lilian Amu, Lisoh Masu, Samuel Saulep
2024/4/24 (Wed) 13:30 - 15:30	ditto	Cathy Kutkue, Beda Kuglame, Belinda Amo, Lilian Amu, Lisoh Masu, Samuel Saulep
2024/5/7 (Mon) 10:00 - 12:00	Exercise in financial analysis for a project and lecture on how to use the Goal Seek command	Cathy Kutkue, Beda Kuglame, Belinda Amo, Lilian Amu, Lisoh Masu, Samuel Saulep
2024/5/9 (Thu)	Exercise in financial analysis for a project	Cathy Kutkue, Beda

10:00 - 12:00		Kuglame, Belinda Amo, Lilian Amu, Samuel Saulep
2024/5/13 (Mon) 13:30 - 15:30	ditto (supplemental session)	Beda Kuglame, Lisoh Masu
2024/5/14 (Tue) 10:00 - 12:00	ditto	Cathy Kutkue, Beda Kuglame, Lilian Amu, Samuel Saulep
2024/5/16 (Thu) 13:30 - 15:30	Lecture on the difference between project and equity IRRs	Beda Kuglame, Lilian Amu, Lisoh Masu, Samuel Saulep
2024/5/22 (Wed) 13:30 - 15:30	Lecture on how to use the PMT function	Cathy Kutkue, Beda Kuglame, Lilian Amu, Lisoh Masu, Samuel Saulep
2024/5/24 (Fri) 13:30 - 15:30	Exercise in the calculation of interest and principal payments, and financial analysis for a project	Cathy Kutkue, Beda Kuglame, Lilian Amu, Lisoh Masu, Samuel Saulep

○WG2-1 Transmission line

On-site training and Online training were conducted from January to May with the aim of improving knowledge of maintenance work for transmission line facilities and asset management, and enhancing work skills. We conveyed the concept of patrol and inspection cycles, and methods for systematically managing transmission line facilities in the training. Also, we conducted a review of the training content and comprehension tests for trainers so that the trainers could properly lecture to the trainees as instructors from June.

Table4. WG2-1 Training of the Transmission line WG in PNG

Date and Time	Contents	Trainees
2024/5/29 10:00-15:30 (PNG time)	・Review of training regarding tower, foundation and insulation design concepts	Chris Luther, Ben Kaum Esorom Passingan Deanne Kilamanu-Naime

2024/5/30 10:00-15:30 (PNG time)	・ Review of training regarding how to conduct patrol and inspection and checklists ・Training of patrol and inspection at an actual tower	Chris Luther Ben Kaum Esorom Passingan Deanne Kilamanu-Naime

Table5. WG2-1 Online Training of the Transmission line WG

Date and Time	Contents	Trainees
2024/4/11 10:00-12:00 (PNG time)	Training of how to management of transmission line facilities	Chris Luther Ben Kaum Esorom Passingan Deanne Kilamanu-Naime
2024/4/25 10:00-12:00 (PNG time)	Comprehension test of training contents related to maintenance work for transmission line facilities	Chris Luther Ben Kaum Esorom Passingan Deanne Kilamanu-Naime

○WG2-2 Substation

Training was continued with the aim of improving knowledge of substation equipment maintenance work and asset management, as well as maintenance plan formulation skills. In addition, since Training of Trainer (TOT) by current WG members is scheduled for the 7th trip, online training was provided on how to proceed with the TOT, providing the trainers with the necessary mindset and knowledge.

Table6. WG2-2 Training of the Substation WG in PNG

Date and Time	Contents	Trainees
2024/2/28 10:00-11:00 (PNG time)	-Concept of criteria for inspection of substation facilities at KANSAI	S. Deveo, R. Rawali, D. Kilamanu-Naime(WG2-1)
2024/2/29 10:00-16:00 (PNG time)	-Introduction of maintenance method using measurement instruments -Review of patrol frequency for	S. Deveo, R. Rawali, D. Kilamanu-Naime(WG2-1)

	substation equipment -Mobile Equipment in Kansai -Failures of equipment in Kansai	
2024/5/8 10:00-12:00 (PNG time)	-How to proceed with Training of Trainer (TOT) ・Objective of TOT ・Effectiveness and importance of training ・Trainer's knowledge and qualifications ・How to proceed with training on the 7th trip	S. Deveo, R. Rawali, T. Naipu Note: S.Robert and B.Inamo was followed up at a later date.

○WG3 Protection coordination

All technology transfer to C/P was completed with the completion of practical training during the fifth trip.

ANNEX4

本邦研修実施報告書

独立行政法人
国際協力機構（JICA）

パプアニューギニア国
電力系統計画・運用能力向上プロジェクト
（第 1 回技術支援）

実施報告書

令和 5 年 8 月
（2023 年）

関西電力送配電株式会社
株式会社ニュージェック
シードおきなわ合同会社

パプアニューギニア国
電力系統計画・運用能力向上プロジェクト（第 1 回技術支援）
実施報告書

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添付資料
・本邦研修カリキュラム
・本邦研修参加者リスト
・最終報告会資料

1章.　研修の概要

1.　目的

本プロジェクトは、パプアニューギニア電力公社（以下、「PPL」）の職員の技術力向上、マニュアルの策定、トレーニングの枠組み構築を通じて、パプアニューギニア国（以下、「PNG」）の電力系統計画・運用能力向上を図り、PNG の電力の供給信頼度及び品質の向上に寄与することを目的とした技術協力プロジェクトであり、プロジェクト活動を通じて、カウンターパート（C/P）の技術能力向上を達成することが、プロジェクトの成果の一つとして求められている。

今回の本邦研修では、適切にメンテンスされた日本の設備を直接見てもらうことでメンテナンスの重要性を感じてもらうことや、日本の技術者の講義やディスカッションを通じて、自身の知見をさらに深めてもらうことを目的としている。

2.　日程

2023 年 7 月 24 日～2023 年 8 月 4 日

3.　参加者

PPL：20 名

JICA　CDN：2 名

コンサルタント：15 名

PPL の参加者の詳細については、添付資料「本邦研修参加者リスト」参照

4.　内容

研修の概略工程については、下表の通りである。詳細な工程については、別添資料を参照。

	AM	PM
7/24	東京→大阪	オリエンテーション
7/25	WG 別活動	猪名川変電所視察
7/26	WG 別活動	【WG1・3】三菱電機視察 【WG2】野江電力所視察
7/27	WG 別活動	発表資料準備
7/28	蹴上発電所視察	金閣寺視察
7/29・7/30	休日	
7/31	帰国ブリーフィング	人材育成制度・MG セット講義
8/1	WG 別活動（オンライン）	WG 別活動（オンライン）
8/2	WG 別活動（オンライン）	WG 別活動（オンライン）
8/3	WG 別活動（対面）	WG 別活動（対面）
8/4	発表会	閉講式

関西での研修については、午前中はWG別の活動を中心に実施し専門分野の知識を深める一方、午後は共通プログラムとして設備視察を中心に実施し自らの業務分野以外の幅広い知見を得てもらう内容とした。

沖縄での研修については、台風の影響を受け対面での講義・実技や設備の視察が不可能となったため、2日間のプログラムをオンラインでの実施へと変更した。

全体共通のプログラムとしては、猪名川変電所・三菱電機・蹴上発電所の視察や人材育成制度・MGセットに関する講義を行った。

猪名川変電所では、変圧器、遮断器、断路器、保護リレーといった様々な設備について、机上説明のみでなく、実設備の視察を行った。また、系統事故時における復旧訓練の様子や制御所の視察を通じて、系統運用業務に関する知識も深めた。

三菱電機では、ショールームや組立工場にて、ガス絶縁開閉装置やガス遮断器等の模型・組立現場の視察を行った。パプアニューギニアでは導入されていない420kV設備の視察などを通じて、自らの業務分野以外の幅広い知見を獲得していただいた。

蹴上発電所では、運開から100年以上経過している発電所の設備視察や蹴上発電所が建設された歴史などを学んだ。蹴上発電所の視察を通じて適切にメンテナンスされた機器が長期間使用することが出来ることを認識してもらい、メンテナンスの重要性を伝えた。

人材育成制度の講義では、沖縄電力における技術者育成制度の紹介を行った。本講義では、技術者として期待すべき人材像を明確にした上で教育方針を定め、OJT・Off-JT・自己啓発の取り組みを織り交ぜながら、各分野のエキスパートを育成していく仕組みを説明した。また、効果的な教育を行うためには、各研修においてその目的と成果を明確にした上で実施することが重要であるということと、習得した知識や技術力が組織として持続可能的に継承されていくことが重要である旨を伝えた。

MGセットの講義では、再エネ主力化に向けた沖縄電力の取り組みとして、モーターとディーゼル発電機を組み合わせた発電システムであるMGセットの紹介を行った。パプアニューギニアにおいて、現時点では再エネの導入は盛んではないが、再エネ導入に伴う課題に対するアプローチの一つとして本講義を実施した。

猪名川変電所視察

蹴上発電所視察

人材育成制度講義

MG セット講義

WG 個別の実施内容ついては、下記の通りである。

4-1 WG1-1 系統計画

WG1-1 では、3 種類の講義・ディスカッションを行った。それぞれの実施内容については、下記の通りである。

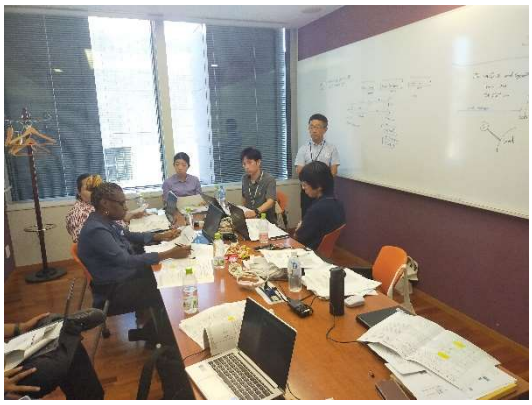
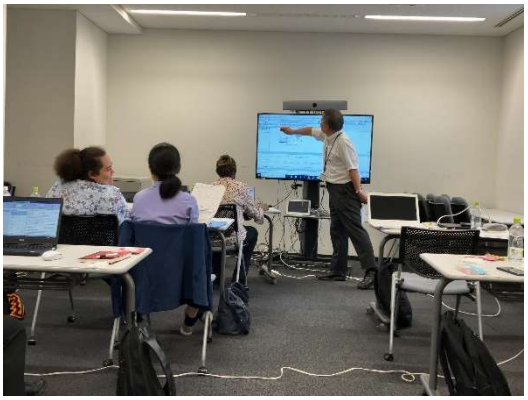
①マニュアルに関するディスカッション

前回の渡航までに、WG メンバーと合意した IPP が PPL の系統に連系する際の業務手順を整備した Operational マニュアルの作成に向けて、PPL メンバーとディスカッションを行った。PPL の系統連系における問題点として、IPP が PPL の系統連系する際に技術部門の意見が反映されないケースがあった。PPL からのヒアリング結果と Grid code を基にコンサル側にて作成したワークフロー案をベースとして、技術部門の意見が反映されるワークフローとなるようにディスカッションを行った。一度目のディスカッション内容を踏まえて修正したワークフローで再度ディスカッションを行い双方の認識に齟齬がないことを確認した。今後は、ワークフローを簡素化し理解しやすいものへと変更する。簡素化したワークフローを WG メンバーがレビューし、次回渡航時に再度ディスカッションを行う予定としてる。

②系統解析に関する講義・実技

PPL が供給信頼度の高い系統構成を検討できるよう、同期安定度や電圧安定度等について、講義およびシミュレーションを実施した。講義では、数式を用いて安定度に関する基礎理論に関する説明を行った後、理解度確認のため演習問題を実施した。演習問題の内、難易度の高い応用問題では苦戦したものの、基本的な知識は研修員に定着していることを確認できた。また、シミュレーションでは、定常状態および数秒から数十秒のタイムスケールで送電網をシミュレートするために使用する系統解析ソフトウェア「PSS/E」を用い、負荷電流、動的安定性、短絡電流の計算および時間変化を確認した。講師から PSS/E の操作方法やパラメータ入力時の留意点を説明した後、各研修員が実際に PSS/E を操作してシミュレーションを実行することで理解を深めさせた。研修成果として、供給信頼度の高い系統構成の検討に直結する知識と系統解析ソフトを用いたシミュレーションの実行能力を、各研修員に付与できた。

③Least cost development plan に関するディスカッション
世界銀行の発行した「Papua New Guinea Least Cost Power Development Plan Update December 2020」を理解し更新する能力を付与するための講義を 2 日間実施した。講義では、始めに PPL の研修生に世界銀行の立案した計画を確認させた。次に、JICA 専門家が主導した解説とディスカッションにより、各研修生の理解を深めた。JICA 専門家からは、計画の全体像と、計画更新のための検討事項を詳細に説明した。他方、PPL の研修生自身も、世界銀行の計画と自社の計画との相違、計画時点と現時点での前提条件の相違など、細部に亘る気づきを得ることができた。研修の成果として、PPL の研修生に目標としていた能力を付与することができた。

WG1-1 個別活動の様子

4-2 WG1-2 経済財務分析
①　財務モデルの演習
昨年 10 月から開始した一連の研修の流れに沿って、講義および演習を行った。演習は先月 6 月までに終了した問題集「Problem 6」に続く「Problem 7」を使用した。
演習問題は徐々に複雑な財務モデルを作成するように構成してあり、演習の途中でエクセルの組み込み関数の使い方も講義した。今回の演習では、モデル内で判断条件を定義する if 関数の使い方を取り上げた。
全員がエクセルでモデルを組む経験に富むわけでなく、さらに十分なプログラミングの経験を持つわけでもない。研修生には、最初、戸惑いや間違いもあったが、日本研修では時間をかけて対面指導できるという利点があり、皆の理解を深めさせることが可能となった。
②　PPL が抱える問題についての議論
独立系発電事業者（IPP）からの発電（買電）コスト上がるなか、過去 10 年間にわたって料金値上げが認められず、PPL のマージンが縮小し、十分な維持管理費の捻出や将来投資ができなくなっていることに議論の焦点が当たった。
一方、PPL の将来の財務状況の予測や新規投資の財務評価がこれまで十分行われて来なかったという現状がある。この点で、関連する部門の管理職や専門職・エンジニアがモデルを使った財務評価の知識を身につけるべきという意見に至ったことは、研修の大きな成果と考える。

4-3 WG2-1 送電

WG2-1 では関西の研修を視察中心のカリキュラムを設定し、沖縄の研修では訓練設備を使った実務のカリキュラムを設定した。それぞれの内容に関しては下記のとおり。

・2023 年 7 月 25 日（火）午前：茨木研修センター視察

関西電力送配電の茨木研修センター（以下、研修Ｃ）の新入社員研修ならびに訓練設備の視察を実施した。研修Ｃは同社の人材育成の拠点として、新人から熟練者までの技術、技能といった幅広い教育を行っている箇所である。今回、同社の教育プログラムと安全文化の理解浸透と意識向上を図った。PPL 研修生からは作業班の体制や作業工法、使用工具に関して質問が多く寄せられた。

新入社員研修の様子

視察時の様子

・2023 年 7 月 25 日（火）午後：猪名川変電所視察

全体カリキュラムとしては前述の通り。WG2-1 の特筆すべき内容としては、当変電所付近には 500kV と 275kV の送電鉄塔が存在しているため併せて概要説明と鉄塔部材の選び方について説明を実施し、PPL 研修生の知見を広げた。

・2023 年 7 月 26 日（水）午前：新加古川線改良工事視察

架空送電線建設現場を視察した。当現場は長期間メンテナンスを行い維持管理してきた設備の改修工事となっている。今回、当社の設備維持管理方法だけでなく、工事工法や安全対策について理解浸透を図った。PPL 研修生にとって、工事工法に関しては非常に関心が高く、搬器や重機の必要性や工事工法について多くの質問を受けた。

新加古川線改良工事視察

乗用モノレールへの試乗

・2023 年 7 月 26 日（水）午後：野江電力所視察
メンテナンスオフィスである野江電力所を視察した。野江電力所は現場第一線で当社の設備保全を行っている組織である。講義としては野江電力所概要と関西電力送配電で使用しているアセットマネジメントシステムの紹介、保守倉庫視察、構内鉄塔の視察を行った。同社のアセットマネジメントシステムは定期点検の計画や結果、事故障害データ等の登録や自由な閲覧ができる。ＰＰＬは現在アセットマネジメント（MEX システム）を構築中であるため、研修生からシステムに対する質疑が多く寄せられた。

ハーネス式安全帯の説明

倉庫内部説明

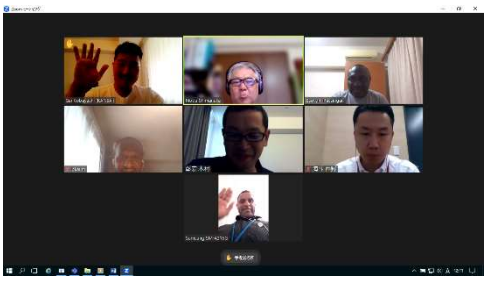
・2023 年 7 月 27 日（木）終日：フォロートレーニング
オンライントレーニングで実施した架線設計に関する再トレーニングを中心に机上トレーニングを実施した。今回、我々で架線検討を円滑に実施できるエクセルプログラムを作成したので、使用方法の説明ならびに架線設計の基本的概念についての復習を行い、理解促進を図った。また PPL が計画している L401 送電線路の復旧作業（現在は断線中）に向けた、当該プログラムの活用方法や留意点についてディスカッションを実施した。

講義の様子

架線条件説明

・2023 年 8 月 1 日（火）終日：オンライントレーニング
台風 6 号の襲来に伴い沖縄電力㈱の訓練設備を利用できず、オンライン研修に変更した。
3 日に計画していたドローンの技術紹介を前倒し実施し、ドローンで精度良く送電設備を撮影する為のポイント、充電線との必要安全距離など、今後 PPL がドローン点検導入を見据える中で理解すべき内容を中心にトレーニングを実施した。

・2023 年 8 月 2 日（水）終日：オンライントレーニング
台風 6 号の襲来に伴い沖縄電力㈱の訓練設備を利用できず、オンライン研修に変更した。本邦研修を受け PPL が自ら考えた成果報告会資料のドラフト版を提供され、我々と共にレビューを行い、適宜質疑応答により内容の精緻化を図った。



オンライントレーニングの様子

・2023 年 8 月 3 日（木）終日：点検チェックリストの運用方法と点検結果の評価方法
台風 6 号の襲来により訓練設備を使用した点検の模擬訓練は実施できなかったものの、机上にて設備別の点検方法や点検チェックリストの使用方法について再説明を行った。さらに、点検で発見された異常の事例を活用し、異常ランク判定や修繕方法策定などのアセットマネジメントの実習を行い、PPL 研修生の知識向上を図った。

ディスカッションの様子

4-4 WG2-2 変電
WG2-2 では関西の研修を視察中心のカリキュラムを設定し、沖縄の研修では訓練設備を使った実務のカリキュラムを設定した。それぞれの内容に関しては下記のとおり。

・2023 年 7 月 25 日（火）午前：茨木研修センター視察
関西電力送配電の茨木研修センター（以下、研修Ｃ）の新入社員研修ならびに訓練設備の視察を実施した。同社における新入社員研修の概要（対象者、期間、内容等）を説明し、実際に新入社員が行っている変電機器点検作業の視察を行った。PPL 研修生は、同社の教育プログラムに非常に関心が高く、積極的な質疑応答がなされた。


・2023 年 7 月 25 日（火）午後：西部基幹制御所・猪名川変電所視察

全体カリキュラムとしては前述の通り。WG2-2 の特筆すべき内容として、PNG が所有していない５００ｋＶ変電設備の概要と２７５ｋＶ以下設備との違いや、５００ｋＶ母線の構成について重点的に説明を行ない、ＰＰＬの知見を深めた。


・2023 年 7 月 26 日（水）午前：

2023 年 6 月 28 日に実施したオンラインワーキングでの研修内容について、今回供与する資機材に関し、「直流接地事故点探査」及び「避雷器漏れ電流測定」に関する資料の穴埋め問題による試験の実施、解説、ディスカッションにより研修生の理解浸透を図った。また、各種マニュアルに関して当社における例を示し、ＰＰＬの具体的イメージを深めた。


・2023 年 7 月 26 日（水）午後：野江電力所視察

メンテナンスオフィスである野江電力所を視察した。講義としては野江電力所概要と関西電力送配電で使用しているアセットマネジメントシステム紹介、保守倉庫視察、野江変電所視察を行った。同社のアセットマネジメントシステムは定期点検の計画や結果、事故障害データ等の登録・閲覧等ができる。ＰＰＬは現在アセットマネジメントを構築中であるため、研修生からシステムに対する質疑が多くなされた。

・2023 年 7 月 27 日（水）午前：大阪北電力本部事故復旧訓練視察

変圧器事故復旧における健全性確認試験に関する訓練について寝屋川変電所での視察を行った。まず、訓練実施前の訓練内容の事前打合せ、危険予知活動の様子を視察し、当日の作業体制や実施手順の再確認や安全に関わるリスクマネジメントの重要性について認識を深めた。また試験においては試験回路構成や測定結果判定の様子や変圧器のタップ切換器の構造及び活線浄油機について特に関心を持って視察された。

・2023 年 8 月 1 日（火）終日：オンライントレーニング

台風 6 号襲来により沖縄電力での訓練設備を使用した研修からオンライントレーニングに変更となった。講義としては変圧器負荷時タップ切換装置の構造と動作、ならびにガス遮断器の構造と開閉特性試験について行った。両講義とも今後 PPL が保全能力を向上させるにあたり、なぜ点検が必要なのか、また不具合時の影響等を考えられるように、まずは機器の構造と動作原理を理解することに重点をおいた。

・2023 年 8 月 2 日（水）終日：オンライントレーニング
台風６号襲来により沖縄電力での訓練設備を使用した研修からオンライントレーニングに変更となった。講義としては、関西電力送配電における標準的な変電所構成について行った。７月２６日の寝屋川変電所視察の際に、屋内変電所について PPL 研修生の関心が深かったため、補足講義を行ったもの。

・2023 年 8 月 3 日（木）午前：机上トレーニング
台風６号襲来により沖縄電力での訓練設備を使用した研修ができなくなったことから、対面机上による研修に変更となった。講義としては、今回ＰＰＬに供与する機材の内、ガス漏れ検知器及び絶縁油性能試験器に関し、目的や原理について説明を行い、現地訓練前におけるＰＰＬの知見を深めた。

4-5 WG3 保護協調

WG 別活動にて実施した講義内容は下表の通りである。研修の具体的な内容については議事メモを参照。

	AM	PM
7/25	CT 比の検討方法	※1
7/26	インピーダンスの算定方法	※1
7/27	事故分析方法	発表資料準備
7/28	※1	※1
7/29・7/30	休日	
7/31	※1	※1
8/1	沖縄の系統概要※2	給電指令所の概要※2
8/2	系統安定化システムの概要※2	宮古島メガソーラー実証の概要※2
8/3	シミュレーションツールの紹介	シミュレーションツールの紹介
8/4	※1	※1

※1 全体研修または視察、報告会等
※2 台風 6 号襲来のためオンラインで実施

①WG3 活動総括

今回の本邦研修を通して、CT 比の検討やインピーダンスの算定、事故分析等の業務が保護リレーとどのように関わっているかを示すことができた。また、最終講義であるリレー整定技術計算システム(シミュレーションツール)の紹介では、必要な諸元を揃えることで、これまでに検討が困難であった保護リレーの動作確認や保護協調を比較的容易に実施可能であることを認識いただいた。更に、PNG では将来に向けて需要増が見込まれるため、沖縄で導入している系統安定化システムを紹介し、小規模系統での系統安定化に必要な技術を紹介した。

②今後の活動について

今後の実施内容については、今回の本邦研修を通して CP から頂いたコメント(更に学びたいトピック等)を基に、下記事項について活動を進める。

■　業務マニュアル作成に向けた項目の整理およびドラフト版作成

■　保護リレーに関する研修の実施(差動リレー整定手法、架空線インピーダンス算定、距離リレーの保護協調の検討方法)

■　インピーダンスマップ作成および距離リレーの整定値確認


WG3 個別活動の様子

4-6 WG4　人材育成

本プロジェクトにて作成している人材育成要領（案）について、人財育成に関するプロジェクトマネージャーの Kevin 氏へ内容の説明およびディスカッションを行った。いただいたコメントをもとに要領（案）の内容を整理し、次回渡航時には WG4 メンバー全員でディスカッションを行う予定。なお、今回 Kevin 氏からいただいたコメントは以下の通り。

・トレーナー資格の有効期限を３年としているが、資格の継続ルール（図１）として、毎年トレーナーの評価を行い、その評価が３年間続けて未達の場合には資格失効するというルールにした方が良い。なお評価内容は、「講義の実施有無」などとしたい。

・トレーナー資格の申請および承認ルートは、各分野のリーダー⇒能力評価マネージャー⇒研修マネージャーの順とする。

・本人材育成制度要領の管理は、最終承認者として設定予定である、研修マネージャーとする。

・人事異動があった場合、異動前の分野で取得したトレーナー資格を使用して、異動後の分野でトレーナーとして研修することはできないこととし、その分野でトレーナーになるためには、新たにその分野のトレーナー資格を取得する必要がある。例えば、送電分野でトレーナー資格を持っている者が変電分野へ異動となった場合に変電分野のトレーナーとなるためには、変電分野でトレーナー資格を取得する必要がある。なお、別の分野へ異動した場合でも、引き続き異動前の分野でトレーナーとして研修を実施することは可能とする。（トレーナー資格の有効活用）（図２）

Y2024 ﾄﾚｰﾅｰ資格取得	Y2025 ﾄﾚｰﾅｰ条件	Y2026 ﾄﾚｰﾅｰ条件	Y2027 ﾄﾚｰﾅｰ条件	Y2028 ﾄﾚｰﾅｰ条件	備考
Mr.XX	×	○	×	ﾄﾚｰﾅｰ継続	2025年~2027年の内、1年でも条件を満たしていれば、2028年～2030年もﾄﾚｰﾅｰ資格の維持が可能。
Mr.YY	×	×	×	ﾄﾚｰﾅｰ資格再取得	3年連続で条件未達のため、ﾄﾚｰﾅｰ資格剥奪。 2028年以降に再受講し合格したら次年度からﾄﾚｰﾅｰとして復帰。

図１：トレーナー資格の継続ルール

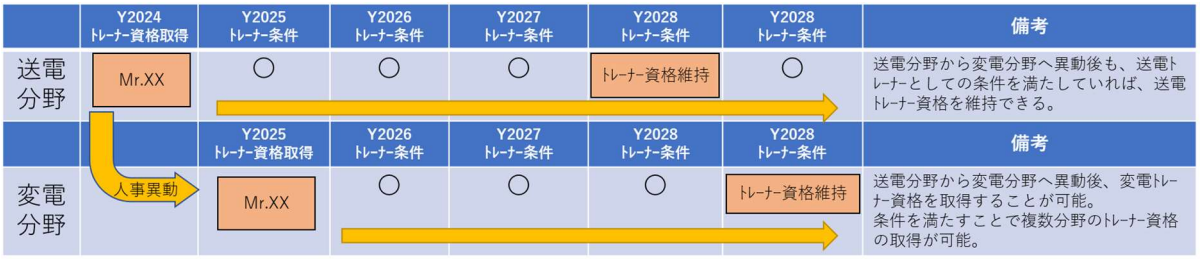


図２：トレーナー資格の有効活用

2章.　実施結果についての所見

1.　カリキュラムの評価・改善点等

WG 別の活動と全体での設備視察をバランスよく取り入れることで、専門分野の理解を深め、また専門分野以外の知見を広げる機会を提供することが出来た。

WG 別の活動においては、日本で実施している訓練の様子の視察やコンサルメンバー以外の日本の技術者からの講義を通じて知見を広げるとともに、日常業務から離れた環境の中で日本人専門家とじっくり議論の場を持つことで研修員自身の専門知識をより深いものとすることが出来た。

設備視察においては、自身の専門分野外の設備の視察においても、積極的に質疑を行っている様子も見受けられた。やはり実際に設備を見て、日本のシステムや自国との違いが印象に残ったようである。

沖縄研修においては、台風の影響で急遽カリキュラムを変更する必要が生じた。規模の大きい台風であったため予定していた設備視察等は実施出来なくなったものの、オンラインや JICA 沖縄の施設を利用させて頂いたことで、研修を継続する事が出来た。研修生からは、悪天候の中、研修を継続してもらったことへの謝意を頂いた。

今回の研修全体としては、研修員の人数が多くまたWG別活動を導入したことにより様々な内容が含まれ、研修計画や実施において特に研修監理員の方にご負担をおかけしたが、各WG及びプロジェクト全体のチームワークの醸成に大きな効果があり、今後の活動において有効であると考えている。なお、計画変更を余儀なくされた点については、自然条件によるので難しい面もあるが、今後は研修の実施時期・場所については、台風の影響が少ない時期や場所を選定することが必要であると考えている。

2.　研修員からの評価

最終日には、各 WG から研修を通じて学んだことや日本での生活を通じて印象に残ったことを発表した。詳細については、添付資料「最終報告会資料」を参照。

改善点に関する意見も少しあったものの、研修員の方々からは本研修で多くのことを学ぶことが出来たので、学んだことを持ち帰って自国の業務の改善に努めたいといったポジティブな意見を多く聞くことが出来た。発表会で出た研修員からの意見としては、主に下記の通りである。

○良かった点

・現場視察では、パプアニューギニアに無い設備や設備の製造現場を見ることができ、大変有意義であった。
・講義資料が細かく作られており非常に理解しやすかった。
・関西の制御所におけるバックアップ体制や事故発生時の訓練について学べたため、PPL へ反映できるようにしたい。
・オペレーショナルマニュアルをはじめとする、各種のマニュアルの必要性を実感できたため、本プロジェクトを通じて、より良いマニュアルを作成したい。

○改善点

・台風により研修スケジュールの変更が生じてしまったので、実施時期については、台風が少ない季節を選んではどうか。
・台風の影響によるスケジュール変更によって実技の時間が無くなってしまったので、実技の時間が欲しかった。
・日本語の講義の時間を設けてほしい。
・日本での研修の頻度を増やしてほしい。

最終報告会風景

WG1-1

WG1-2

WG2-1

WG2-2

WG3

3. その他気づきの点

研修員が集合時間となっても現れないケースなどで、CDN と研修員が直接電話でのやり取りが出来ていないようであった。緊急時の対応などもあるので、研修員と電話での連絡が取れるように、SIM カードの支給などを検討しても良いのではないかと感じた。

日程表

研修日程表

研修コース名	パプアニューギニア国電力系統計画・運用能力向上プロジェクト		
研修コース番号	202005171-J002	※必須(半角英数字)	
研修期間	2023/7/24 ～ 2023/8/4		

研修プログラム名	パプアニューギニア国電力系統計画・運用能力向上	
研修プログラム番号	1	※必須(半角数字)
受入形態	国別研修	
研修員数	20	人

日付 ※必須	時刻	形態	研修内容 ※必須	講師又は見学先担当者等			講師使用言語	都道府県	研修場所	備考	連絡事項	対象グループ	強調
				氏名 (敬称略)	所属先及び職位名	連絡先							
7/24(月)	15:45 ～ 16:00		移動（ホテル→関西電力本店）					大阪府	関西電力本店:大阪市北区中之島3丁目6-16			全員	
	16:00 ～ 17:00		JICAオリエンテーション					大阪府	関西電力本店:大阪市北区中之島3丁目6-16			全員	
	17:00 ～ 18:00		大阪プログラムオリエンテーション	上岡 誠治	関西電力送配電/マネジャー		英語	大阪府	関西電力本店:大阪市北区中之島3丁目6-16			全員	
	18:00 ～ 18:15		移動（関西電力本店→ホテル）					大阪府				全員	
7/25(火)	8:00 ～ 9:00		移動（ホテル→茨城研修センター）					大阪府			研修生8名	WG2-1,2-2	
	8:30 ～ 9:00		移動（ホテル→関西電力本店）					大阪府			研修生12名	WG2以外	
	9:00 ～ 12:00	講義	WG1-1：系統計画 机上講義	上岡 誠治	関西電力送配電/マネジャー		英語	大阪府	関西電力本店:大阪市北区中之島3丁目6-16		研修生4名	WG1-1	
	9:00 ～ 12:00	講義	WG1-2：経済・財務分析 机上講義	石黒 正康	関西電力送配電		英語	大阪府	関西電力本店:大阪市北区中之島3丁目6-16		研修生6名	WG1-2	
	9:00 ～ 12:00	講義	WG3：保護協調 机上講義	桃原 正悟	シードおきなわ/スペシャリスト		英語	大阪府	関西電力本店:大阪市北区中之島3丁目6-16		研修生2名	WG3	
	9:00 ～ 12:00	視察	WG2-1,2-2:茨木研修センター送変電訓練設備視察	福本 拓生	関西電力送配電/所長		英語	大阪府	茨木研修センター:茨木市4丁目4		研修生5名	WG2-1,2-2	
	12:00 ～ 13:00		昼食（デリバリーorレストラン）					大阪府					
	13:00 ～ 14:30		移動（関西電力本店or茨木研修センター→猪名川変電所）					兵庫県					
	14:30 ～ 17:00	視察	500kV猪名川変電所視察	矢野 健治	関西電力送配電/所長代理		日本語	兵庫県	猪名川変電所:川辺郡猪名川町鎌倉南山		研修生20名	全員	
	17:00 ～ 18:30		移動（猪名川変電所→ホテル）					大阪府					
7/26(水)	8:30 ～ 10:00		移動（ホテル→送電線建設現場）					大阪府			研修生5名	WG2-1	
	8:30 ～ 9:00		移動（ホテル→関西電力本店）					大阪府			研修生15名	WG2-1以外	
	9:00 ～ 12:00	講義	WG1-1：系統計画 机上講義	上岡 誠治	関西電力送配電/マネジャー		英語	大阪府	関西電力本店:大阪市北区中之島3丁目6-16		研修生5名	WG1-1	
	9:00 ～ 12:00	講義	WG1-2：経済・財務分析 机上講義	石黒 正康	関西電力送配電		英語	大阪府	関西電力本店:大阪市北区中之島3丁目6-16		研修生5名	WG1-2	
	10:00 ～ 11:30	視察	WG2-1：送電 現場視察	設楽 義隆	関西電力送配電/所長代理		英語	兵庫県	送電線建設現場：兵庫県宝塚市切畑付近		研修生3名	WG2-1	
	9:00 ～ 12:00	講義	WG2-2：変電保守 机上講義	宮下 孝司	ニュージェック		英語	大阪府	関西電力本店:大阪市北区中之島3丁目6-16		研修生5名	WG2-2	
	9:00 ～ 12:00	講義	WG3：保護協調 机上講義	桃原 正悟	シードおきなわ/スペシャリスト		英語	大阪府	関西電力本店:大阪市北区中之島3丁目6-16		研修生2名	WG3	
	11:30 ～ 12:30		昼食（デリバリーorレストラン）					兵庫県			研修生5名	WG2-1	
	12:00 ～ 13:00		昼食（デリバリーorレストラン）					大阪府			研修生15名	WG2-1以外	
	12:30 ～ 13:30		移動（送電線建設現場→関西電力本店→野江電力所）								研修生5名	WG2-1、2-2	
	13:00 ～ 14:00		移動（関西電力本店→三菱電機）					大阪府			研修生15名	WG2以外	
	13:30 ～ 17:00	視察	野江電力所視察	酒井 昇	関西電力送配電/係長		日本語	大阪府	野江電力所:大阪市城東区野江2丁目12-12		研修生8名	WG2-1,2-2	
	14:00 ～ 16:30	視察	三菱電機視察	金岡 夏哉	三菱電機		日本語	兵庫県	兵庫県尼崎市塚口本町8丁目１－１		研修生12名	WG2以外	
	17:00 ～ 17:30		移動（野江電力所→ホテル）					大阪府			研修生8名	WG2-1,2-2	
	16:30 ～ 17:00		移動（三菱電機→ホテル）					大阪府			研修生12名	WG2以外	
7/27(木)	8:30 ～ 9:30		移動（ホテル→変電所）					大阪府			研修生8名	WG2-1,2-2	
	8:30 ～ 9:00		移動（ホテル→関西電力本店）					大阪府			研修生12名	WG2以外	
	9:00 ～ 12:00	講義	WG1-1：系統計画 机上講義	上野 清隆	ニュージェック/マネジャー		日本語	大阪府	関西電力本店:大阪市北区中之島3丁目6-16		研修生5名	WG1-1	
	9:00 ～ 12:00	講義	WG1-2：経済・財務分析 机上講義	石黒 正康	関西電力送配電		英語	大阪府	関西電力本店:大阪市北区中之島3丁目6-16		研修生5名	WG1-2	
	9:00 ～ 12:00	講義	WG2-1：送電 机上講義	木村 彰宏	関西電力送配電		英語	大阪府	関西電力本店:大阪市北区中之島3丁目6-16		研修生5名	WG2-1	
	9:00 ～ 12:00	講義	WG3：保護協調 机上講義	桃原 正悟	シードおきなわ/スペシャリスト		英語	大阪府	関西電力本店:大阪市北区中之島3丁目6-16		研修生2名	WG3	
	9:30 ～ 11:30	視察	WG2-2:寝屋川変電所 障害探査研修	鳥居 明生	関西電力送配電		日本語	大阪府	寝屋川変電所:寝屋川市大成町7－11		研修生8名	WG2-2	
	11:30 ～ 12:30		移動（変電所→関西電力本店）					大阪府			研修生8名	WG2-1,2-2	
	12:00 ～ 13:30		昼食（デリバリーorレストラン）										
	13:30 ～ 15:00		大阪研修のまとめ＋質疑	上岡 誠治	関西電力送配電/マネジャー		英語	大阪府	関西電力本店:大阪市北区中之島3丁目6-16		研修生20名	全員	
	15:00 ～ 16:30		発表資料準備	上岡 誠治	関西電力送配電/マネジャー		英語	大阪府	関西電力本店:大阪市北区中之島3丁目6-16		研修生20名	全員	
	16:30 ～ 17:00		移動（関西電力本店→ホテル）					大阪府					

日程表

7/28(金)	8:00 ～ 9:30		移動（ホテル→蹴上発電所）					京都府			研修生20名	全員	
	9:30 ～ 12:00	視察	蹴上発電所視察	太根　彩羽	関西電力/再生可能エネルギー事業本部　マネジャー		**日本語**	京都府	蹴上発電所:京都市左京区粟田口鳥居町１		研修生20名	全員	
	12:00 ～ 13:00		昼食（デリバリーorレストラン）								研修生20名	全員	
	13:00 ～ 14:00		移動（蹴上発電所→京都市内）								研修生20名	全員	
	14:00 ～ 15:00	視察	京都市内視察	上岡 誠治	関西電力送配電/マネジャー		日本語	京都府	金閣寺：京都府京都市北区金閣寺町１		研修生20名	全員	
	15:00 ～ 16:30		移動（京都市内→ホテル）					大阪府					
7/29(土)			移動（大阪→沖縄）					沖縄県					
7/30(日)			沖縄視察					沖縄県				希望者	
7/31(月)	9:30 ～ 10:00		帰国ブリーフィング					沖縄県	JICA沖縄		研修生20名	全員	
	11:30 ～ 12:30		昼食（デリバリーorレストラン）					沖縄県			研修生20名	全員	
	12:30 ～ 13:00		移動（JICA沖縄→沖縄電力）					沖縄県	沖縄電力本店:浦添市牧港5丁目2-1		研修生20名	全員	
	13:00 ～ 14:00	講義	技術者育成制度講義	宮里 清大	シードおきなわ/スペシャリスト		英語	沖縄県	沖縄電力本店:浦添市牧港5丁目2-1		研修生20名	全員	
	14:00 ～ 15:00	講義	ＭＧセットに関する講義	當山　優太	沖縄電力		英語	沖縄県	沖縄電力本店:浦添市牧港5丁目2-1		研修生20名	全員	
	15:00 ～ 16:00		移動（沖縄電力本店→JICA沖縄）					沖縄県	JICA沖縄		研修生20名	全員	
8/1(火)													
	9:30 ～ 12:00	講義	WG1-1：系統計画 オンライン講義	上岡 誠治	関西電力送配電/マネジャー		英語	沖縄県	JICA沖縄		研修生5名	WG1-1	
	9:30 ～ 12:00	講義	WG1-2：経済・財務分析 オンライン講義	石黒 正康	関西電力送配電		英語	沖縄県	JICA沖縄		研修生5名	WG1-2	
	9:30 ～ 12:00	講義	WG2-1：送電保守 オンライン講義	木村 彰宏	関西電力送配電/副長		英語	沖縄県	JICA沖縄		研修生3名	WG2-1	
	9:30 ～ 12:00	講義	WG2-2：変電保守 オンライン講義	宮下　孝司	ニュージェック		英語	沖縄県	JICA沖縄		研修生5名	WG2-2	
	9:30 ～ 12:00	講義	WG3：保護協調 オンライン講義	桃原 正悟	シードおきなわ/スペシャリスト		英語	沖縄県	JICA沖縄		研修生2名	WG3	
	12:00 ～ 13:00		昼食（デリバリーorレストラン）					沖縄県	JICA沖縄		研修生20名	全員	
	13:00 ～ 16:00	講義	WG1-1：系統計画 オンライン講義	上岡 誠治	関西電力送配電/マネジャー		英語	沖縄県	JICA沖縄		研修生5名	WG1-1	
	13:00 ～ 16:00	講義	WG1-2：経済・財務分析 オンライン講義	石黒 正康	関西電力送配電		英語	沖縄県	JICA沖縄		研修生5名	WG1-2	
	13:00 ～ 16:00	講義	WG2-1：送電保守 オンライン講義	木村 彰宏	関西電力送配電/副長		英語	沖縄県	JICA沖縄		研修生3名	WG2-1	
	13:00 ～ 16:00	講義	WG2-2：変電保守 オンライン講義	宮下　孝司	ニュージェック		英語	沖縄県	沖縄電力本店:浦添市牧港5丁目2-1		研修生5名	WG2-2	
	13:00 ～ 16:00	講義	WG3：保護協調 オンライン講義	桃原 正悟	シードおきなわ/スペシャリスト		英語	沖縄県	沖縄電力本店:浦添市牧港5丁目2-1		研修生2名	WG3	
8/2(水)													
	9:30 ～ 12:00	講義	WG1-1：系統計画 オンライン講義	上岡 誠治	関西電力送配電/マネジャー		英語	沖縄県	JICA沖縄		研修生5名	WG1-1	
	9:30 ～ 12:00	講義	WG1-2：経済・財務分析 オンライン講義	石黒 正康	関西電力送配電		英語	沖縄県	JICA沖縄		研修生5名	WG1-2	
	9:30 ～ 12:00	講義	WG2-2：変電保守 オンライン講義	宮下　孝司	ニュージェック		英語	沖縄県	JICA沖縄		研修生5名	WG2-2	
	9:30 ～ 12:00	講義	WG3：保護協調 オンライン講義	桃原 正悟	シードおきなわ/スペシャリスト		英語	沖縄県	JICA沖縄		研修生2名	WG3	
	12:00 ～ 13:00		昼食（デリバリーorレストラン）					沖縄県	JICA沖縄				
	13:30 ～ 16:00	講義	WG1-1：系統計画 オンライン講義	上岡 誠治	関西電力送配電/マネジャー		英語	沖縄県	JICA沖縄		研修生5名	WG1-1	
	13:30 ～ 16:00	講義	WG1-2：経済・財務分析 オンライン講義	石黒 正康	関西電力送配電		英語	沖縄県	JICA沖縄		研修生5名	WG1-2	
	13:30 ～ 16:00	講義	WG2-1：送電保守 オンライン講義	木村 彰宏	関西電力送配電/副長		英語	沖縄県	JICA沖縄		研修生3名	WG2-1	
	13:30 ～ 16:00	講義	WG2-2：変電保守 オンライン講義	宮下　孝司	ニュージェック		英語	沖縄県	JICA沖縄		研修生5名	WG2-2	
	13:30 ～ 16:00	講義	WG3：保護協調 オンライン講義	桃原 正悟	シードおきなわ/スペシャリスト		英語	沖縄県	JICA沖縄		研修生2名	WG3	

日程表

8/3(木)													
	10:30 ～ 12:00	講義	WG1-1：系統計画 机上講義	上岡 誠治	関西電力送配電/マネジャー		英語	沖縄県	JICA沖縄		研修生5名	WG1-1	
	10:30 ～ 12:00	講義	WG1-2：経済・財務分析 机上講義	石黒 正康	関西電力送配電		英語	沖縄県	JICA沖縄		研修生5名	WG1-2	
	10:30 ～ 12:00	講義	WG2-1：送電保守 机上講義	木村 彰宏	関西電力送配電/副長		英語	沖縄県	JICA沖縄		研修生3名	WG2-1	
	10:30 ～ 12:00	講義	WG2-2：変電保守 机上講義	宮下 孝司	ニュージェック		英語	沖縄県	JICA沖縄		研修生5名	WG2-2	
	10:30 ～ 12:00	講義	WG3：保護協調机上講義	桃原 正悟	シードおきなわ/スペシャリスト		英語	沖縄県	JICA沖縄		研修生2名	WG3	
	12:00 ～ 13:00		昼食（デリバリーorレストラン）					沖縄県	JICA沖縄			全員	
	13:00 ～ 16:00	講義	WG1-1：系統計画 机上講義	上岡 誠治	関西電力送配電/マネジャー		英語	沖縄県	JICA沖縄		研修生3名	WG1-1	
	13:00 ～ 16:00	講義	WG1-2：経済・財務分析 机上講義	石黒 正康	関西電力送配電		英語	沖縄県	JICA沖縄		研修生5名	WG1-2	
	13:00 ～ 16:00	講義	WG2-1：送電保守 机上講義	木村 彰宏	関西電力送配電/副長		英語	沖縄県	JICA沖縄		研修生3名	WG2-1	
	13:00 ～ 16:00	講義	WG2-2：変電保守 机上講義	宮下 孝司	ニュージェック		英語	沖縄県	JICA沖縄		研修生5名	WG2-2	
	13:00 ～ 16:00	講義	WG3：保護協調机上講義	桃原 正悟	シードおきなわ/スペシャリスト		英語	沖縄県	JICA沖縄		研修生4名	WG3	
8/4(金)	10:00 ～ 12:00	発表	成果（アクションプラン）発表 研修生発表（各WG 15分×5グループ＝75分） 講評・質疑応答（各WG 5分×5グループ＝30分）	田頭 英朗 木村 彰宏 宮下 孝司 桃原 正悟	関西電力送配電 関西電力送配電/副長 ニュージェック シードおきなわ/スペシャリスト		英語	沖縄県	JICA沖縄		研修生20名	全員	
	12:00 ～ 13:00		昼食（デリバリーorレストラン）					沖縄県	JICA沖縄		研修生20名	全員	
	13:00 ～ 14:00	討議	今後のWG活動の進め方に関するディスカッション	田頭 英朗 木村 彰宏 宮下 孝司 桃原 正悟	関西電力送配電 関西電力送配電/副長 ニュージェック シードおきなわ/スペシャリスト		英語	沖縄県	JICA沖縄		研修生20名	全員	
	14:30 ～ 15:00		閉講式					沖縄県	JICA沖縄		研修生20名	全員	

Project Name: The project for the Improvement of Planning and Operation of Power System

WG Member List

Gender	Title	Name	E-mail address
Male	Project manager	Kevin Kautu	KKautu@pngpower.com.pg
Male	Project coordinator	Michael Pasi	MPasi@pngpower.com.pg

WG1		Gender	Department	Name	E-mail address
WG1-1 SystemPlanning	Trainer candidates	Male	NSO	Charlie Enos	cenos@pngpower.com.pg
		Female	NSO	Benedicta Savage	bsavage@pngpower.com.pg
		Female	Strategic Partnership IPP Development	Haidi Wanya	hwanya@pngpower.com.pg
WG1-2 Financial and economic analysis	Trainer candidates	Male	NSO	Jonah David	jdavid@pngpower.com.pg
		Male	Finance	Keith Kalama	kkalama@pngpower.com.pg
		Male	Economist	Beda Kuglame	bkuglame@pngpower.com.pg
		Female	Asset Management	Vera Lama	vlama@pngpower.com.pg
		Female	Asset Management	Cathy Kutkue	ckutkue@pngpower.com.pg

WG2		gender	Department	Name	E-mail address
WG2-1 Tansmission Line	Trainer candidates	Male	Transmission and Substation	Chris Luther	cluther@pngpower.com.pg
		Male	Transmission and Substation	Ben Kaum	bkaum@pngpower.com.pg
		Male	Alu (Asset info)	Esorom Passingan	epassingan@pngpower.com.pg
WG2-2 Submission	Trainer candidates	Male	Transmission and Substation	Simon Robert	srobert@pngpower.com.pg
		Male	Informarions & Engineering	Simon Deveo	sdeveo@pngpower.com.pg
		Male	Transmission and Substation	Brian Inamo	binamo@pngpower.com.pg
		Male	Transmission and Substation	Terry Naipu	tnaipu@pngpower.com.pg
		Male	Reliability Engineers & Condition Monit	Rawali Rawali	rrawali@pngpower.com.pg

WG3		gender	Department	Name	E-mail address
	Trainer candidates	Male	NSO (Protection)	Melvin Angi	mangi@pngpower.com.pg
		Male	NSO (Protection)	Michael Akep	makep@pngpower.com.pg

Training in Japan Report （WG　1-1）

August 4th, 2023

Members: Charlie Enos, Benedicta Savage and Haidi Wanya

PNG power sector problems in each field

- Frequent Total System Outages
- Proper workflow process from planning stage to implementation of major projects is required.
- Unplanned IPP approvals
- Frequent Changes in Management

Findings through lectures and discussion Ⅰ

❖ Frequent Total System Outages

- Technical assessment is required prior to PPA approvals.
- Requires reinvestment into grid strengthening projects.
- Annual grid assessments is required for operational and planning needs.

❖ Proper workflow process from planning stage to implementation of major projects is required.

- Need standard design specification for transmission lines and generation.
- Enforcement of implementation of N-1 planning
- Require reactive power planning
- Need to create SOPs for Planning
- Review of operational projects to be inline with planning view.

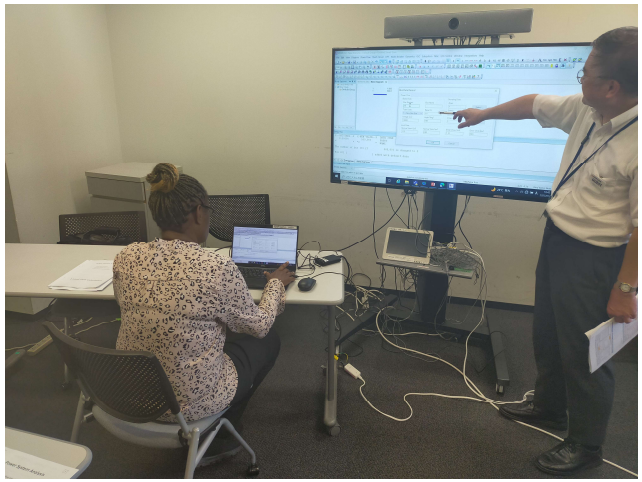
❖ Unplanned IPP approvals

- Require technical assessment to be done prior to IPP PPA approvals.
- Standard regulatory documentation available as per grid code requirements

Findings through lectures and discussion Ⅱ

❖ Frequent Changes in Management

- Requires regulatory documentation available as per grid code requirements
- Proper review of operational projects required.
- FYPDP (LCPDP) should be institutionalized so that regardless of management changes, plan is still followed.



❖ Basic PSSE Modelling of 4 node system training

- Accessibility of asset data records
- Centralized document management system required.
- Basic Power system analysis calculation and theory.

❖ Human Resource Development Lecture

- Induction of new employees is required
- Legal and Technical specialist training need to be implemented to enable knowledge transfer and upskill of PPL staff.

Findings through lectures and discussion III

❖ MG set technology

- New technology that is being implemented to assist in RE penetration into grids.
- Introduction of new technology is being piloted in small scale prior to roll out of the technology.

Findings through site visit and practice Ⅰ

❖Inagawa Substation

- N-1 redundancy available for communication and automation system
- N-1 redundancy available Protection System
- N-1 redundancy available for Transmission and substation and switchyard arrangement
- Monthly restoration training for operators

❖Mitsubishi Electrics Visit

- Switchgear manufacturing timeframe for Mitsubishi Electrics
- Research and development to meet customer demands
- Procurement process of full turn key availability
- Certified testing facilities.

❖Keage Hydro Power Station Visit

- Proper maintenance/reinvestments to extend lifetime of hydropower plant.

Summary

- This training has enlightened us of the gaps available in our current planning processes
- Revision of Basic Power system analysis calculation and theory was very useful
- Basic PSSE modelling lecture was relevant to power system planning
- We were privileged to visit The Golden Pavilion in Kyoto and the Churaumi Aquarium in Okinawa while in Japan

- **Thank you JICA and Kansai T&D for the training and exposure in Japan**

Impressions of Japan（free format)

❖ Work
- Admirable work ethics
- Well planned and coordinated work activities.
- Role demarcation is clear and observed.

❖ In general
- Well planned infrastructure (eg: Okinawa buildings)
- Social inclusiveness.
- Polite and friendly people.
- Excellent customer service.

- To conclude, we have observed that Japanese people are respectful and considerate of all individuals.

Assessment of the training in Japan

❖ Good points

- site visits were informative

- Exposure to Japanese lifestyle

- Exposure to Japanese work ethics

❖ Improvement points

- NIL

-

-

Training Report
(WG1-2: Economic and Financial Analysis)

August 4th, 2023

Member: David Jonah, Keith Kalama, Beda Kuglame, Cathy Kutkue, Vera Lama

PNG power sector problems in each field

Generation:

- Increasing costs of IPPs (NiuPower, Dirio and Munum)

Transmission, Substation and Distribution:

- 97 % of the land is customary owned. Hence, land acquisition and access is a major challenge towards new projects and maintenance. [T]
- Inadequate redundancy for transmission lines (e.g., overloading of transmission lines). [T]
- Lack of specialist tools and equipment to carryout inspections and routine condition monitoring. [T, SS, and D]
- Lack of skilled manpower and logistics to carryout planned maintenance. [T, SS, and D]
- Lack of material spares. [T, SS, and D]

Retail:

- Tariff levels have been frozen since 2013 2nd Qtr.
- Energy Billing Challenges
  - ✓ Outstanding bills from major customers including government institutions.
  - ✓ PPL meter readers are threatened when they go out on the field to take energy readings.
- The average power loss is estimated at 20 - 30% including both technical and non-technical losses.

Findings through lectures and discussion

Two component to the training: Financial analysis and economic analysis

Lesson learned:

- How to interpret financial statements (i.e., balance sheet, income/profit & loss statement, and cashflow statement).
- Calculating financial ratios (i.e., debt to equity ratio, return on equity (ROE), return on asset (ROA), interest coverage ratio (ICR). [during the third mission in Oct. 2022]
- Financial Analysis for Project including the following:
  - ✓ To understand the concepts of financial analysis and planning for project investment.
  - ✓ To build a project financial model
  - ✓ To Acquire basic knowledge on various costs of a project;
    - i. Fixed cost (e.g., depreciation of assets, O&M, wage, insurance, and overhead)
    - ii. Variable cost (e.g., fuel and utilities)
    - iii. Financial cost (interest)
  - ✓ To Understand the Fund procurement for a project
    - i: Equity financing or debt financing

Findings through site visit and practice I

Inagawa Substation:

- Inspections and preventative maintenance (PM) are effectively carried out on a timely basis.
- At present they have moved from Time Based Maintenance (TBM) to Condition Based Maintenance (CBM).
- PM are now carried out in line with the level of fault current. If total fault current matches (or exceeds) the rated fault current, inspection and/or PM will be conducted.
- Scada simulation room (backup Scada room)
  - ✓ Backup Scada room is used for training, simulation of system faults, and supporting the main Scada.
- The control room is manned and operated over three (3) shifts. One shift is composed of at least two system controllers (or operators) and one overseer.

Findings through site visit and practice II

Mitsubishi Electric Power

- The showroom is well set up with displays of its products (GIS, various switchgear, etc.).
- Patented product using “Torsion Bar Spring Operated Mechanism” for CBs. This product has 70% reduction in the number of parts.
- Development of vacuum type CB to reduce SF6 CB. SF6 gas will be replaced with vacuum type CB by 2030,.
- Development of a polymer type lightning arrester, which is safer to install compared to a conventional porcelain type.
- The entrance of the manufacturing facility is highly controlled with safety measures.
- Test labs use the per unit testing system, with colour coding for testing.
- Production of 72kV GIS: 150 - 200 units per year
- GIS product: Visual inspection is to be conducted once every 3 years; maintenance every 6 years; relay replacement once every 10 years; and design life 30 years
- Maintenance support is provided by the company.
- Training of procurement contract is also provided (incl. one-week on-site training as an option)

Findings through site visit and practice III

Keage Hydro Power Station

- This hydro power station is more than 100-year old, but running perfectly attributed to proper maintenance
- The station is well blended with the surrounding environment.

Summary

ISSUES	RECOMMENDATIONS
Assets are deteriorating because maintenance plans are not implemented due to budget constraints.	To prioritize funding for planned maintenance.
For new projects, land acquisition is a major challenge that impedes development.	Responsible policy makers (i.e., NEA and DNPM) should develop proper policy frameworks and guidelines.
Outstanding non-payments for landowner prevent access to maintenance, new projects, and breakdowns. For example, PPL staff is restricted to access sites or facilities and carry out maintenance such as line clearance.	
The protection system is not adequately discriminating fault(s) condition.	Protection System review on all grids.
	Upskilling and resourcing of protection engineers
The asset registry is not updated. Hence, the real value of the company is not correctly represented.	To review and make improvements on the fixed asset registry.
Lack of training for general workforce and also for specialists in different sections.	To develop individual training plans for each staff in collaboration with the HR department.
Lack of compliance to established business processes.	Review and enforce compliance to established business processes.

Summary (continued)

ISSUES	RECOMMENDATIONS
Lack of Personnel Protective Equipments (PPEs) and compliance to safety standards.	To prioritize funding and effectively enforce safety standards at the workplace.
Outstanding non-payments to creditors or suppliers.	To prioritize funding and strictly implement payment plans.
Lack of proper financial analysis for new projects.	Develop (a) financial model(s) or template(s).
Project managers lack financial knowledge necessary for project management.	It is essential for project managers/engineers and managements to get training on financial and economic analysis.

Impressions of Japan（free format)

- Citizens are welcoming and friendly.
- Cities are clean, safe and well planned.
- Food
  - ✓ Variety (traditional, western, asian etc)
- Gender inclusive.
  - ✓ Prioritize senior citizens, people with special needs, mothers and children.
- Energy Sector
  - ✓ 100 % reliable power supply (last blackout experienced 40-50 years ago).
  - ✓ Japan have and apply their own standards.
  - ✓ Zero emission from thermal power, an area where Japan is advocating and balancing energy, transition that adapts to climate change.
  - ✓ All the distribution poles are concrete.
- Transportation Infrastructure is extremely efficient.
  - ✓ Bullet trains servicing inter-cities.
  - ✓ Railways and subways.
  - ✓ All roads are sealed from city to the rural.
  - ✓ Noise barriers along subways and residential areas.

Assessment of the training in Japan

☐ Good points:

- Some of us come from non accounting and non financial background, however the training has taught us the approach of financial analysis for a project.
- The lectures and exercises using different utility financial statements facilitated good understanding for the trainees (WG1-2).
- Exercises gradually became complex. However, with the experience, patience and expertise of the tutor/facilitator enabled us to successfully perform the exercises.

☐ Points for improvement:

- Include Japanese language class session.
- Increase the frequency training in Japan.
- Work attachment (example; 2-3 months) in Japan.

Training Report
（WG　2-1）

August 4th, 2023

Members: Esorom Passingan, Ben Kaum, Chris Luther
Akihiro Kimura, Gai Kobayashi, Masashi Takeuchi

OUR PRESENTATION IS BASED ON THE FOLLOWING:

1. Problems affecting PPL Transmission Lines Maintenance & Operations (O&M)
2. Findings through lectures & discussions I
3. Findings through lectures & discussions II
4. Findings through site visits & practice I
5. Findings through site visits & practice II

- ❑ Summary
- ❑ Impressions of Japan
- ❑ Assessment of the Training in Japan
- ❑ Photos & End of Presentation

Problems affecting PNG Power Transmission O&M

1. Asset information management system

- Incomplete asset registry (*field data not corresponding with GIS system data*)
- Asset Installation and commissioning registry (*not proper keeping*)
- Technical drawings (*most technical drawings are no longer kept*)

2. Training and development.

- Staff training (*lacking*)
- Technical training facility (*inadequate*)

3. Resources

- Logistics (*Inadequate*)
- Material Procurement (*delay*)
- Specialist tools and equipment (*Inadequate*)
- Skilled manpower (*Inadequate*)
- SOPs, operational manuals, and training manuals (Inadequate)

4. Safety

- Safety compliance (*compromised*)
- PPEs (*delayed*)
- Safety gears (*inadequate*)

Findings through lectures and discussions Ⅰ

- **Maintenance Management System in the Transmission Sector (MMST).** (*Kansai transmission asset information management system is very robust and effective*)
- **MMST enables the unification of all information relating to the asset management system.** (*The MMST is very efficient and convenient for transmission asset management. For instance, it records and provides accurate and detailed information for all the transmission tower members)*.
- **Development and implementation of a Maintenance Management System in PPL similar to MMST.**

- **The tension & sag calculation lecture that we had in Kansai, Osaka is very important to us. This is applicable to current L401 conductor stringing works and other future conductor stringing upgrade works as well.**

- **Training and development** (*You have fully fledged training facilities (in Osaka & here in Okinawa) for ease of training for all your transferred and new employees*)
- **Development and implementation of proper transmission engineers and linesmen training**

Findings through lectures and discussions Ⅱ

- **Drones are used for the inspections of transmission lines, transportation of materials to towers located far from the roads, and stringing of transmission lines.** (*The use of drones makes it convenient and easy to conduct line inspections and even facilitate other works)*.

- **More drone training for officers and drone deployment for transmission line inspections utilizing what we learned from current training in Japan.**

- **There is a difference between transmission line inspection and patrol**.
  (Inspection is a close assessment of the towers and their members through using vision-enhancing devices like drones and binoculars or sometimes through climbing the towers whilst patrol is about walking on foot or using helicopters through the transmission line routes to identify possible fault or vegetation growth)

Findings through site visits and practices I

Site visit #1 – Osaka Technical Training Facility

- **During the site visit on transmission line training it was observed that proper safety procedures were followed.** (*For instance, about 60% to 70% of the training was about how they could comply with safety standards and procedures)*
- **All necessary safety pieces of equipment were on site with all required materials.** (*This was quite outstanding where the trainees will be fully trained on all the necessary safety training requirements*)
- **It was ensured that all work procedures were carefully followed by the person in charge.** (*Good coordination and onsite leadership practice. The team leader had a checklist & timing for every task performed)*
- **All safety equipment and materials have proper storage housing which is kept very neat and tidy.** (*Displayed effective and efficient coordination and management)*

Standard Operating Procedures (SOPs), Training Manuals and Operational Manuals will be developed by end of this training program to address some of these issues.

Findings through site visits and practices Ⅱ

- **Site Visit #2 - Inagawa Substation**

- **Substation is kept very clean and tidy.**
- **Proper condition monitoring of substation assets resulting in effective preventative maintenance being carried out by technical staff.**

Site Visit 3 – New Kakogawa Transmission Line Replacement Project

- **Well coordination and management of safety requirements**
- **Minimal environmental damages (*good environmental conservation practice)***

- **We will need to improve on taking good care of our assets and work sites.**

- **Site Visit 4 – Noe Electric Power Operation and Maintenance Centre.**

- **Proper storage of tools and spare parts**
- **Proper storage of safety gear and equipment**
- **The conversion of the overhead transmission line to an underground transmission line.**
- **A Total of 14 Linesmen are responsible for the management of transmission assets in Osaka.**

- **PPL will try to adopt tools/equipment arrangements similar to that of Noe Electric Power O&M Center and Osaka Technical Training Facility.**

Summary

- We have through the training lectures and various site visits noted that PPL and Kansai or Japanese Power Utility Companies have quite a huge difference in many areas of power system asset maintenance, management, and operations.
- We have noted that PPL needs to learn a lot from Japanese Power Utility companies in the maintenance and operations of its power system assets, asset information management, human resources training and development, and health and safety at the workplace.
- Though it is a long way for PPL to catch up with the level and standard of the Japanese power utility companies, we are determined that this exposure and cooperation is a stepping stone towards achieving PPL'S goals.
- Finally, we would like to thank the government and the people of Japan, JICA and the Japanese power utilities companies, and individual experts who have been involved in this training to make it a success so far. We are gladly looking forward to the next phase of the training and finally completing this through the development of operation manuals and standard operating procedures (SOPs).
- Lastly but not the least, if there is any possibility for further similar training that you presume to be of importance to the improvement of power systems planning and operations in PNG Power, we will be also grateful of it.

Impressions of Japan

- Very humble
- Hardworking
- Honest
- Creative
- Respectful
- Orderly
- Safe and clean
- The reputation of the Japanese for civility and attentiveness is unwavering.

Assessment of the training in Japan

○Good points

- There have never been any system outages (SO) experienced
- Osaka & Okinawa Power Grid always have a backup system.
- Effective management of vegetation.
- Overall planning, coordination, and execution are great
- Excellent safety measures

○Improvement points

・Need weather situation considerations in future training programs.

Photos

End of Presentation!

Any Question?

Training report
WG　2-2: Substation Team

August 4th, 2023

Group Members:

Simon Deveo | Rawali Rawali | Simon Robert | Terry Naipu | Brian Inamo|
Katsuki Yuuki | Miyashita Takashi | | Matsubara Yasuharu | Masuhara Keiko

PNG power sector problems in each field

- Lack of Redundancy on Transmission Lines and Substations
- Many aging assets & equipment in the Substations, i.e.; operated over 20 years
- No proper Training Facilities on Substation Equipment and Operation.
- No proper Substation SOP, Standards, Manuals
- The systems and subsystems that must operate to support the core function of PPL are operated in isolation and do not provide accurate and appropriate data for informed decision making.

Findings through lectures and discussion Ⅰ

- **Operations Manual**

Parent Manual consists of procedures & process outlining tasks around; Maintenance Work (Patrol Inspection, Periodic Inspection), Implementation of Work (Planned Power Outage, Work Plan), Management of Equipment (Management of Test Equipment, Management of Tools), Dealing with Failure of Power Outage (Overview of how to find faults, Overview of how to recover fault points), Management of Equipment Specification (Managing Person, How to manage Facilities Data)

- **Method for confirmation and judgment on the health of transformer**

a. Risk Assessment Activity and Preparation of Testing
b. Electrical Test
    i. Insulation Resistance Test
    ii. Winding Resistance Test
    iii. Low Voltage Excitation Test
    iv. Impedance Measurement Test
    v. Transformer Ratio Test

Findings through lectures and discussion Ⅱ

- Overview Motor-Generator (MG) Set Demonstration Project aimed at maximizing Renewable Energy Penetration – Okinawa
- Grid Stabilizer Control
- Structure & Principle of Operation of OLTC
- The Breaking Principle and features of SF6 Gas Circuit Breaker & Leak Detector

Findings through site visit and practice　I

- **Transformer Oil Treatment – Neyagawa**

On-line transformer OLTC oil treatment/Filtration unit observed on some of HV 154 kV&77kV) Transformer. Have the advantage of automated (self) treatment once a day. Reduces manhours and cost-effective transportation.

- **Kansai Training Centre - Ibaraki**

State-of-Art Training facilities where trainees are trained to work on actual equipment and systems in the field upon completion of their training. Specifically the substation switchgears including transformers, circuit breakers, line isolators.

- **Emergency Vehicles, Tools set – Noe**

Emergency Vehicles are equipped with the basic maintenance tool and spares, prepared and always ready to attend to any breakdowns.

One and Half Busbar Configuration switching for Redundancy –Inagawa

N-2 redundancy, High reliability during outage or maintenance

- **Indoor Substation**

Highly beneficial near the sea against corrosion and humidity improving performance and operational life of equipment besides just saving space and/or utilization of minimal substation space.

Findings through site visit and practice Ⅱ

- **Insulated distribution lines**

Minimizes tripping of Feeders and cascading faults when strategically applied Culture & work ethics, procedures

- **Exercise on SOP and Operation Manual**

Well structured and very strong working culture maintained

- **Vertically mounted OLTC**

The OLTC motor and gears are mounted vertically and close to the tap changer, thus reduces long mechanical linkages. In addition, the gears are mounted in between the tap-selectors on the bottom and diverters on the top which keeps all movement in perfect synchronism.

- **State-of-art Substation Maintenance Training Facilities**

- **Inagawa Substation**

This substation plays a very important role in the transfer of bulk power within the southern and northern grids on 500kV. With the size of its switching equipment, it delivers a large amount of power, 5.25GW and has the highest redundancy.

Summary

- The first part of the presentation has stated the issues that we face on our PNG Power grid.
- The second part basically outlines the lectures that we have gone through at Osaka and Okinawa.
- The third part we have reported our findings in our site visits on Osaka.
- The lectures & site visits have given insights of the power operational system of Osaka & Okinawa.
- Finally , we have expressed our views on Japanese work ethics and cultures in relation working in a power industry in Japan.

Impressions of Japan（free format)

Japan has a very admirable culture which is built over the years through generations. This culture blends well in a working environment and support the professional ethics in a business environment.

This fosters great achievements as seen and obviously Japan is one of the Top Countries in the World technologically advanced and a global industrial leader.

All this materialize because of a very high Reliable and Stable Electric Power Utility Network System.

Assessment of the Training in Japan

○Good Points

・Importance of Operational Manual through the lectures implemented in general work ethics and approaches

. Exposure to GIS system– this is new to PPL

・Exposure to the Highly Reliable, Redundant and Efficient Power Network System which give us the challenge go back and improve the Network in PNG

・ High level of Team Bonding

. Despite Language barrier, lectures and field visits were presented in a simplified version which were understood.

○Improvement points

・ Short duration of the program - unable to have actual involvement in a maintenance activity.

・Start developing Manuals and practice using them

・Implement network equipment training facilities

WG2-2 Acknowledges the Major Sponsor of this program JICA and contributions from New-JEC and Kansai T&D Consultants.

Thank you

Training report
（WG 3）

August 4th, 2023

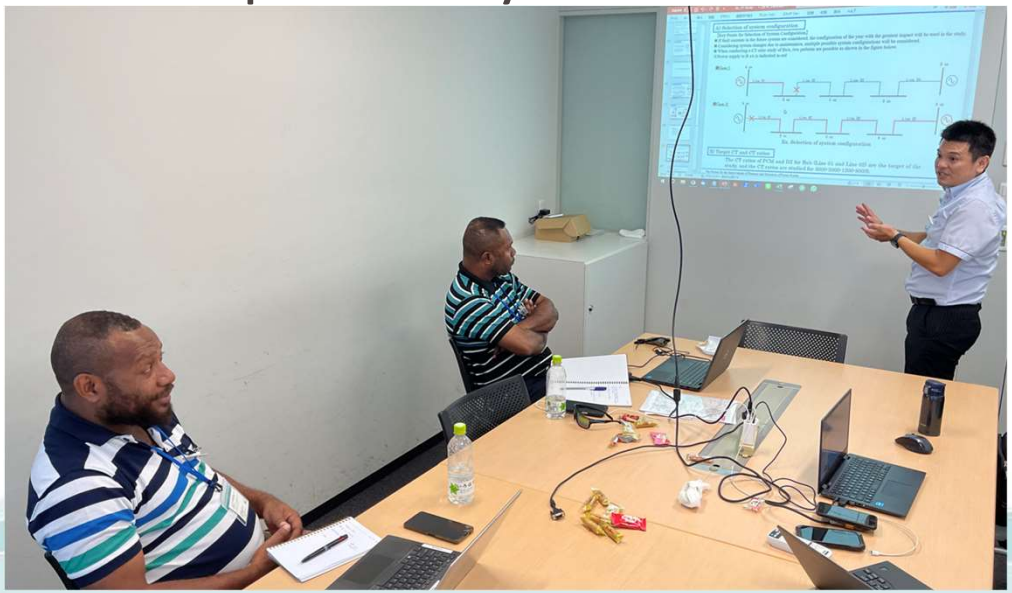
Member: Melvin Angi, Michael Akep

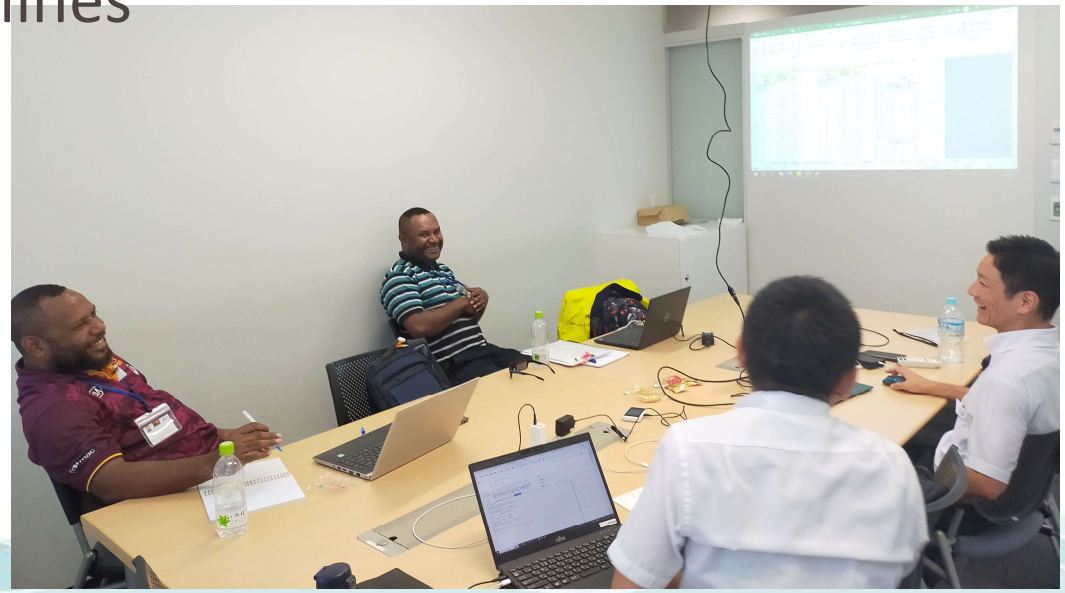
Lectures

- Presentation Training Lecture and discussion Topics
  - Current Transformer Study
  - Impedance Calculations for Transmission Lines
  - SOP for Fault analysis – Case study on point of fault locator
  - Auto-Reclose Function
  - 3- terminal differential Protection for T-Networks in transmission lines
  - Overview of Okinawa Main Island Power system
  - Human Resource Development Training Program
  - Miyako Island Mega Solar Project
  - System Stabilizing Controller

Findings through lectures and discussion

- PPL does not have a protection manual or calculation setting guideline for different protection schemes. Settings are only done based on experience and research.
- PPL does not have CT specification requirements manual guideline.
- PPL system network monitoring center does not have access to remote fault information.
- No proper SOP for fault analysis
- PPL needs a proper protection scheme for T-networks specifically for transmission lines





Findings through site visits　I

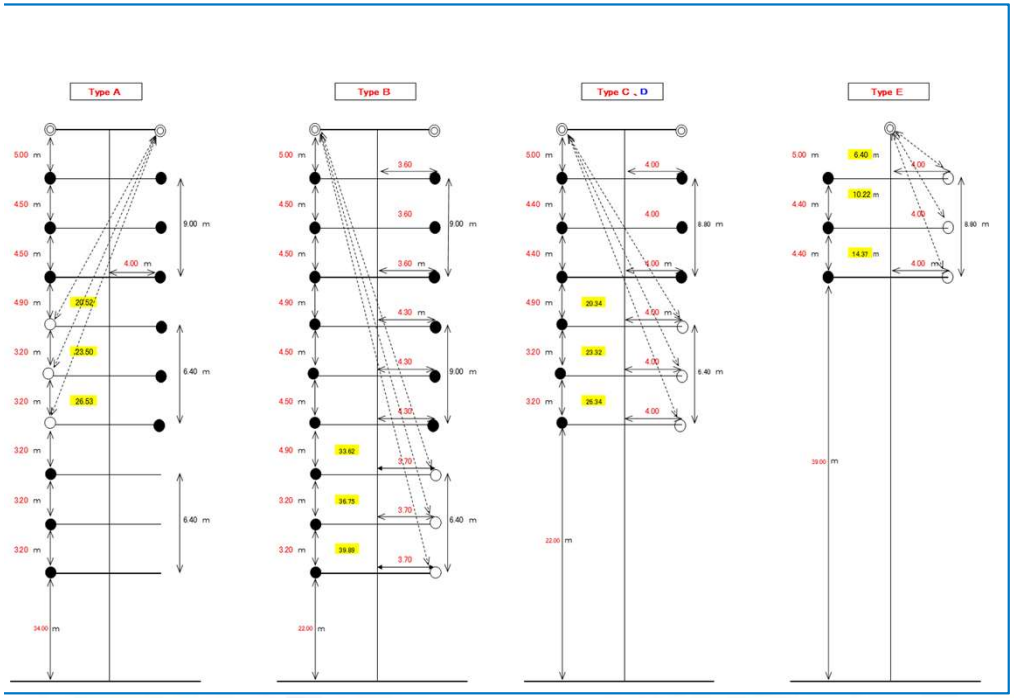
- 500kV Inagawa substation
  - Single phase power transformers
  - Fully Automated Power system
  - N-1 Protection and Control Panel; A and B
- Mitsubishi
  - 550kV GIS
  - Polymer insulator made to replace the Glass and porcelain insulators
- Keage Hydro Power Station
  - First commercialized Power Station in JAPAN

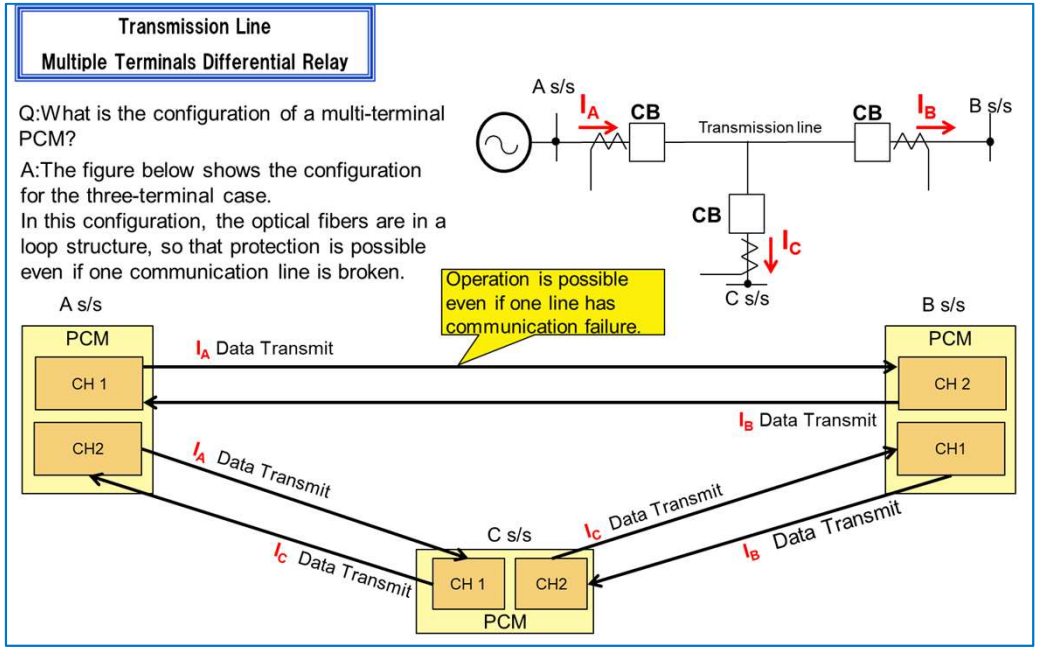
Findings through site visit Ⅱ

- Training Facility Center OEPC
  - Protection Relay control Panel for testing
  - Older Electro Mechanical Protection relays still been used

Applicable Findings

- Implement Three way Terminal Line Differential Scheme
- Auto Reclose function application for Transmission Lines
- Zero Sequence Impedance Calculation
- Simulator Model for Protection Relay Operation
- Training facility for protection relay testing





Summary and Conclusion

Key training areas of concern for PPL;

- CT selection and specification requirements
- Impedance calculations
- SOP for Fault Analysis
- Simulation model for protection relay operations
- Proper Training Facilities
- Applying the Auto reclose function in Transmission Line

Assessment of the training in Japan

○Good points

- Clear presentation
- Simple calculation (CT Saturation, Case study point of Fault, Impedance Calculations) Formulated Spreadsheets
- Clear simulation demonstration of protection relay operations

○Improvement points

- More hands-on training
- More simulation demonstration

Impressions of Japan

- Very respectful and Law abiding people
- Very High standard Infrastructure; Road, Building, Bridges,
- Very Clean environments
- Unique Toilet Facility; (Flushing experience)
- Japanese Noodle
- Golden Pavilion
- Aquarium

Thank you to JICA, Kansai, Newjec, Okinawa
Arigato gozaimasu

ANNEX5

キャパシティアセスメント報告書

独立行政法人
国際協力機構（**JICA**）

パプアニューギニア国
電力系統計画・運用能力向上プロジェクト

キャパシティアセスメント報告書

令和 **5** 年 **1** 月
（**2023** 年）

関西電力送配電株式会社
株式会社ニュージェック
シードおきなわ合同会社

パプアニューギニア国電力系統計画・運用能力向上プロジェクト

キャパシティアセスメント報告書

目次

1. キャパシティアセスメントの目的

本プロジェクトは、パプアニューギニア電力公社（以下、「PPL」）の職員の技術力向上、マニュアルの策定、トレーニングの枠組み構築を通じて、パプアニューギニア国（以下、「PNG」）の電力系統計画・運用能力向上を図り、PNG の電力の供給信頼度及び品質の向上に寄与することを目的とした技術協力プロジェクトである。本プロジェクトの目標と成果およびプロジェクト活動の関係を図 1-1 に示す。

図 1-1 プロジェクトの目標と成果（PDM）

プロジェクト活動を通じて、カウンターパート（C/P）の技術能力向上を達成することが、プロジェクトの成果の一つとして求められている。したがって、技術能力向上を含めたプロジェクト成果や目標達成の進捗を適切に確認することが出来るよう、プロジェクト開始時点での C/P の技術能力等の現状を把握することを目的として、キャパシティアセスメントを実施する。

2. キャパシティアセスメントの実施方法

ベースライン調査、WG 活動を通じた PPL の現状調査、トレーニングを通じて、PPL のキャパシティアセスメントを実施する。

ベースライン調査は、技術移転効果を測定するための初期値の測定になるので、技術移転を開始する前に、各ワーキンググループ（WG）の C/P 各人に対して実施した。

初めに、ベースライン調査は、各 WG の C/P に対して、表 2-1 に示すチェックポイントを中心にアンケート調査を実施した。アンケート調査票は別添に示すとおりである。

表 2-1　ベースライン調査のチェックポイント

分野	チェックポイント
系統計画・ 系統連系技術	-系統分野の基礎知識は有しており、必要なデータ、検討条件について理解している。 -電源開発計画と調和した系統開発計画を検討出来る。 -研修に何を期待するのか。
経済財務分析	-財務・経済分析に係わる知識と経験をどの程度備えているか。 -研修に何を期待するのか。
送電（保守管理）	-送電設備のメンテナンスやアセットマネジメントに係わる知識と経験をどの程度備えているか。 -現業務における問題点や改善方法について、意識を持っているか。 -研修に何を期待するのか
変電（保守管理）	-安全措置に関する基本的な知識を有している。 -変電機器に関する基本的な知識を有しており、保全業務が行えている。 -資材管理に関する基本的な知識を有している。 -研修に何を期待するのか。
保護協調[1]	-保護継電器リレー[2]の基礎知識を有しており、整定検討に必要な諸元について理解している。 -保護継電器リレーの整定値検討および保護協調の経験を有している。 -研修に何を期待するのか。

これに加え、専門家によるインタビュー調査を実施した。それぞれの WG メンバーに対して 30 分程度行った。アンケート調査が C/P の自己評価であるのに対して、インタビューは専門家による他者からみた評価であり、両者を総合して評価結果とした。インタビューの内容については、アンケート調査の回答に基づき、以下の点を中心にヒアリングを行っている。

[1] 保護協調：電力系統に発生する様々な異常により電気事故が発生した際に、停電の拡大防止を図るため、最小限の範囲(回路)のみを切り離すよう保護リレーの設定値調整を行うこと。
[2] リレー(保護リレー)：電気事故を瞬時に検出し、遮断器へ回路遮断の信号を送信する装置で距離リレー、差動リレー、過電流リレー、周波数リレー、電圧リレーなどの種類がある。

（1）　職歴、これまでに経験した業務の確認
（2）　学歴、専門性の確認
（3）　職歴の中で、具体的に従事したプロジェクトにおける業務内容と経験年数
（4）　所属する WG で実施する技術移転内容に関連する知識、経験
（5）　アンケート調査の回答内容の確認
（6）　本件技術協力に対する要望事項

インタビューは主に各 WG を担当する専門家に加え、総括、人材育成／研修担当の数名で実施し、各 WG の評価に偏りが生じないよう配慮した。インタビュー調査を実施した専門家は以下のとおり。

1. 上岡　誠治　　総括／系統計画
2. 石黒　正康　　経済・財務分析
3. 大津　啓　　系統連系技術
4. 木村　彰宏　　送電（保守管理）
5. 宮下　孝司　　変電（保守管理）
6. 桃原　正悟　　保護協調
7. 宮里　清大　　人材育成／研修
8. 田頭　英朗　　系統連系技術補助／業務調整
9. 坂東　宏紀　　系統計画（補強）
10. 菅井　良祐　　機材評価／試験（補強）

WG 活動やトレーニングを通じて、PPL の人材、組織・業務の仕組や設備について現状調査を行い、キャパシティアセスメント結果に反映した。

3. ベースライン調査の実施

各 WG へのアンケート調査およびインタビュー調査は以下の日程で実施した。

表 3-1　アンケート調査・インタビュー調査の実施

	WG	アンケート調査	インタビュー調査	インタビュー実施者
1-1	系統計画	2022.5.23 - 5.26	2022.5.26	上岡、大津、宮里、田頭
1-2	経済財務分析	2022.5.23 - 5.26	2022.5.25/26/30	上岡、石黒、宮里、坂東
2-1	送電	2022.5.23 - 5.26	2022.5.24	上岡、木村、宮下、宮里、菅井、田頭
2-2	変電	2022.5.23 - 5.26	2022.5.25	上岡、宮下、木村、宮里、菅井、田頭
3	保護協調	2022.5.23 - 5.26	2022.5.25	上岡、桃原、宮里、坂東

表 3-2　追加メンバーへのアンケート調査・インタビュー調査の実施

	WG	アンケート調査	インタビュー調査	インタビュー実施者
1-1	系統計画	2022.10.6 - 10.12	2022.10.10	上岡、大津、宮里、田頭
1-2	経済財務分析	2022.10.6 - 10.12	2022.10.13	上岡、石黒、田頭

4. WG 活動を通じた PPL の現状調査

今回のプロジェクトに関する PPL の各組織の役割や、業務プロセス、人材などについて WG 活動やトレーニングを通じて調査を行った。

具体的な WG 活動実績とトレーニング実績については、以下の通りである。

表 4-1 WG 活動実績

WG		WG 活動実績	主な活動内容
1-1	系統計画	2022/10/6 - 10/21	・系統解析ソフトの使用状況の確認 ・PPL における事故統計データの確認 ・POM 系統における停電原因の確認 ・RAMU 系統の需給状況の確認 ・15 ヵ年電力開発計画策定のプロセスの確認
1-2	経済財務分析	2022/10/3 - 10/21	・ 追加された WG メンバーの面接 ・ 戦略計画部門マネジャーとの財務評価モデルの協議 ・ 研修の実施
2-1	送電	2022/10/7 - 10/21	・巡視点検の年次計画と実績データの確認 ・異常判別クライテリアやアセマネシステムの現状について確認 ・PPL による工具類・機器類の現状を確認 ・送電設備の基本設計について講義を実施
2-2	変電	2022/10/6 - 10/21	・PPL におけるアセットマネジメントシステムの構築状況の確認 ・POM エリア内変電所における保守実態調査 ・PPL における保守体制、設備故障実態や測定器の運用・管理等についての実態調査 ・アセットマネジメントの定義についての講義 ・変圧器の異常診断、避雷器の劣化、変電所巡視点検等に関する講義と認識レベルの把握 ・点検、巡視インターバルに関する提言 ・Waigani 変電所受電ガントリー不具合対応の提案 ・Bomana 変電所漏油箇所に関する見解と対応策提案 ・関西送配電アセットマネジメントシステムの紹介
3	保護協調	2022/10/6 - 10/21	・組織および要員の確認 ・保護リレー整定業務フローの確認 ・シミュレーションツール使用状況の確認 ・保護リレー設備について(設置数、保護スキーム等)
4	人材育成	2022/10/6 - 10/21	・組織体制および採用方法の確認 ・人材育成制度（案）に関するニーズ確認 ・人材育成制度（案）の整理

表 4-2　トレーニング実績

WG		トレーニング実績	トレーニング内容
1-1	系統計画	2022/8/22, 10/3	・基幹系統における系統計画の基本的な考え方 ・STATCOM 技術について ・設備構成の考え方
1-2	経済財務分析	2022/10/14 - 10/19	・ 財務諸表の構成と読み方 ・ 財務諸表分析の方法
2-1	送電	9/1, 10/20, 11/25, 12/20	・関西送配電の保守保全方法、異線間クリアランス ・鉄塔にかかる荷重（理解度確認テスト） ・基礎に掛かる荷重（理解度確認テスト） ・絶縁設計（理解度確認テスト）
2-2	変電	2022.10/6 - 10/21, 12/15 - 16	・ 関西送配電における制御システムと監視制御（SCADA）システムについて ・ 関西送配電における予防保全の考え方と概要について ・ 油中ガス分析による変圧器の内部異常診断 ・ ISO55000におけるアセットマネジメントの定義 ・ 変圧器の寿命に影響する項目と内部異常診断 ・ 設備状態診断に用いる測定器類の紹介 ・ 変電所巡視点検のテクニック（その１） ・ PPLの設備実態に照らした点検、巡視インターバルの考え方
3	保護協調	9/14, 9/26, 11/18, 12/7	・電力系統概要 ・保護リレー概要 ・距離リレー[3]整定手法

5.　調査結果と技術移転計画への反映

5.1　ベースライン調査結果

各 WG の調査結果を次に示す。評価については、1~5 までの五段階評価で、5 が最も高得点となる。

1:全く知識がない	2:部分的には理解している	3:基本的な事項は理解している	4: 専門知識を有し、自ら業務として遂行できる	5:他人を指導できる知識経験を有する

「WG Member's Ansewer（WG メンバーの自己評価）」は、各 WG 毎に作成した業務経験や知識に関するアンケートの中で WG メンバー自身が自己評価を行った結果の平均値を記載

[3] 距離リレー：事故点までの距離に応じて動作区間毎(Zone 1～3)に時限を持たせることができるリレーを距離リレーという。

している。

「Interviewer's Input（インタビュアーの評価）」はアンケート回答結果を基に実施したインタビュー調査を受けて、各インタビュアーによる評価の平均値を記載している。

(1) 系統計画

表 5-1-1　系統計画におけるベースライン調査の調査票集計とインタビュー調査結果

Item		A	B	C	Average
WG Member's Answer	Average of self-evaluation	1.5	1.6	3.5	2.2
Interviewer's Input	Average	2.0	3.0	4.0	2.6
	Experience	2.0	3.0	4.0	3.0
	Knowledge	2.0	3.0	4.0	3.0

注釈：表上部の A,B,C については WG メンバーを表す。

WG メンバーは系統計画に係る技術検討の一部を担当業務として実施しているが、系統計画全般の業務経験はないため、現時点での系統計画や需要・供給想定の評価点は自己評価もインタビュー結果も比較的低い。しかし、系統解析業務に関しては、業務で自ら実施していることもあり一定の知識を有していることが分かった。今後の WG 活動を通じて、系統計画や需要・供給想定の業務については基礎的な知識の付与から必要となる。また、系統解析業務については一定の知識を有していることから先方の要望も確認しつつ技術移転の内容を決定する。

また、WG メンバーの人選については、ベースライン調査の結果、系統解析に関する基礎的な知識/技術や新しい知識を獲得する意欲を持ち合わせており、将来的に PPL の他職員へ取得した知識を展開することが出来る職位の方であり、本プロジェクトの技術移転する相手として適している。

(2) 経済・財務分析

表 5-1-2　経済・財務分析におけるベースライン調査の調査票集計とインタビュー調査結果

Item		A	B	C (離職)	D	E	F	G	Average
WG Member's Answer	Average of Self-evaluation	1.5	1.4	1.8	4.2	2.4	4.6	2.0	2.6
Interviewer's Input	Average	1.7	1.0	1.7	5.0	1.8	5.0	1.8	2.9
	Experience	1.7	1.0	1.7	5.0	1.8	5.0	1.5	2.7
	Knowledge	1.7	1.0	1.7	5.0	1.8	5.0	2.0	2.6

注釈：表上部の A,B,C,D,E,F,G については WG メンバーを表す。

6 名のうち 2 名（D と F）は会計士の資格を持ち、財務計算を行う技量に問題ない。さらに、うち 1 名（F）は IPP 入札に係わっており、投資プロジェクトの専門知識も十分あると思われる。このため F については研修生ではなく、アドバイザーとして参加するものとした。

一方、残りの 4 名（A、B、C と E）はこれまで携わってきた仕事の中で自らの手で経済・財務分析を行う機会がなく、基礎知識をほとんど持っていない。このため研修では、分析のイロハから教える必要がある。

とは言うものの、上記 4 名のうち 2 名（B と E）は資産管理部門のマネジャーの職にあり、資産の運用評価やリスク評価に経済財務分析を行うことの必要性と重要性を十分理解している。かつ、これまでは経済・財務分析作業を外注してきたが、今後は自らの手で行うべきという認識を持っている。

ドナーの技術協力プロジェクトのコーディネーターを務める 1 名（C）は、自らの手でプロジェクトを実施することの便益評価、あるいは限られた原資で複数のプロジェクトを実施する際の最適化を評価したいという意思を述べている。しかし、彼女は 2022 年夏に PPL を離職し、メンバーから外れた。

C に替わる人材として新たに G が加わった。事業戦略部門の職員としてプロジェクト投資の評価に係わっているが、まだ経験が浅く財務の基礎知識が十分ではない。しかし、能力強化のための知識を学ぶ意思と向上心がある。

系統管理のマネジャーは（A）、天然ガス価格の急上昇を背景に、燃料の選択は重要になっている中で、経済・財務分析の知識を身につけて、燃料選択の最適化を行いたいという明確な目的を持っている

このように、例え現状では知識に乏しい者であっても、研修に参加することの目標が明確である。会計士 2 名と残り 4 名の間で知識レベルに差はあるが、いずれのメンバーも研修への参加に強い意欲と期待を持っている。

(3) 送電

表 5-1-3　送電におけるベースライン調査の調査票集計とインタビュー調査結果

Item		A	B	C	D	E	Average
WG Member's Answer	Average of Self-evaluation	3.2	3.8	3.8	2.4	4.3	2.2
Interviewer's Input	Average	3.4	2.9	2.3	3.2	3.0	3.0
	Experience	3.5	3.0	2.3	3.0	3.0	3.0
	Knowledge	3.3	2.8	2.3	3.3	3.0	2.9

注釈：表上部の A,B,C,D,E については WG メンバーを表す。

5 名のうち 3 名は、送配電部門の送電メンテナンスチーム（A と B が POM 系統、C が Ramu 系統）に所属しており、日常業務において送電設備のメンテナンス（点検・補修）に携わることから、一定の知識・経験を有し、自己評価も高くなっている。インタビューにおいても、自己評価に裏付けされる業務の知識・経験を確認でき、それぞれの立場より業務で抱える問題点や、改善に向けて研修に期待すること、に対する意識が感じ取れたことから技術移転の候補者として適切と評価された。また一方で、特に保守業務に用いられる工具類・測定機器類の知識に関して、機材の不足もあって弱みも散見されたことから、今後の活動において知識付与が必要と考えられる。

残りの 2 名はアセットマネジメントチームに所属しており、D は送電設備のメンテナンスの経験は無く自己評価は低いものの、メンテナンス、信頼性評価やネットワークに係る国家資格を有しており、インタビューでも、アセット評価やシステム開発に係る貢献性・技術力を確認でき、業務改善に向けた強い意識を感じ取れた。E も過去に一定の保守・メンテナンス経験を持ち、特にデータ処理に係る高いスキルを有することを確認できた。以上から、アセットマネジメントチームに所属する２名も、技術移転の候補者として適切と評価された。また一方で、経験不足に伴うメンテナンス業務の知識不足については、知識付与の研修カリキュラムを通じて一定のカバーが必要と考えられる。

(4) 変電

表 5-1-4　変電におけるベースライン調査の調査票集計とインタビュー調査結果

Item		A	B	C	D	E	Average
WG Member's Answer	Average of Self-evaluation	3.7	3.0	2.4	4.4	3.8	3.5
Interviewer's Input	Average	3.7	3.2	3.7	3.2	2.9	3.3
	Experience	3.7	3.3	3.7	3.3	3.0	3.4
	Knowledge	3.7	3.0	3.7	3.0	2.7	3.2

注釈：表上部の A,B,C,D,E については WG メンバーを表す。

アンケート結果より、全体の傾向として変電設備に対するアセットマネジメントの経験が少ない。また変電設備の点検に関する知識や、機材評価（巡視、点検）に使用する測定器類の使用方法に関する知識も低い傾向にある。これらについては、今後の研修やマニュアル等作成を通じて重点的に知識付与を行う。

WG メンバーは保全業務や工事設計業務などバックグラウンドが人により異なるが、各々が自分の担当業務に対して問題意識を持ち、改善の必要な点について認識している。また、インタビューを踏まえた調査団の評価としては大きな点数差はない。WG メンバーC, D, E については自己評価と調査団の評価が乖離しており、理由は以下の通り。

・C はテクニシャンの経験が少ないが、他社での経験や大学での知見など幅広い知識があるため。

・D は変電業務を長年行ってきたが、インタビューを通じてそれぞれの知見があまり深くないと判断したため。

・E は送配電に関する経験が豊富であるが、インタビューの中で具体的な内容が出てこなかったため。

WG メンバーA,B についてはマネジャーの職にあり、業務に対する問題点をよく理解している。また WG メンバー全員に共通していることは本技術プロジェクトに対しての要望が明確であり意欲も高いことである。以上をふまえて、本技術プロジェクトを通じて WG メンバーに不足している設備保全の技術・知見を付与することで、PPL の技術力の向上に直結することが期待できることから、技術移転する相手として適切である。また、今回の取組みが陳腐化しないよう、PPL が組織として技術力向上に継続的に取組める仕組みづくりを行うように提案していく。

(5) 保護協調

表 5-1-5　保護協調におけるベースライン調査の調査票集計とインタビュー調査結果

Item		A	B	Average
WG Member's Answer	Average of Self-evaluation	3.1	2.8	3.0
Interviewer's Input	Average	2.3	4.3	3.3
	Experience	2.3	4.3	3.3
	Knowledge	2.3	4.3	3.3

注釈：表上部の A,B については WG メンバーを表す。

WG メンバーは保護リレー整定に関する実務を行っているメンバーで構成されており、知識や経験に差はあるが、両者とも本プロジェクトに対する意欲が感じられ、技術移転する相手として適切である。調査票の集計結果では、ディジタル型保護リレーの整定要素や距離リレー整定に関する知識が全体的に低いことを確認した。これは、PPL が抱えている課題の一つであるエンジニア部門の技術継承ができていないためであり、教育資料や手順書の必要性を訴えていた。本 PJ を通じて、研修マニュアル作成し、研修を行うことで保護整定に関する知識向上を図る。

5.2　WG メンバーが感じる PPL の課題・本プロジェクトへの期待事項

アンケートやインタビューを通じて確認できた、WG メンバーからの PPL の課題や本プロジェクトへ期待する事項については、下表の通りである。

WG	PPL の課題	本プロジェクトへ期待する事項
系統計画 WG	・ グリッドコードが定める電力品質を達成するために必要な設備構築ができておらず、大規模停電が頻発している。系統連系前の技術検討で、必要性を確認された設備が構築されない。 ・ IPP からの系統連系の申込みに対する社内業務が文書化されておらず、明確でない。 社内で技術検討の方法が継承されておらず、人事異動後に技能が消失している。	・ 改修計画や増強計画を系統計画に反映させ、適切な設備構築を実現する。 ・ 業務フローや各種文書の様式を定めて、系統連系申し込みへの対応業務を定型化する。 ・ マニュアル類を整備して、人事異動があっても必要な技能を業務所管箇所が維持できるようにする。

経済財務分析 WG	・ PPL と政府の使命が同じではない中で、PPL がどのように政府と歩調を合わせるか考えていかねばならない。 ・ 直近での天然ガス価格の高騰が発電コストの上昇を招いている。 ・ 所有する資産のリスク評価、古くなった設備のライフサイクルアセスメント、設備保全の最適化には、経済・財務分析が必要であるが、これまでは作業を外注してきた。	・ 国にとっての便益と PPL にとっての収支の確保を定量的に評価したい。 ・ 燃料価格が高騰する中で、燃料の選択が重要である。燃料価格の変動が発電コストに及ぼす影響や燃料の切り替えによる発電コストの最適化を行いたい。 ・ これまで外注してきた分析作業を社内で出来るようにしたい。 ・ IPP 開発において様々な財務分析モデルがあるが、技術者でも理解できる簡単な分析モデルを作りたい。
送電 WG	・今年度より点検の周期、点検の方法等を定めたルールが試行開始されたが、うまく機能しておらず計画と実績で大きな乖離が見られる。 ・設備異常が適切に管理されておらず、設備事故が発生してから改修を行うといった事後保全となっている。また異常のランク判定も点検者の経験に委ねられており、判定を均一にできるクライテリアが存在していない。	・保守作業員のマンパワーや技量を考慮した、持続性の高い点検計画を策定し、適切な点検方法を実践できるようになる。 ・適切な設備異常管理のフローを策定し、それを遵守することで、事後保全から予防保全に切り替え、停電時間の減少させたい。 ・ルール、クライテリアの策定により、統一された設備状況管理及び、設備改修の優先順位を決定できる環境としたい。
変電 WG	・メンテンナンスマニュアルがなくメンテナンススキルに課題がある。コンディションモニタリングのための分析技術やクライテリアがない。 ・得られたデータを上手く活用することができない。 ・メンテナンス用の機材が不足している。 ・設備仕様を登録・管理する設備仕様管理システム及び、設備状態のトレンド管理を行い、保守業務を効率的に運用	・メンテナンスやコンディションモニタリングの方法についての教育を希望する。 ・変電設備のトラブルシューティングやライフサイクルプランニングの方法についての教育を希望する。 ・巡視点検の改善を行いたい。 ・測定器類の供与。 ・予防保全に用いる測定器の原理や分析方法等に関する教育。

	するためのアセットマネジメントシステムが構築できていない。 ・主要機器の主要部分にのみ注視し、変電設備をシステムとして捉えていない ・漏油、ガス漏れ、直流回路接地故障などに対応できておらず、重大事故に繋がる原因が多数放置されている	・設備仕様管理システムとアセットマネジメントシステムの構築に向けた教育と支援。 ・変電設備各部の重要性や仕組みに関する教育 ・漏油、ガス漏れ、直流回路接地不具合への対応方法の教育と資機材供与
保護協調 WG	・保護リレー誤動作により大規模停電が発生している。 ・保護リレー整定に関する手順書がない。 ・フェイルセーフ機能[4]を不使用としている。 ・３端子線路での距離リレー整定ができていない。 ・シミュレーションツールの系統モデルがない。 ・送電線保護の冗長性が確保されていない。	・手順書を作成することで、保護リレーの整定を適切に行う。 ・日本で採用している保護スキームについて学び、PPL で活用できるスキームについて検討を行う。 ・フェイルセーフ機能を活用し保護リレーの不要動作を防ぐことで停電を減らす。 ・距離リレーの分岐誤差と整定方法を学び、送電線の３端子運用を行う。 ・シミュレーションツールを用いた保護協調手法を学びたい。
人材育成 WG	・エンジニア向けの育成制度が無いことから技術継承が適切に行われていない。 ・研修環境の整備が不十分である。	・技術継承が適切に行われるよう、エンジニア向けの育成制度を構築したい。 ・研修実施に必要である資機材をリストアップし、社内承認を得たい。

5.3　WG 活動・トレーニングを通じた PPL の現状調査結果

(1) 系統計画

A) 人材

➢ *系統連系に関する実業務の経験が不足している*

PPL では、IPP からの申し込みに基づく系統連系の実績が限定的であり、数年に 1 度程度であるため、系統連系に関する業務のスキル保有者を社内で維持する仕組みが整っておらず、系統連系の実業務に係る経験者が継続的に確保されていない。そのため、系統連

[4] フェイルセーフ機能：保護リレーの誤動作を防ぐための機能。フェイルセーフ機能の一例として、距離リレーでは、距離要素(メイン)と過電流要素(フェイルセーフ)の両方が動作した場合（AND 条件）に電気事故として判定する。

系申し込み受付時の技術検討は、コンサルティング会社 SMEC などへの外部委託と社内検討を併用している。

B) 組織・業務の仕組

➢ *系統連系に係る書類が整備されていない*

系統連系時に PPL と IPP 間で相互に交付が必要となる書類様式を定めることがグリッドコードで PPL に求められているが、完全には整備されていない。実態として、新規の系統連系の申込みがあった場合は、過去の申込み時の書類を参考にして必要な書類を作成している。また、社内規定や過去の検討方法の標準化が行われておらず、仕事の進め方が人によって異なる。

➢ *系統連系時の役割分担が確立されていない*

系統連系の申し込み受付後に PPL で必要となる技術検討は、系統計画箇所である Network Planning と、系統運用箇所である NSO（National system operation）の 2 箇所が分担している。代表箇所である Strategy & Innovation 部門の判断に基づき、Network Planning が自ら行うのか、NSO に技術検討を依頼する体制となっているが、明示された分担ルールは確認できていない。現実的な問題として、Network Planning は技術検討の経験者を有していないため、技術検討を Network Planning は NSO に依頼することが常態となっている。

➢ *業務ワークフローが確立されていない*

系統連系申し込み受付後の社内業務フローが確立されておらず、過去の記憶や経験を基に業務を実施している。このため、系統連系のための技術検討の検討項目などが、不明確である。また、技術検討の結果と申込者（IPP）への回答との関係性が不明確である。特に、技術検討で必要性が提示された設備が申込者への回答で変更される場合には、その合理的な判断理由の把握が困難である。

➢ *部署間での情報共有ができていない*

部署が縦割りとなっており、技術検討の結果を実務者レベルで議論する場が無く、GM などの幹部クラスでしか部署間を跨ぐ議論はなされていない。結果として、技術検討を担当した NSO の実務者では、技術検討に基づき必要と考える設備と実際に構築される設備との間に、理由が把握できない乖離を感じている。特に、グリッドコードが要求する信頼度を確保するための送電線の 2 回線化や、適正電圧維持のための変電所への無効電力供給設備の増設に関して、技術検討箇所である NSO の実務者は課題認識の共有が望ましいと考えている。そう考える理由は、提案していた設備の未構築が関係して、既に系統に幾つかの懸念していた問題が生じており、事故波及や計画停電が頻発しているためである。

C) 設備

➢ *系統解析ソフトが部署によって統一されておらず、スキルも乏しい*

部署によって使用する系統解析ソフトが異なり、現在 3 種類の解析ソフトを使用しているがソフトを統一する動きは PPL 内で確認できていない。系統連系に関わる技術検討をおこ

なう部署においては、系統解析ソフトが 2 種類あるが、2 種類導入していることに理由はなく、過去にドナーによって供与されたため、そのまま使用しているとのことである。
また、PSSE については、Network Planning において 1 ライセンス保有する。ただし、使用スキルを有するエンジニアが他部署へ異動したため、現在 Network Planning の箇所で使える人はいない。その点も含め、系統連系に必要な系統解析は、現状は外部委託に頼っている。

- *GridCode に基づく設備構築が出来ていない*

GridCode では N-1 の設備構築について定められているが、現状 IPP の連系線は N-1 要件[5]を満たさず、実質的に送電線 1 回線で構成されている箇所が多い。
また、本来 IPP 発電所へ接続する送電線も PPL が建設する必要があるが、PPL が建設費用を捻出できず、IPP が建設*している。そのため、最低限の設備のみしか構築されず、結果として Grid Code 違反となっている。特に、POM の需要容量の約 50%をカバーする NIUPOWER 発電所に繋がる送電線は実質的に 1 回線で構成されているため、この送電線で停電事故が発生すると POM 系統でブラックアウトが発生する。問題が非常に大きいため、DFAT の支援により NIUPOWER 発電所と DIRIO 発電所から Kanudi 変電所まで新ルートで 1 回線が建設される予定である。
*IPP が支払った建設費用は、電力買取契約の電気料金に上乗せされる。

- *無効電力を考慮した設備増強計画がなされていない*

POM 系統では、西側と東側で送電線の電圧の傾向が異なる。具体的には、西側は大規模電源により比較的高い電圧が維持される一方、東側は需要が中心であり電圧が低下するという問題を抱えている。この電圧問題を解消するために進相無効電力を供給できる調相設備を負荷端に設置する必要があることから、Boroko 変電所に無効電力を進相にも遅相にも連続的に調整できる STATCOM[6]を設置している。しかし、STATCOM は設置後に解消が困難な不具合が発生し、STATCOM の機能停止が継続している。このような経緯で、電圧問題に調相設備以外の方法での対応が必要となったことから、応急的に負荷を減らすことにより電圧低下を抑制するため、配電線の計画停電を実施している。
進相無効電力の供給には、STATCOM に比較してより安価で系統運用者でのメンテナンスが容易なコンデンサで十分に必要条件を満たす。STATCOM は、大型の電炉などへの供給があるため電圧の瞬時的な上下が激しいフリッカ対策として変電所に設置されることがあるが、Boroko 変電所においてより高価で高機能な STATCOM の設置が必要な理由は確認できなかった。STATCOM の設置経緯は明らかでないが、系統計画を実施する際に、無効電力調整装置を設置する計画が適切に検討されていないことが原因と推定する。

[5] N-1 要件：単一設備故障発生時でも，停電を発生させず電力を送電可能な状態とすること。
[6] STATCOM：Static Synchronous Compensator(無効電力補償装置)
従来の電力用コンデンサ・分路リアクトルを使用せず、系統の要求に応じて無効電力の出力を高速で自由に変える事ができる装置。

(2) 経済財務分析

A) 人材

一名が離職によりメンバーから外れた。戦略部門のマネジャーの推薦により、新たに一名が追加となった。正しくは二名が推薦されたが、一名は休暇中であった事から面接と研修に参加しなかったため、PPL 側との協議の結果、除外した。

第 3 次現地調査における研修では、出席率は高く、例えスケジュールが合わなくとも別途補講で研修時間を確保することができており、メンバーの参加意識は高い。

B) 組織・業務の仕組

狭義には、プロジェクトが目標とする経済財務分析の知識が必要な組織は戦略計画部門であるが、その陣容は限られる。エコノミストの人数は、マネジャー一名に部下一名、他部門から一名が補助として加わっているのが実態である。

一方、資産管理部門、系統管理部門、そして財務部門からも WG への参加者がいる。組織として直接的に係わるものではないが、知識の底上げという点で個々人のみならず組織の質的強化として意義がある。

C) 設備

パソコンがあれば分析は可能であり、他の設備は必要ない。

(3) 送電

A) 人材

➢ *送電設備の保全業務に必要な作業員数および資源の不足*

POM 系統では、9 人の作業員（内昇塔作業可能 7 人）が保全業務に従事し、1 台の車両を保有している。一方 RAMU 系統では、Costal 地域および Highland 地域にそれぞれ 8 人、9 人の作業員および 2 台、3 台の車を保有している。このうち RAMU 系統側で保有する車の一部は良好な状態ではない。

各系統で所管する設備量から考えるに、保全業務に必要な作業員数や車両台数が絶対的に不足しており、設備点検の年間計画は遅延している状況にある。調査結果では、計画より最大 3 ヵ月程度遅延して点検を実施している線路も確認された。計画通り点検を実施できていない原因の多くは、予定外の停電や事故等で緊急を要する復旧作業に追われ、予防保全業務が後回しにされる為である。

B) 組織・業務の仕組

➢ *点検計画の策定および定期点検の実施*

PPL では、今年より年間点検計画に基づいた点検実施を目指しており、各系統における点検計画が 5 月に承認された。点検計画の管理はアセットマネジメント部門が担当しており、点検計画に基づく業務指示をメンテナンスチームへ指示し、メンテナンスチームが点検を実施後、点検報告書をアセットマネジメント部門へ提出するとした運用フローが開始された。

しかし導入直後であり、アセットマネジメント部門とメンテナンスチーム間の連携がうま

く機能していない。例えば、運用フロー開始前の昨年や今年に、約１０線路の点検作業を既に完了しており、点検結果も存在しているが、業務指示書がまだ２線路分しか発行されないため、過去の点検結果は未報告のままとなっている。点検結果は直ちに関係各所へ報告され、共有されることが設備の予防保全の観点からも望ましいため、本状況を改善する必要がある。

- *設備異常の評価に関する判定基準の不足*

PPL では、今年より点検報告書を定例様式で管理することを目指し、報告書と一緒に、点検時に使用するチェックリストも添付している。現在試行運用中であるが、基本は異常無しならば「レ」を入れ、異常ありの場合は、その詳細を記述するようになっている。
しかし、設備異常を評価する為の判断基準が点検作業員の経験や力量に委ねられており、写真が添付されないケースも存在するなど、その作業員しか設備の状態を把握できない状況となっている。設備別に異常の度合を評価できる判断基準を設け、異常の継続監視や取替補修要否などの判断を属人化せず、常に一定の品質を確保して実施できるような運用ルールの制定が必要である。

C) 設備

- *PPL 管内における送電設備事故の実態*

POM 系統および RAMU 系統における送電線路に起因する送電線事故（線路停電が発生し、復旧作業を要したケース）を調査した結果、POM 系統においては、コンクリート柱の木製アーム腐食劣化、がいしの劣化、樹木の接触、蛇の接触など様々な要因が過去１年で少なくとも１０件以上されており、RAMU 系統では、樹木の接近が大半を占めることを確認した。基本的には、事故発生後直ちに復旧作業にあたり、早急に送電復帰となるが、今年の８月に POM 管内 L401 送電線路で発生した、電線断線による送電線事故においては、復旧用の資材や工具が確保できず、未復旧の状態が続いている。

(4) 変電

A) 人材

- *POM 系統で変電設備の保守に携わる人員不足*

  POM 系統で変電設備の保守に携わる人員は 8 名程であり、かつ、設備の障害発生数が多いことから、人員不足に拍車がかかっている
- *予防保全に係るノウハウの不足*

  予防保全、特に、状態管理保全の導入を志向しているが、そのノウハウが絶対的に不足している。
- *変電設備に関するシステムの未整備*

  アセットマネジメントシステムを開発中であるが、変電設備の多様性に加え、ノウハウの不足もあり、変電設備に関する部分のシステム構築はその前段階の設備仕様管理システムの段階においても進んでいない状況である。従ってアセットマネジメントを導入し、有効に維持・管理・運用していくための総体的な技術移転（人材育成）が急務である。
- *変電設備に対する誤った解釈*

変電設備がシステムとして捉えられて（認識されて）いない為、アセットマネジメントシステムを導入してもその効果が十分に活かせないばかりか、誤った解釈が大規模停電を招く恐れすら内在している。

B) 組織・業務の仕組

➢ *人材育成のための教育体系が未整備*

人材育成のための教育体系が未整備な上、変電設備の保守業務に必要な人員が絶対的に不足しているため、人員の充足と体系立てた教育の実施による数と質の両面における体制の整備が必要である。

➢ *エンジニアへの教育体系が未整備*

研修施設とテクニシャンへの教育カリキュラムは一部有しているが、エンジニアへの教育体系が無い。

➢ *非効率な運用体制*

テストチーム（測定器を取り扱うチーム）とメンテナンスチームが分かれており、メンテナンスにおける簡易な測定においてもテストチームが出動する必要があり、測定器類と人員の運用が非効率である。テストチームと測定器が POM エリアにしか存在しない為、点検作業を同日に複数箇所で実施できないことや、事故・障害対応が定期点検とバッティングするケースも予想される。

C) 設備

➢ *設備構成に冗長性が無い*

送電線１回線、変圧器１台（１バンク）での送電を行っている場合もあり、日本と比較して、設備構成に冗長性が無い部分が多い。冗長性が無いことにより下記のような悪影響が大きい。

○ 事故時に需要家の停電に繋がる。
○ 変電設備の保守に係る計画停電の取得が難しく、障害の程度が重くなるまで対応ができず、結果的に重故障が発生し、長期の停電に繋がっている。

➢ *機器製作メーカーが多様なため、事故対応に時間を要する*

途上国支援等で海外企業が置いた設備も多く、国際入札による設備新増設が主体であるため機器製作メーカーや機種が多様で、重大故障発生時の対応に時間を要する、もしくは、対応できない場合があり、影響をさらに大きくしている。

➢ *測定機器類・設備障害対応資材の不足、不適切な管理*

設備状態を把握するための測定器類と設備障害対応に係る資材が不足している。設備冗長性の脆弱さやノウハウの不足とも相まって、多数の設備障害が放置されている状況にある。

(5) 保護協調

A) 人材

WG3 保護協調のメンバーは、プロテクションチームの 2 名で構成されている。プロテクションチームは NSO Group の Power System Engineering に属しており、組織は下図のとおりとなっている。7 つ(赤枠)のポジションのうち 5 つ(赤塗)は空き状態であり、新たに 5 名

(ジュニア 3 名、シニア 2 名)の採用を予定している。本プロジェクト３年目には、トレーナー候補者がエンジニア向けにトレーニングを行うこととなっており、新たに採用される予定者 5 人の内 2 名のエンジニアをトレーニングの対象者とする。

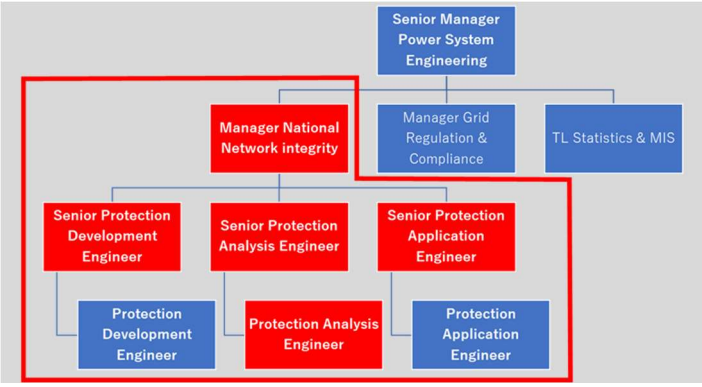


図 5-3-1　PPL 保護協調チーム組織図

B)　組織・業務の仕組

現在は明確な SOP が存在していないため、担当レベルで整定の依頼承認が行われている。聞き取り調査を基に新規プロジェクトの保護リレー整定 SOP のドラフト版を作成した(下図参照)。SOP を作成し、承認手続きや整定に必要な諸元、資料を明確にすることで、新たに人が配属された場合でも適切に整定業務を処理することができるようになると考えられる。

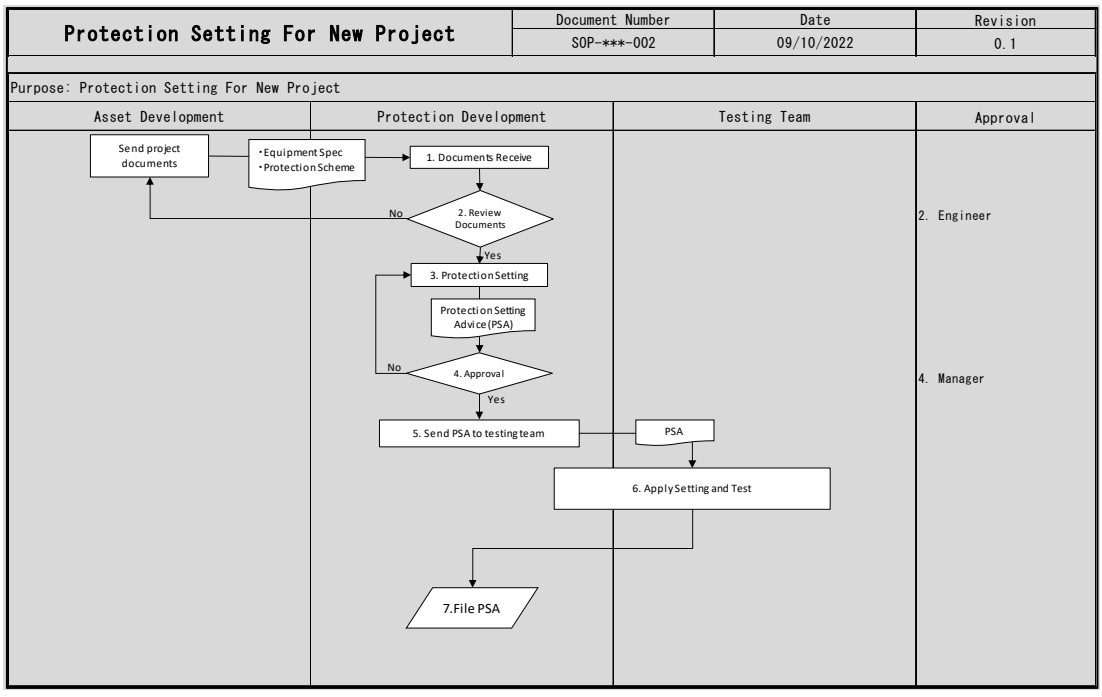


図 5-3-2　保護整定に関する SOP(ドラフト版)

C)　設備

➢　*無保護箇所の有無*

母線保護リレーが設置されていない変電所については距離リレー(zone2 やリバース)を用いて保護しており、適切な整定がされていれば問題ないと認識している。仮に、無保護の区

間が存在する場合、大規模な停電が発生する可能性があることから、下記について確認を実施した。

・保護リレーの盲点がないか(無保護の設備がないかを確認)

・1 系列で保護している線路での装置故障有無(設備不良による無保護箇所有無)

聞き取りを行った結果、現時点で無保護となっている設備は存在しないと考えられる。

➢ *シミュレーションソフトウェア*

ETAP ソフトウェアにおける各 Ry の応動を確認しようとしたが、現状の業務としてはシミュレーションツールを使用していないため、取り扱い方法を熟知しておらず確認は困難であった。故障電流の計算は可能であるが、特性図[7]の表示等は扱えていない。また、距離リレーの特性図表示については、ソフトウェアの機能追加が必要であり、ソフトウェアのアップグレード(追加購入)が検討されている。シミュレーションが実施できることで確認可能な項目が増えるため、保護リレーの誤動作等を早期に発見することが可能となる。本プロジェクトでは研修を通して日本で用いているソフトウェアを紹介し、リレー応動確認や動作チェックなどの教育を実施する。

(6) 人材育成

A) 人材

PPL 職員は自分のスキルを上げることに十分インセンティブを感じることから、本プロジェクトにて構築する研修を積極的に受講することが多いに見込める。

B) 組織・業務の仕組

➢ *人材育成体制*

・テクニシャン向けの研修はあるものの、エンジニア向けの教育体制が整っていないことから、エンジニアスキルが適切に継承されず、仕事が属人的となっている。

・テクニシャン向けの研修では、社内の技術的な研修に加え社外の TOT 研修を活用しトレーナースキルの育成を行っているが、それをエンジニアが活用することは職種柄現実的ではない。

➢ *人材採用*

・現在、空席となっているポジションは、リクルートを開始してから採用が決定するまでに、通常は最大 2 か月を要する。

・ただし、マネージャーもエンジニアも両方空席になっている場合は、シニアマネージャーがマネージャーを採用（最大 2 か月）し、その後、採用されたマネージャーがエンジニアを採用（最大 2 か月）するため、合計最大 4 か月を要する。

・従業員は 3 年に 1 回 Key Performance Indicators(KPI)に基づいて評価され雇用契約を更新している。

C) 設備

[7] 特性図：保護リレーの動作領域、不動作領域を図に示したもの。

➢ *トレーニング設備の老朽化*

トレーニング設備が老朽化しているが、予算確保ができないことから約 20 年間設備更新ができていない。

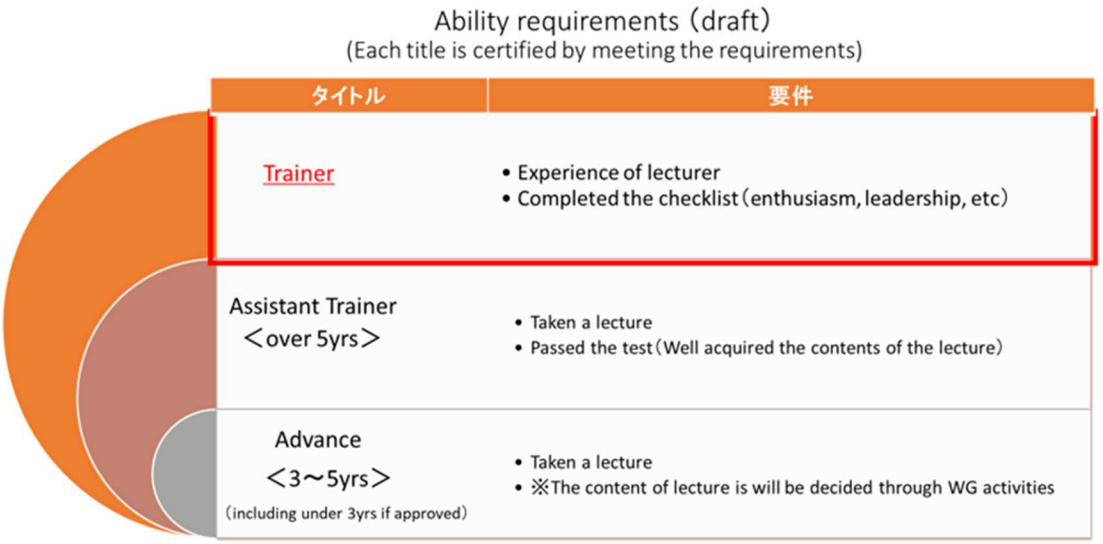


図 5-3-3　トレーナー認定制度の能力要件（案）

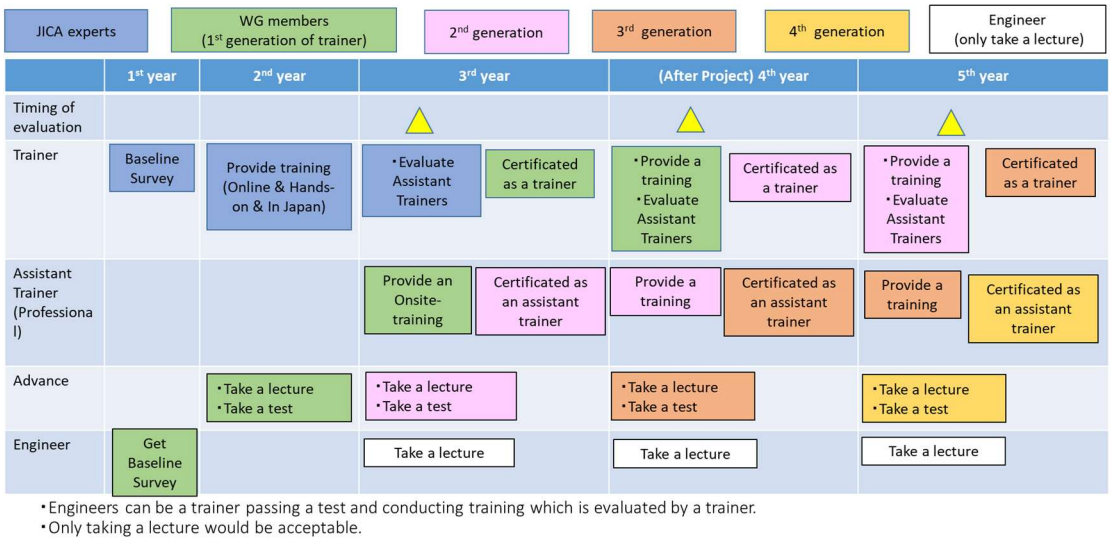


図 5-3-4　トレーナー認定制度のフローチャート（案）

5.4　技術移転計画への反映

ベースライン調査や現状調査の結果を WG 毎に 2,3 年目の技術移転の内容へ反映させるため、留意事項と具体的に反映すべき点として、以下のように整理した。

(1) 系統計画

WG メンバーは、今後、PPL での系統計画業務や IPP の系統連系時における技術検討を行う役割を担う可能性のある立場であるとともに、系統連系時の社内ルールの策定の重要性については共通認識を有している。主な留意事項と技術移転への反映は以下のとおり。

表 5-4-1　1 年目の調査結果における留意事項（系統計画 WG）

分類	留意事項	技術移転プログラムへの反映	解決法	可否※
人材	PPL では、IPP からの系統接続の申し込みに基づく系統連系の実績が限定的であり、系統連系に関する業務のスキル保有者を社内で維持する仕組みが整っていない。	➢ 系統連系に係る申込数は限られるものの、今後も継続的に系統連系に関する技術検討業務が発生することが予測される。そのため、技術検討の機会を活用し、技術検討を行える人材を育成していく体制を構築する。	・マニュアルへの反映 ・トレーニングの実施	可
	IPP からの系統連系申し込み時に必要となる技術検討の実施箇所が、社内で 2 つの部署に分かれて配置されている。	➢ 業務分担ルールの実態を確認して、業務効率化やスキル維持の観点で必要であれば変更を加え、ワークフローを整備する。	・マニュアルへの反映	可
組織	系統連系申し込みから連系完了迄の一連の手続きの過程で、IPP と PPL で取り交わしが必要となる各種書類が明確に定義されていない。	➢ 業務実態を確認して、実際に使用されている各種書類を収集して、必要であれば修正を加えたうえで、標準様式とする。	・マニュアルへの反映	可
	社内組織間での情報共有の仕組が十分でなく、系統連系のための設備対策の実施計画が、技術検討箇所では正確に把握できない。	➢ PPL が IPP に連系要件として求める設備対策を、技術検討箇所を含む社内関係個所に IPP への回答責任箇所から共有するよう、ワークフローを整備する。	・マニュアルへの反映	可
設備	技術検討のための系統解析ソフトが社内で統一されておらず、部署によって PSSE または Power Factory を使用している。また、保有スキルも乏しい。	➢ 系統解析ソフトの種類に依らない、シミュレーションの根本にある電気工学的な原理について知識を付与する。	・マニュアルへの反映 ・トレーニングの実施	不可
	Grid Code に則った設備構築が出来ていない。 特に、N-1 や無効電力を考慮した設備増強計画がなされていない。	➢ Grid Cord に基づいた技術検討により必要と判断された設備構築が設備増強計画に反映されるよう、ルールを明確化する。	・マニュアルへの反映	可

※可否については、本プロジェクトでの対応可否を指す。

(2) 経済・財務分析

狭義の WG の目的は、投資プロジェクトを経済財務分析するための能力育成であるが、メンバーの組織上の属性に幅があることから、視野を広げてエコノミストとして求められる基礎的な財務知識の底上げを重視したい。

参加メンバーにはマネジャークラスの人材が多く、財務に係る基礎知識を持つことは、彼らにとっても日々の仕事をこなす上で重要な能力強化となる。この点でメンバーの意識は高い。

表 5-4-2　1 年目の調査結果における留意事項（経済・財務分析 WG）

分類	留意事項	技術移転プログラムへの反映	解決法	可否※
人材	直接関連する戦略計画部門の人材が限られ、現状ではマネジャー以外に十分な能力を持つ者がいない。	➢ 戦略計画部門から新たに一名がメンバーに加わったので、戦力として彼の能力強化を目指す。	研修を通した知識の移転と能力強化	可
	一方、資産管理部門から二名のマネジャーが参加しているが、財務に係る基礎知識が殆どない。	➢ 資産管理業務の中で財務の知識は是非とも必要であり、その能力向上を図る。	研修を通した知識の移転と能力強化	可
組織	戦略部門で財務経済分析ができる人材がマネジャーにとどまる。	➢ 部下一名の能力を育成することで、当該部門の人材を強化する。	研修を通した知識の移転と能力強化	可
設備	パソコンは各自が保有しており、取り立てて問題はない。	➢ 特になし。	現状で問題無し	-

※可否については、本プロジェクトでの対応可否を指す。

(3) 送電

WG メンバーは、それぞれの立場より業務で抱える問題点や、改善に向けて意識を持っているものの、保守業務に関する知識や業務遂行に関して弱みも散見された。今後の活動において、主な留意事項と技術移転への反映は以下のとおり。

表 5-4-3　1 年目の調査結果における留意事項（送電 WG）

分類	留意事項	技術移転プログラムへの反映	➢　解決法	可否※
人材	現在のエンジニア、テクニシャンに対する知識・ノウハウの付与を行い、個々の技術力や業務効率の向上を図っていく必要がある。	➢ PPL 内に送電設備に関する基礎知識を持った人材を継続的に確保するため、トレーニング内容の資料整備やマニュアル類の作成にも取り組み、人材育成制度の定着化を図る。	・トレーニング資料整備 ・マニュアルへの反映	可
組織	点検計画に基づく巡視点検フローが新たに開始されたものの、まだ計画と実績の乖離が大きい為、原因を分析し、改善する必要がある。	➢ オンライントレーニングや本邦研修を通じて、送電設備の保全業務やアセットマネジメントの知識向上、業務の高度化を図る。 ➢ 保全業務フローやアセットマネジメントの業務フローや着眼点を整理した業務マニュアルの制定および部門間連携改善を図る。	・トレーニング資料整備 ・マニュアルへの反映 ・業務フロー策定	可

	点検で発見した設備異常の評価が属人的になっている。業務別の着眼点等を網羅した判断基準や運用ルールの整備が必要である。	➢ 設備別の必要点検項目や設備異常度合の判別方法の統一化を図る ➢ 点検業務や補修業務における着眼点や感受性を養う目的で、送電設備の機能や基本的な設計思想に関する内容の知識付与を行う。		
設備	様々な要因の事故発生しており、基本的には、事故発生後直ちに復旧作業に取り掛かるが、復旧用の資材や工具が確保できず、未復旧の状態が続いている。 設備復旧作業に必要な工具類の老朽化や不足も顕在化しており、使用用途や整備方法等の整備が必要である。	➢ 設備損傷箇所の現状を理解し、設備の危険性や改修の緊急性を判断できるよう送電設備の機能や基本的な設計に関する考え方について知識付与を行う。 ➢ 現在未復旧の状態を解消するために工具資材の調達方法、新たな工具の採用、使用方法等について知識付与を行う。	・トレーニング資料整備 ・不足資機材の調達 ・マニュアルへの反映	可

※可否については、本プロジェクトでの対応可否を指す。

(4) 変電

2, 3 年次の本格フェーズにおいて、WG2-2 に対し技術移転を実施する上で留意すべき事項と、技術移転プログラムへ反映する事項を下記に示す。

表 5-4-4　1 年目の調査結果における留意事項（変電 WG）

分類	留意事項	技術移転プログラムへの反映	解決法	可否※
人材	保守に係る人員不足とノウハウ不足により予防保全が実施できていない。	➢ 予防保全を導入するための、巡視・点検に関する基礎知識や、測定器の扱いに関する教育を行いノウハウを醸成する。 ➢ 少人数でも効率的な保全業務を行うための教育体系・人員体制の整備を行う。	・トレーニングの実施 ・マニュアルの作成	可
	変電設備がシステムとして捉えられて（認識されて）いない。	➢ 機器の主要部分以外も全て重要であるという認識の下、どのように維持管理していくのかノウハウを伝達する。	・トレーニングの実施	可
	変電設備の多様性とノウハウの不足によりアセットマネジメントシステムの構築ができていない。	➢ まずは、設備仕様管理システムの構築を支援する。 ➢ 設備状態をトレンド管理する分析ツールを紹介する等、アセットマネジメントシステム構築に向けた教育を行う。	・トレーニングの実施	可
組織	メンテナンスに係る簡易な測定においても、テストチームの出動が必要であり、人員と測定器の運用が非効率である。	➢ 保守に係る基本的な測定器をメンテナンスチームに供与し、簡易な測定等についてはメンテナンスチームで完結するよう人員体制の整備を提案する。	・測定器類の供与と教育	可
	人材育成のための教育体系が未整備である。	➢ 教育マニュアルを整備し、トレーナーを継続して育成できる教育体制を構築	・マニュアルの作成	可

		する。		
設備	PPL の設備構成は、日本と比較して、冗長性がないこと。	➢ 冗長性がないことによる設備障害の影響を緩和するために、予防保全を導入する必要性と導入方法について教育を行う。	・トレーニングの実施 ・実務マニュアルへ冗長性がない実態を反映する。	可
	設備状態を把握するための測定器類と設備障害対応に係る資材が不足している。	➢ 予防保全に係る資機材を供与し、測定器については、測定原理や分析方法等について教育を行う。消耗品資材については、予防保全を行うための使用方法を教育するとともに、PPL で継続的に調達が可能となるよう支援する。	・資機材の供与 ・トレーニングの実施	可

※可否については、本プロジェクトでの対応可否を指す。

(5) 保護協調

熟練者と初心者の差を埋めるために必要な研修を行い、PPL 独自の研修マニュアルを作成することで技術継承が行えるようにする必要がある。また、保護協調が図れていない事が要因で停電範囲が拡大する傾向があることから、保護リレーの整定手法を見直し、SOP やマニュアルを整備していくことで、停電範囲の縮小化を図る必要がある。主な留意事項と技術移転への反映は以下のとおり。

表 5-4-5　1 年目の調査結果における留意事項（保護協調 WG）

分類	留意事項	技術移転プログラムへの反映	解決法	可否※
人材	保護協調の検討について、過去にコンサルタント会社に依頼しているが、PPL 自ら実施した経験はない。	➢ 保護協調検討手法についての理解を深める。 ➢ 保護協調図を作成する。	・マニュアルへの反映 ・トレーニングの実施	可
	保護リレー概要はある程度理解しているが、教育資料が整っていないため、技術継承が課題となっている。	➢ 保護リレー概要や動作特性に関する理解度向上を図る。 ➢ PPL の保護リレーに応じた教育資料を作成する。		可
組織	新規プロジェクトの承認手続き、リレー整定、事故解析などの手順書が定められていない。	➢ ワークプロセスを明確化し、現状に基づいた手順書を作成する。	・マニュアルへの反映	可
	連系申し込みに対する保護リレー確認項目や手続きが明確化されていないことが要因で大規模な停電が発生している。	➢ 連系申し込み時の保護リレー検討項目に関する理解を深め、手順書を作成する。		可
設備	保護リレー二重化の思想は有しているが、予算不足から実施されていない。	➢ 保護リレー誤不動差による停電範囲拡大を防止するためには、全ての系統保護リレーを二重化することが理想ではあるが、本プロジェクトでの実施は困難である。	・系統保護リレー(約 80 台)追加設置	不可
	シミュレーションツールは所有しているが、系統モデルが作成されていないため、シミュレーションは実施され	➢ シミュレーションツールを活用することでより精度の高い保護リレー整定や保護協調を図ることが可能となるが、シミュレーションツールの動作環境を整えるためには膨大な時間がかかる。	・シミュレーションモデル構築	不可

	ていない。	本プロジェクトではその代替策として保護協調図を用いた検討手法を教育する。		

※可否については、本プロジェクトでの対応可否を指す。

(6) 人材育成

PPL では、エンジニア向けの人財育成制度がないことから、技術継承に課題を抱えている状況である。本プロジェクトでは、WG 活動を通じ、PPL にとって必要な人材育成のあり方について聞き取りを行いながら、彼らのニーズを踏まえた人財育成制度の構築に取り組んで行く。主な留意事項と技術移転への反映は以下のとおり。

表 5-4-6　1 年目の調査結果における留意事項（人材育成 WG）

分類	留意事項	技術移転プログラムへの反映	解決法	可否※
人材	本プロジェクトを通じて構築する研修について、プロジェクト終了後も PPL 職員が持続的かつ積極的に参加していく必要がある。	➢ PPL 職員は、自らのスキルが向上することに十分インセンティブを感じる、ということを WG 活動を通じて把握している。従って、研修を受講することでスキル向上につながる内容となるよう、彼らのニーズを踏まえながら研修内容を構築する。	・WG 活動を通じた WG メンバーへのヒアリング	可
組織	PPL ではエンジニアに対する人材育成制度が存在しないことから、十分な技術継承が行われていない。	➢ エンジニア向けに技術継承できるトレーナーを確実に確保できるよう、トレーナー認定制度を構築し、また、トレーナーとしてのスキル習得およびエンジニアとしてのスキル向上を図る研修制度を構築する。	・能力認定制度および研修制度の構築およびマニュアル作成	可
	各 WG の部所において、空きポジションが存在する。	➢ 本プロジェクト３年目には、トレーナー候補者がエンジニア向けにトレーニングを行うことから、新たに採用される人員数が適切に確保される必要がある。適宜、採用担当マネージャーへ採用に関する進捗状況を確認する。	・PPL 採用担当マネージャーへの聞き取りでは、空きポジションについてしっかり埋めていくとのことから、適宜進捗を確認することで採用活動を促していく。	可
設備	PPL より、エンジニア向けの研修設備は特段必要ないとのことから、特段留意事項はない。	➢ 左記のとおり、特段の反映事項は無し	-	可

※可否については、本プロジェクトでの対応可否を指す。

6.　各ワーキンググループへの技術移転

6.1　トレーニングによる技術移転

各 WG の技術移転計画への反映すべき事項を踏まえ、各 WG に対するトレーニングによる技術移転計画を次のとおり整理した。

表 6-1-1　系統計画 WG の技術移転プログラム（案）

主題	項目	ベースライン調査結果を受けた留意事項
系統計画の基本	大規模な系統計画の基本コンセプト	✓ 2022/8/22, 10/3 に Web で実施
	FACTS	
	設備設計のコンセプト	
需給計画	電力系統と系統運用	✓ 2022/12/1 に Web で実施
	経済効率の追求	
資産管理システム	関西電力送配電の資産管理システムの概要	✓ 2022/12/1 に Web で実施
	資産管理システムで用いる IT システムと 3 ステップ	
	資産管理システムのための他の手段	
系統計画のコンセプト（解析事例を含む）	系統計画の概要	✓ 2023/1/16 に Web で実施
	系統解析	
	PSSE による系統解析の例	
対面研修	これまでの研修のフォローアップ	✓ PNG で実施予定
	マニュアル整備のトレーニング	
需給調整	需要予測	✓ 後年度実施予定
	供給力計画	
	需給と周波数調整	
系統の相互接続における運用ルール	運用方法	✓ 後年度実施予定
	周波数品質	
	送電系統間の調整	
再生可能エネルギー普及が及ぼす電力系統運用への影響と課題	系統連系の規則	✓ 後年度実施予定
	再生可能エネルギー普及が及ぼす電力供給の信頼性への影響と課題	
対面研修	これまでの研修のフォローアップ	✓ 後年度実施予定
	マニュアル整備のトレーニング	

表 6-1-2　経済財務分析 WG の技術移転プログラム（案）

主題	項目	ベースライン調査結果を受けた留意事項
財務諸表の読み方と分析方法	財務諸表の構成と用語の定義	✓研修を通して財務諸表の構成（損益計算書、貸借対照表、キャシュフロー）について理解する。 ✓主な分析指標として、利益率やインタレストカバレッジレシオの概念を理解する。 ✓PPL の財務状況について、具体的に分析を行う。
	財務分析で使う指標の定義と概念	
諸外国の電力会社の財務状況の分析	南太平洋諸国の電力会社の財務分析	✓財務諸表の表記が企業によって差異があることを理解する。

	ASEAN 諸国の電力会社の財務分析	✓各国の電力会社の財務諸表を分析することで、収益状況について PPL との違いを理解する。 ✓その違いが何に起因するかを考える。
投資プロジェクトの財務分析	名目価格とインフレーションの概念	✓投資プロジェクトの財務分析について、基本的な考え方を理解する。 ✓そこで使う用語の定義を理解する。 ✓財務分析モデルの構造を理解する。
	割引率の概念	
	投資プロジェクトのキャシュフロー	
	投資の是非の判断	
投資プロジェクトの経済分析	財務分析と経済分析の違い	✓財務分析と経済分析の根本的な違いを理解する。 ✓国家経済にとっての便益評価の考え方を理解する。
	名目価格と実質価格の違い	
	ハードルレートの意味	

表 6-1-3　送電 WG の技術移転プログラム（案）

主題	項目	ベースライン調査結果を受けた留意事項
予防保全業務（巡視・点検）	巡視、点検の目的、実施方法	✓ 将来に亘り持続可能かつ高品質予防保全業務を実現する為、マンパワーに応じた適切な業務配分を踏まえた巡視点検計画を検討する。
	巡視・点検を行う対象設備	
	巡視・点検の着眼点	
	巡視・点検時の携行品ならびに使用方法	
巡視・点検チェックリスト	PPL 設備を網羅したチェックリスト	✓ PPL 職員の技能や経験に左右されない設備異常レベルの判定を実現すべく、判定基準の見える化を検討する。 ✓ アセットマネジメント部門との連携強化のため、指示・報告ルールを検討する。
	急所をおさえたチェック項目	
設備異常レベルの判定基準および設備改修基準	異常レベルの判定基準の定義	✓ ルール、クライテリアの策定により、統一された設備状況管理及び、設備改修の優先順位を決定する業務スキームを検討する。 ✓ 改修計画の策定において、送電設備設計に関する基本的な知識の補填が必要である。
	効率的な改修計画の策定	
供与資機材の使用・管理	供与資機材の使用方法	✓本プロジェクトを通じて新たに導入される供与資機材を中心に、適切な使用方法や安全管理対策についてトレーニングする。
	安全管理対策	

表 6-1-4　変電 WG の技術移転プログラム（案）

主題	項目	ベースライン調査結果を受けた留意事項
予防保全の実施	巡視・点検において管理すべき数値とその閾値	✓変電所を 1 つのシステムとして捉える重要性について教育する。

	巡視・点検実施方法 操作手順書の運用	✓本邦研修では、関西送配電における点検作業等を視察してもらう。 ✓障害原因調査復旧方法の教育。
アセットマネジメントシステムの構築と運用	設備仕様管理システムの構築 トレンド管理に係る分析ツールの使用 トレンド管理方法	✓ システム構築に携わっている PPL メンバーは WG2-1 送電メンバーの一人であるため、変電保守に係る知識が乏しい。
変電設備/変電設計に関する基礎知識	変電設備の基礎知識 変圧器・遮断器・Ry 変電設計の基礎 絶縁・耐震・接地設計等	✓変電所を 1 つのシステムとして捉える重要性について教育する ✓直流回路の役割・重要性について教育を行う。
測定器の原理と使用方法について	測定器の原理 測定器の使用方法 測定結果の分析方法	✓測定器の校正については、PPL の実態に合わせた実施・運用方法について検討する。
資材の使用方法と目的	資材を用いた設備障害への対応方法 資材の調達・管理方法	✓PPL が継続的に資材を調達できるよう調達方法について調査・支援する。

表 6-1-5　保護協調 WG の技術移転プログラム（案）

主題	項目	ベースライン調査結果を受けた留意事項
保護リレーの概要	保護リレー概要 VT/ CT 概要 T 分岐線路の分流誤差 保護リレー整定値の見直し 距離リレーの時限協調	✓保護リレー概要に関する知識の向上
保護リレー整定検討	整定手続、整定方針 整定に必要な定数 差動リレー整定 距離リレー整定	✓保護リレー整定および保護協調に関する知識の向上
電気事故解析検討	事故解析手順、検討項目 事故点測距	✓事故解析に関する知識の向上

	シミュレーションの精度検証	
	保護リレー動作判定	

6.2 マニュアルによる技術移転

各 WG の技術移転計画への反映すべき事項を踏まえ、各 WG に対するマニュアルによる技術移転計画を次のとおり整理した。

表 6-2-1　系統計画 WG のマニュアル（案）

種類	タイトル	ベースライン調査結果を受けた留意事項
Training Manual	系統計画の基本	✓ 本プロジェクトで使用するトレーニング教材を基に構成する
	系統計画のコンセプト（解析事例を含む）	
	系統の相互接続における運用ルール	
	再生可能エネルギー普及時の電力系統運用への影響と課題	
	需給計画	
	需給調整	
	資産管理システム	
Operational Manual	社外ルール（PPL と IPP 間）	✓ PNG の Grid Code「5th November 2014 Independent Consumer and Competition Commission」を参照
	社内ルール（PPL 社内）	✓ Dirio からの申込み時の社内手続きを参考に構成する
Standard Operating Procedures	技術検討のための収集する情報	✓ 系統、発電機 ✓ 需要、将来計画など
	技術検討の項目	✓ Dirio の系統連系時の検討例を参照 ✓ コンサルタント会社である SMEC による検討結果を参照
	系統解析	✓ 系統解析に関する一般的事項を記載 ✓ ソフトウェアの具体的な使用方法はソフトウェア開発会社のマニュアルを参照することとし、ここには含まない
	系統連系設備に関する標準ルール	✓ 財産分界点 ✓ 工事費の分担 ✓ 設備工事の分担

表 6-2-2　経済・財務分析 WG のマニュアル（案）

種類	タイトル	ベースライン調査結果を受けた留意事項
Training Manual	財務諸表	✓Individual texts will be used for the training, and compiled into a complete edition of the training manual.
	財務諸表分析	

	プロジェクトの財務分析	
	プロジェクトの経済分析	
カリキュラム（シラバス）	トレーニングのコンテンツ	✓Curriculum will be used as an overview of the training and a guideline for staff willing to join the training. ✓It shows what the training teaches and some details of the training schedule.
	トレーニングスケジュール	

表 6-2-3　送電 WG のマニュアル（案）

種類	タイトル	ベースライン調査結果を受けた留意事項
Training Manual	・巡視点検作業	✓予防保全業務ならびにアセットアセットマネジメントを牽引できる人財を育成すべく、トレーニングマニュアルとして整備する必要がある。
	・アセットマネジメント	
Operational Manual	・巡視点検作業	✓持続可能かつ高品質な予防保全業務ならびにアセットマネジメントの手法について整備する必要がある。
	・アセットマネジメント	
Standard Operating Procedures	・巡視・点検の着眼点	✓Operational Manual における補足資料として、左記の内容を充実化させる必要がある。
	・設備故障ランク	
	・巡視・点検の実施フロー	
	・試験機材と資機材の使用方法	

表 6-2-4　変電 WG のマニュアル（案）

種類	タイトル	ベースライン調査結果を受けた留意事項
Training Manual	巡視・点検の着眼点	✓ 予防保全を実施する上で効率的かつ持続性のあるものとする ✓ PPL の実態に即した内容で JICA 専門家が作成
	巡視・点検を行う対象設備	
Operational Manual	巡視・点検の目的、実施方法	✓ 事故防止、設備健全性維持上の重要度を評価して優先順位をつけて作成 ✓ JICA 専門家指導の下、PPL が主体性を持って作成
	設備異常の管理方法	
	関係各所との連絡体制	
Standard Operating Procedures	巡視・点検の実施フロー	✓ 安全面の確保や試験装置の使用方法、管理値等も併記し、手順書だけでの完結も考慮 ✓ JICA 専門家指導の下、PPL が主体性を持って作成

表 6-2-5　保護協調 WG のマニュアル（案）

種類	タイトル	ベースライン調査結果を受けた留意事項
Training Manual	表 6-5　保護協調 WG の技術移転プログラム（案）を参照	✓ 保護リレー概要に関する知識の向上 ✓ 保護リレー整定および保護協調に関する知識の向上 ✓ 事故解析に関する知識の向上
Operational Manual	保護リレー整定	✓保護リレー整定に関する手順の確立
Standard Operating Procedures	新規プロジェクト保護リレー整定	✓保護リレー整定に関する業務フローの確立
	事故解析報告	
	系統連系に関する保護リレー整定	

表 6-2-6　人材育成 WG のマニュアル（案）

種類	タイトル	ベースライン調査結果を受けた留意事項
Training Manual	（各 WG 技術移転プログラム案を参照）	-
Operational Manual	人材育成マニュアル（トレーナー認定制度・研修制度） 研修スケジュール	✓持続可能な人材育成制度となるよう PPL のニーズを反映する ✓PPL エンジニアの業務に配慮した研修スケジュールとする
Standard Operating Procedures	-	-

Project Monitoring Sheet I （Revision of Project Design Matrix） **Appendix1**

Project Title: The Project for the Improvement of Planning and Operation of Power System

Version 1

Implementing Agency: PNG Power Ltd

July,2022

Target Group: Engineers in PPL

Period of Project: March 2022 to March 2025

Project Site: N/A **Model Site:** N/A

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
The quality and reliability of electricity is improved.	The number of incidents violating grid codes in terms of power quality (voltage, frequency, etc.) decreases by XX % by year YYYY.	Data from PPL			
	System investment planning is regularly revised by PPL, and XX projects are implemented by Year	submission of revision of system planning			
	The number of faults resulting from the lack of maintenance and asset management decreases by XX% by Year YYYY.	Questionarre for PPL staffs in charge.			
	The duration of power interruption resulting from the lack of coordination is shortened by XX% compared to the Year YYYY.	Questionarre for PPL staffs in charge.			
				Not Achieved yet	
Project Purpose	Revised system investment planning is proposed by PPL based on simulation and, financial and economic analysis.	Report from Japanese experts	PPL continues commitment to the Project by securing budget allocation as well as assignment of personnel for post- Project activity.		
PPL can properly implement system planning for the transmission line and maintenance for transmission line and substations on its own.	The maintenance for transmission line and substations, and asset management is regularly implemented.	Report from Japanese experts.			
	The setting for protection coordination is regularly confirmed.	Report from Japanese experts			
				In progress	
Outputs	Knowledge for system planning, simulation, and financial and economic analysis is improved.	Exam results (Pre-exam and Post-exam)			
Capacity of system planning for the transmission line is improved.	The XX of engineers are trained by trainer.	Report from Japanese experts			
	Least Cost Development Plan is verified by PPL.	Report from Japanese experts			
				A survey was conducted on the identification and role of related departments in conducting system planning and system interconnection studies.We are also investigating the capabilities of PPL staff.	
Capacity of maintenance for transmission line and substation is improved	Knowledge for maintenance for transmission line and substation, and asset management is improved.	Exam results (Pre-exam and Post-exam)			
	The XX of engineers are trained by trainer.	Report from Japanese experts Questionarre for staff in charge.			
	XX times of preventive maintenance for transmassion line and substations, and asset management are annually implemented.	Report from Japanese experts Questionarre for staff in charge.			
				A survey on the identification and role of related departments in the fields of transmission ine and substation.We are also investigating the capabilities of PPL staff.	
Capacity of protection coordination is improved	Knowledge for protection coordination is improved.	Exam results (Pre-exam and Post-exam)			
	The XX of engineers are trained by trainer.	Report from Japanese experts			
	The setting of protection coordination is confirmed by PPL.	Report from Japanese experts			
				A survey was conducted on the identification and role of departments related toprotection coordination.We are also investigating the capabilities of PPL staff.	

Activities	Inputs		Important Assumption
	The Japanese Side	**The PNG Side**	
1-1 : The current capacity of system planning for the transmission line is	1. Short-term Experts a. Chief advisor/System planning b. Grid technology c. Financial and economical analysis d. Transmission line (maintenance) e. Substation (maintenance) f. Equipment Testing/ Evaluation g. Protection coordination h. Human resource management / traing planning i. Grid technology asistant / Business coordination 2. Equipment 3. Trainings a. Training online b. Training in Japan	1. Office place for Japanese experts 2. Utility 3. Counterpart personnel 4. all expenses for PPL staffs (salaries, in-country transportation, allowance, etc.) 5. Tax exemption 6. Customs clearance for equipment	
1-2 : The current system for human resource development is assessed and workable system is proposed.			
1-3 : 2 Working Groups (WG) for (1) system planning and (2) financial and economic analysis are formulated.			
1-4 : Training for trainer candidates on basis on system planning for the transmission line is conducted.			
1-5 : Training for trainer candidates on system simulation using tools such as PSS/E is conducted.			
1-6 : Training for trainer candidates on financial and economic analysis is conducted.			
1-7 : Sustainable system for human resource development is established.			
1-8 : The training manual for system planning, system simulation, and financial and economic analysis is formulated considering systematic human resource development and the manuals is officially			
1-9 : Based on the training manual, the training for the engineers is implemented by trainers.			
1-10 : The operational manual and Standard Operating Procedure (SOP) for system planning, system simulation, financial and economic analysis are formulated, and the manual and SOP are officially approved by PPL			
1-11 : Based on the operational manual and SOP, PPL verifies the Least Cost Development Plan.			
2-1 The current capacity and technical, structural, and planning challenges of maintenance for transmission line and substations are assessed. Measures for these challenges are proposed			
2-2 : The current system for human resource development is assessed and workable system is proposed.			
2-3 : 2 WGs for maintenance for (1) transmission line and (2) substations are formulated.			
2-4 : Training for trainer candidates on planning of preventive maintenance and asset management is implemented.			
2-5 : Training for trainer candidates on the implementation of preventive maintenance and asset management is implemented.			
2-6 : Sustainable system for human resource development is established.			
2-7 : The training manual for maintenance for transmission line and substations is formulated considering systematic human resource development and the manuals is officially approved by PPL			
2-8 : Based on the training manual, the training for the engineers is conducted by the trainers.			
2-9 : The operational manual and Standard Operating Procedure (SOP) for transmission line and substations are			
2-10: Based on the operational manual and SOP, PPL implements the maintenance of transmission line and substation, and the manuals and SOP are officially approved by PPL			
3-1 The current capacity and technical, structural, and planning challenges of protection coordination is assessed.The measures for these challenges are			
3-2 : The current system for human resource development is assessed and workable system is proposed.			
3-3: WG for protection coordination is formulated.			
3-4:Training to improve capacity of protection coordination setting is implemented for candidate trainers.			
3-5 : Sustainable system for human resource development is built.			
3-6 : The training manual for protection coordination is formulated considering systematic human resource development and the manuals is officially approved by			
3-7 : Based on the training manual, the training for the rest of engineers is implemented by candidate trainers.			
3-8 : The operational manual and Standard Operating Procedure (SOP) for protection coordination are formulated.			
3-9 : Based on the operational manual and SOP, PPL modifies the setting for the protection coordination, and the manuals and SOP is officially approved by PPL.			

Pre-Conditions
1. Political, security, COVID-19 situation etc do not detriorate significantly. 2. Input from PNG and JICA is iplemnted in timely manner. 3. Necessary budget for implementation of project is secured during the project.

<Issues and countermesures>

Project Name: The project for the Improvement of Planning and Operation of Power System

Appendix2

WG Member List

2 or more roles/positions

WG1

		Department	Name	E-mail address
	Leader	National System Operation (NSO)	Ivan Pekaea	ipekaea@pngpower.com.pg
WG1-1 SystemPlanning	Trainer candidates	NSO	Charlie Enos	cenos@pngpower.com.pg
		NSO	Benedicta Savage	bsavage@pngpower.com.pg
		Strategic Partnership IPP Development	Haidi Wanya	hwanya@pngpower.com.pg
WG1-2 Financial and economic analysis	Trainer candidates	NSO	Jonah David	jdavid@pngpower.com.pg
		Finance	Keith Kalama	kkalama@pngpower.com.pg
		Finance	Beda Kuglame	bkuglame@pngpower.com.pg
		Strategic Partnership IPP Development	Jimmy Yareba	jyareba@pngpower.com.pg
		Asset Management	Vera Lama	vlama@pngpower.com.pg
		Asset Management	Cathy Kutkue	ckutkue@pngpower.com.pg
		Strategic Partnership IPP Development	Kero Tom	KTom@pngpower.com.pg

WG2

		Department	Name	E-mail address
	Leader	Transmission and Substation	Simo Kaupa	skaupa@pngpower.com.pg
		Asset Management	Vera Lama	vlama@pngpower.com.pg
WG2-1 Tansmission Line	Trainer candidates	Transmission and Substation	Chris Luther	cluther@pngpower.com.pg
		Transmission and Substation	Ben Kaum	bkaum@pngpower.com.pg
		Transmission and Substation (Ramu)	Roger Tau	rtau@pngpower.com.pg
		Asset Management	Deanne Kilamanu-Naime	dkilamanu-naime@pngpower.com.pg
		Alu (Asset info)	Esorom Passingan	epassingan@pngpower.com.pg
WG2-2 Submission	Trainer candidates	Transmission and Substation	Simon Robert	srobert@pngpower.com.pg
		Informarions & Engineering	Simon Deveo	sdeveo@pngpower.com.pg
		Transmission and Substation	Brian Inamo	binamo@pngpower.com.pg
		Transmission and Substation	Terry Naipu	tnaipu@pngpower.com.pg
		Reliability Engineers & Condition Monit	Rawali Rawali	rrawali@pngpower.com.pg

WG3

		Department	Name	E-mail address
WG3 Protection coordination	Leader	NSO	Ivan Pekaea	ipekaea@pngpower.com.pg
	Trainer candidates	NSO (Protection)	Melvin Angi	mangi@pngpower.com.pg
		NSO (Protection)	Michael Akep	makep@pngpower.com.pg

WG4

		Department	Name	E-mail address
WG4 Human Resource Development	Leader	Recruitment & Performance Management	Andrew Kavanamur	akavanamur@pngpower.com.pg
		Human Resource - Training	Andrew Yuants	ayuants@pngpower.com.pg
	Trainer candidates	NSO	Jonah David	jdavid@pngpower.com.pg
		Transmission and Substation	Chris Luther	cluther@pngpower.com.pg
		NSO (Protection)	Melvin Angi	mangi@pngpower.com.pg

Questionnaires (Baseline Survey)

Working Group Name: Power System Planning

Name: _____ Age _____

Occupation: _____

Position: _____

Division: _____

Department / Enterprise: _____

1. Knowledge possession situation regarding Power System Planning

(1) Do you have an experience of making the following power system plans?

1) Transmission line (T/L) and/or substation expansion project

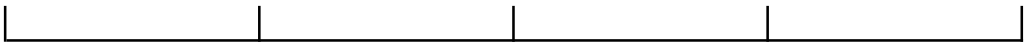
much experienced — experienced — no experience

5 4 3 2 1

2) Long term plan such as 15 years development plan

much experienced — experienced — no experience

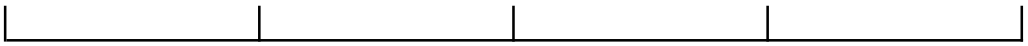
5 4 3 2 1



(2) Do you have an experience to decide the operation starting year and the expansion capacity?

much experienced — experienced — no experience

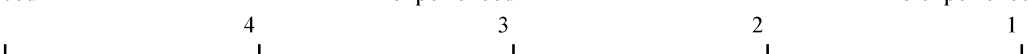
5 4 3 2 1



(3) Do you have an experience to evaluate the power system plan such as transmission line and/or substation expansion project?

much experienced — experienced — no experience

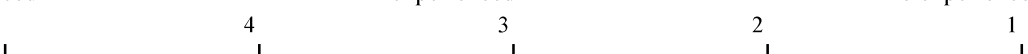
5 4 3 2 1



(4) Do you have experience considering the power generation side plan and reflecting it in the system plan?

much experienced — experienced — no experience

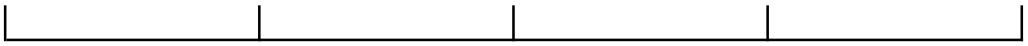
5 4 3 2 1



(5) Do you have experience considering demand assumptions and reflecting them in the system plan?

much experienced — experienced — no experience

5 4 3 2 1



(5) Do you have an experience to revise the power system plan such as 15 years development plan?

much experienced — experienced — no experience

5 4 3 2 1

(6) Do you have an experience to check the project progress based on the power system plan?

much experienced — experienced — no experience

5 4 3 2 1

(7) Do you have an experience to consider the countermeasures when the project is delayed ?

much experienced — experienced — no experience

5 4 3 2 1

(8) Do you have the experience of carrying out power system analysis followings?

1) Power flow calculation

much experienced — experienced — no experience

5 4 3 2 1

2) Short circuit current calculation

much experienced — experienced — no experience

5 4 3 2 1

3) Dynamic stability calculation

much experienced — experienced — no experience

5 4 3 2 1

2. Request to JICA`s Technical Assistance

(1) Please fill in the knowledge or technology you want to learn in this technoloogy transfer.

- .....
- .....
- .....

(2) Pleases fill in anything you request to JICA`s technical cooperation project.

- .....

That's all of our questionnaires. Thank you for your cooperation.

Questionnaires (Baseline Survey)

Working Group Name: Economic and financial analyses

Name: _____ Age _____

Occupation: _____

Position: _____

Division: _____

Department / Enterprise: _____

1. Experience of and knowledge about economic and financial analysis

(1) Job experience and prospect for the finances of the electric utilities

1) Administration of finances of electric utilities such as PPL

well experienced — moderately experienced — little experienced

5 4 3 2 1

2) Government budget allocation to electric utilities

well experienced — moderately experienced — little experienced

5 4 3 2 1

3) Power-tariff setting and/or approval

well experienced — moderately experienced — little experienced

5 4 3 2 1

(2) Do you have experience of economic and financial studies?

1) Sector study (of not only electric power but also other infrastructure)

well experienced — moderately experienced — little experienced

5 4 3 2 1

2) Feasibility study of a specific power project

well experienced — moderately experienced — little experienced

5 4 3 2 1

3) Study on finances of electric utilities (e.g., financial soundness of electric utilities)

well experienced — moderately experienced — little experienced

5 4 3 2 1

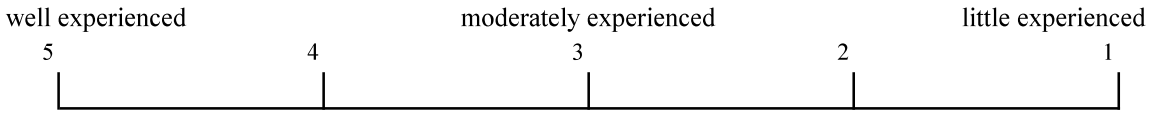
(3) Do you have experience of the following specific analytical works?

1) Analysis of financial statements of electric utilities such as PPL

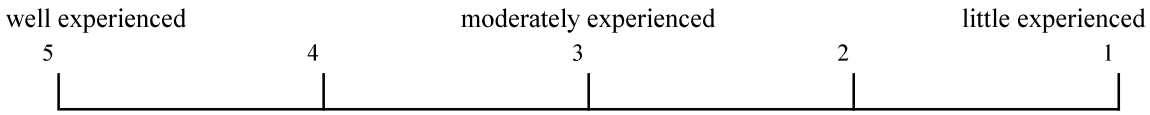
well experienced — moderately experienced — little experienced

5 4 3 2 1

2) Analysis of electricity-tariff levels

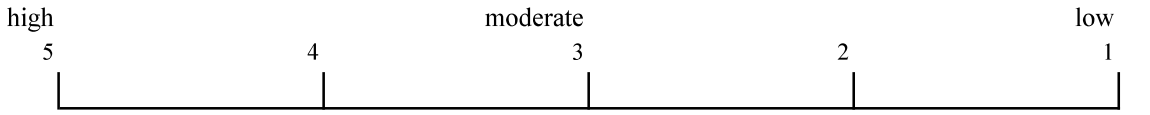


3) Economic and financial analysis of power investment

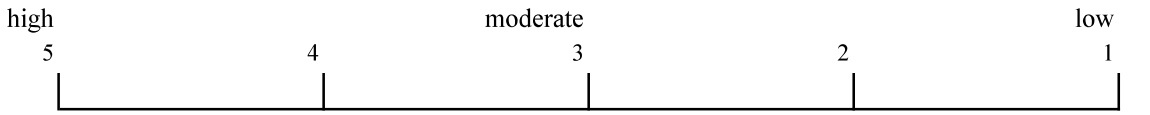


(4) What do you think about your knowledge level in the following fields?

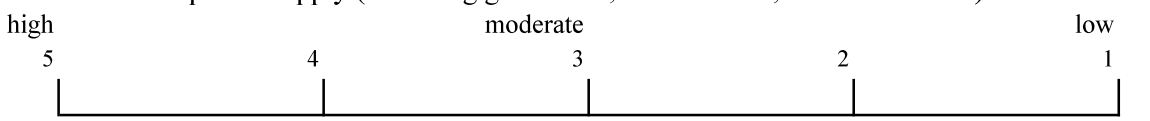
1) Economic and financial evaluation of a power project



2) Corporate accounting (of not only electric utilities but also other business)

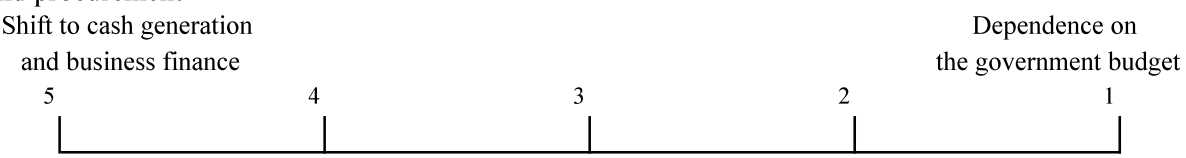


3) Cost evaluation of power supply (including generation, transmission, and distribution)

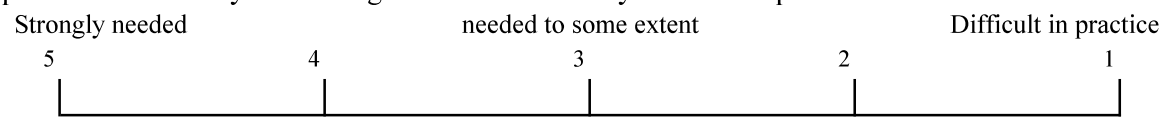


(5) What do you think about the status of PPL in terms of finances?

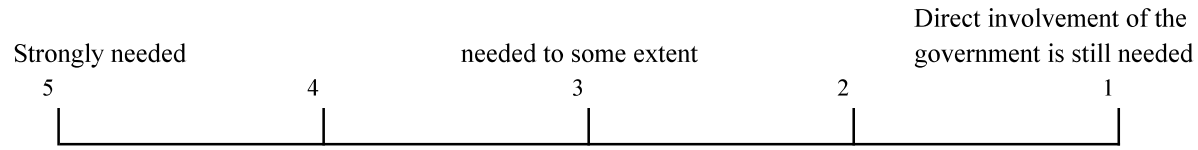
1) Fund procurement



2) Application of ordinary accounting standards commonly used to the private sector



3) Pursuance to financial independence

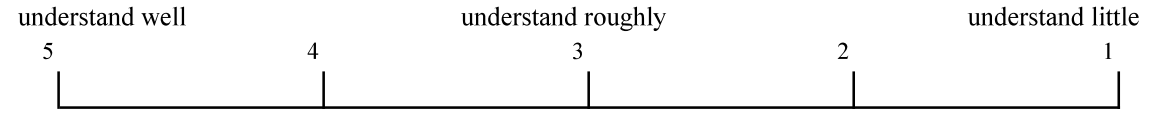


2. Knowledge about technical terms related to economics and finances

(1) Technical terms used to economics

Do you understand the meaning of following technical terms ?

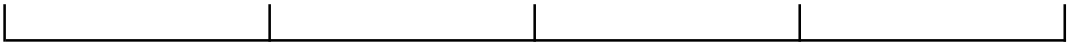
1) Price and cost



2) Marginal cost

understand well — understand roughly — understand little

5 4 3 2 1



3) Value of money in nominal and real terms

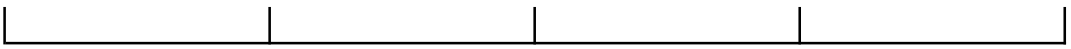
understand well — understand roughly — understand little

5 4 3 2 1

4) Present value

understand well — understand roughly — understand little

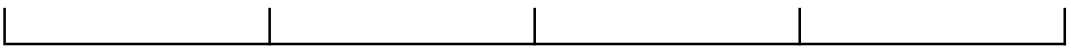
5 4 3 2 1



5) Discount rate

understand well — understand roughly — understand little

5 4 3 2 1



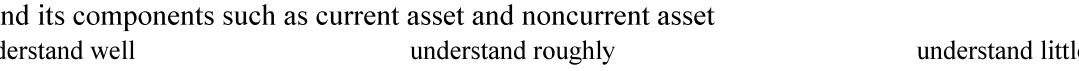
(2) Technical terms used to balance sheet of financial statements

Do you understand the meaning of following technical terms ?

1) Asset and its components such as current asset and noncurrent asset

understand well — understand roughly — understand little

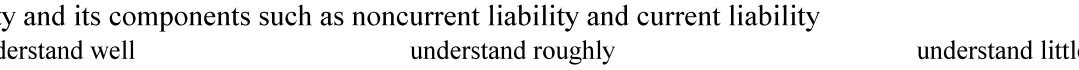
5 4 3 2 1



2) Liability and its components such as noncurrent liability and current liability

understand well — understand roughly — understand little

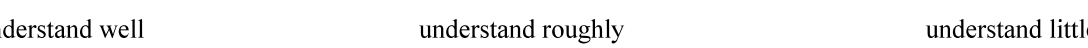
5 4 3 2 1



3) Equity

understand well — understand roughly — understand little

5 4 3 2 1



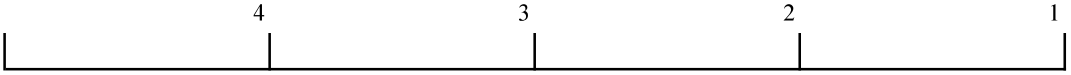
(3) Technical terms used to profit and loss of financial statements

Do you understand the meaning of following technical terms ?

1) Revenue and its components such as operating revenue and non-operating revenue

understand well — understand roughly — understand little

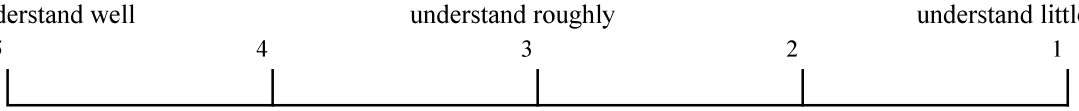
5 4 3 2 1



2) Cost/expense and its components such as cost of sales, selling, general and administrative expenses, and non-operating expense

understand well — understand roughly — understand little

5 4 3 2 1



3) Profit and its variations such as gross profit, operating income, non-operating income, ordinary income, income before tax

understand well — understand roughly — understand little

5 — 4 — 3 — 2 — 1

4) Cash flow

understand well — understand roughly — understand little

5 — 4 — 3 — 2 — 1

(4) Technical terms used to financial analysis

Do you understand the meaning of following technical terms ?

1) Return and its variations such as return-on-asset and return-on-equity

understand well — understand roughly — understand little

5 — 4 — 3 — 2 — 1

3. Request to JICA`s Technical Assistance

(1) Please fill in the knowledge or technology you want to learn in this technology transfer.

- _____
- _____
- _____

(2) Pleases fill in anything you request to JICA`s technical cooperation project.

- _____

That's all of our questionnaires. Thank you for your cooperation.

Questionnaires (Baseline Survey)

Working Group Name: Transmission Line and Substation

Name: _____ Age _____

Occupation: _____

Position: _____

Division: _____

Department / Enterprise: _____

1. The experience of operation and maintenance(O&M) and asset management works regarding Transmission Line / Substation

(1) Do you have an experience of following works by yourself ?

1) Patrol

much experienced — experienced — inexperienced

5 — 4 — 3 — 2 — 1

2) Inspection

much experienced — experienced — inexperienced

5 — 4 — 3 — 2 — 1

3) Asset management

much experienced — experienced — inexperienced

5 — 4 — 3 — 2 — 1

2. Knowledge level regarding Transmission Line / Substation

(1) Do you have enough knowledge about the technical standard for each facility* ?

enough — rough — poor

5 — 4 — 3 — 2 — 1

(2) Do you have enough knowledge about the following items regarding power grids ?

1) Definition of rated voltage, rated capacity, short time overload capacity (current / voltage), short circuit curren and so on of each facility*

enough — rough — poor

5 — 4 — 3 — 2 — 1

2) Relation between current, voltage, power (active and reactive) and phase angle in power grids

enough — rough — poor

5 — 4 — 3 — 2 — 1

(3) Do you have enough knowledge about the role and function of each facility* ?

enough — rough — poor

5 — 4 — 3 — 2 — 1

* Transmission line : E.g. Tower, Pole, Conductor, Insulator, Ground wire, Foundation

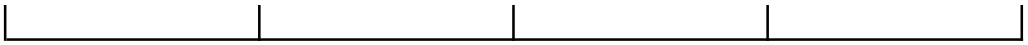
Substation : E.g. Transformer, circuit breaker, cubicle-type switchgear, line switch, instrument transformer, current transformer transformer protection relay

(4) Do you have enough knowledge about following items regarding O&M and asset management works ?

1) Purpose, check points and judgement criteria for the condition of each facility* on patrol

enough — rough — poor

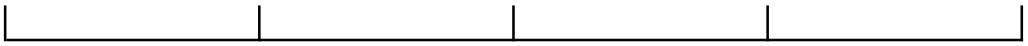
5 4 3 2 1



2) Purpose, check points, safety precaution, functional verification test and values to be controlled for each facilit on inspection

enough — rough — poor

5 4 3 2 1



3) Effectiveness of patrol and inspection to prevent unexpected unplanned outage

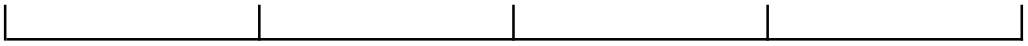
understand well — understand roughly — understand little

5 4 3 2 1

4) Required work area and countermeasures against electric shock for each work, and safety distance to energize conductor for each voltage level to secure labor's safety

enough — rough — poor

5 4 3 2 1



5) Comprehension of drawings and documents required for O&M and asset management works

enough — rough — poor

5 4 3 2 1

(5) Do you have enough knowledge on identifying fault points and developing the recovery policy depending on the cause of faults?

enough — rough — poor

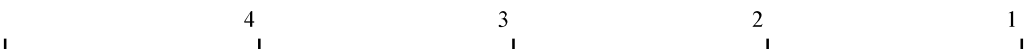
5 4 3 2 1

(6) Do you have enough knowledge about following items regarding measuring insturuments and tools?

1) How to use testing and measuring instruments and maintenance tools that are used during periodic inspectio and patrol in PPL

enough — rough — poor

5 4 3 2 1



2) Importance and necessity of appropriate calibration of measuring instruments

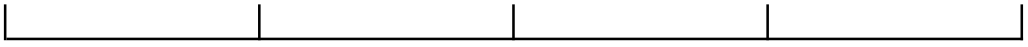
understand well — understand roughly — understand little

5 4 3 2 1

(7) Do you have enough awareness of educating inexperienced staffs on periodic inspections and patrol

enough — rough — poor

5 4 3 2 1



(8) Are you ready to enthusiastically participate in this project?

Yes — So so — No

5 4 3 2 1

2. Request to JICA`s Technical Assistance

（1）Please fill in the knowledge and skills you want to learn in this project.

- .....

- .....

- .....

(2) Pleases fill in anything you request to JICA`s technical cooperation project.

- .....

That's all of our questionnaires. Thank you for your cooperation.

Questionnaires (Baseline Survey)

Working Group Name: Protection Coordination

Name: _____ Age _____

Occupation: _____

Position: _____

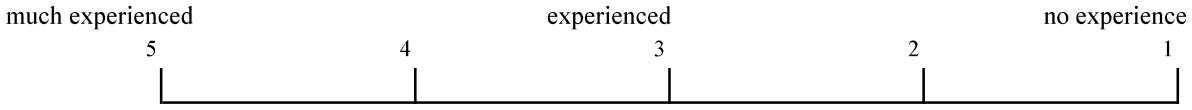
Division: _____

Department / Enterprise: _____

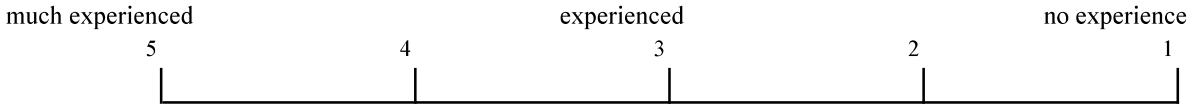
1. Knowledge possession situation regarding Protection Coordination

(1) Do you have experience in studying the following protective relay settings?

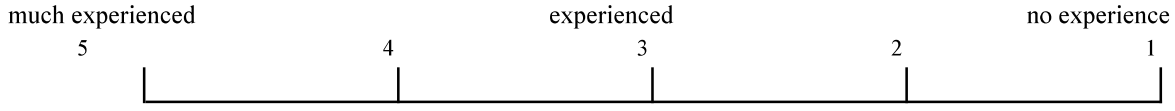
1) Differential relays (transmission line, transformer, bus protection)



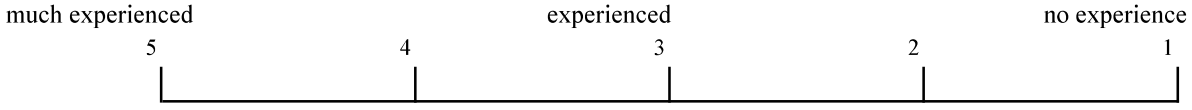
2) Distance relays (transmission line, transformer, bus protection)



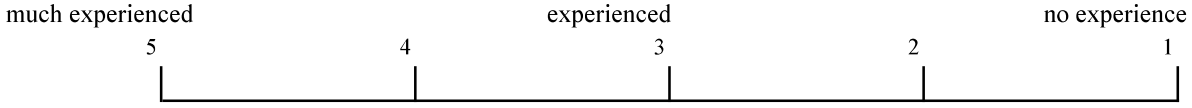
(2) Do you have experience approving protection setting studies?



(3) Do you have experience with power outage analysis?

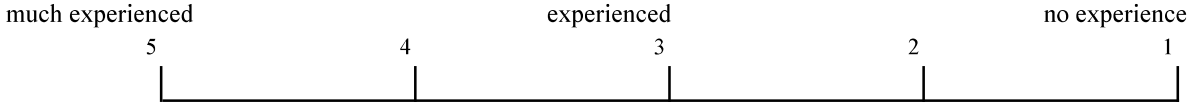


(4) Do you have experience considering countermeasures for protection issues? (Failure of protection)



(5) Do you have experience in conducting power system analysis by using simulation software?

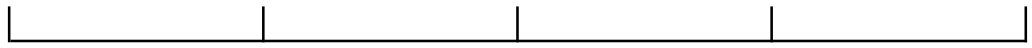
1) Updating power system model



2) Fault calculation

much experienced — experienced — no experience

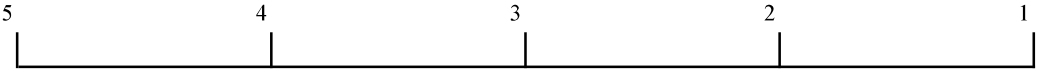
5 4 3 2 1



3) Relay operation check

much experienced — experienced — no experience

5 4 3 2 1

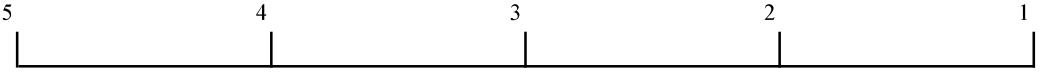


(6) Do you have knowledge of the following keywords related to protection relay settings?

1) Characteristics of differential relays

having perfectly — having roughly — having poorly

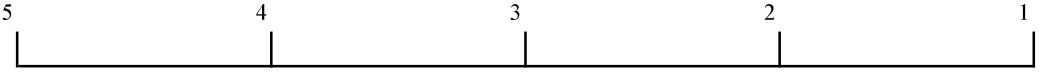
5 4 3 2 1



2) Characteristics of distance relays

having perfectly — having roughly — having poorly

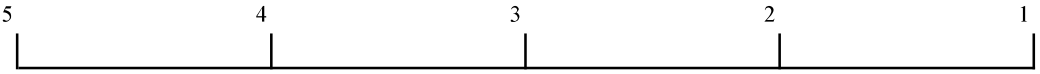
5 4 3 2 1



3) Characteristics of potential transformers (PTs) and current transformers (CTs)

having perfectly — having roughly — having poorly

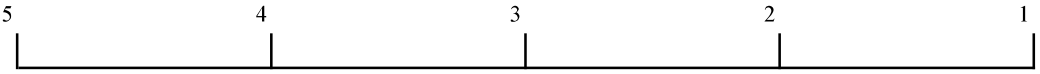
5 4 3 2 1



4) Protection coordination (distance relay / overcurrent relay)

having perfectly — having roughly — having poorly

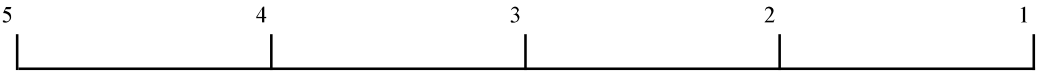
5 4 3 2 1



5) Load avoidance of distance relays

having perfectly — having roughly — having poorly

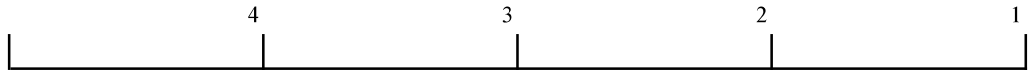
5 4 3 2 1



6) Effect of tee-point infeed

having perfectly — having roughly — having poorly

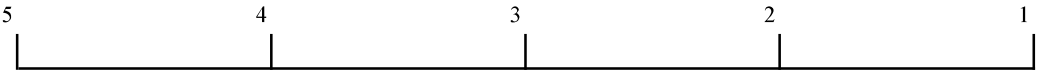
5 4 3 2 1



7) Fail-safe relay

having perfectly — having roughly — having poorly

5 4 3 2 1

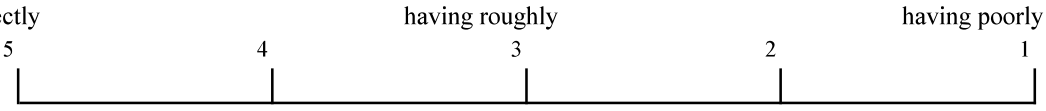


8) N-1 criteria

The idea that even if a component – e.g. a transformer or circuit – should fail or be shut down, network security must be guaranteed

having perfectly — having roughly — having poorly

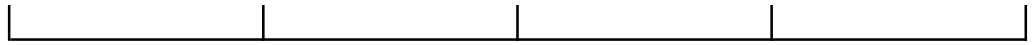
5 4 3 2 1



9) Main / back up protection

having perfectly — having roughly — having poorly

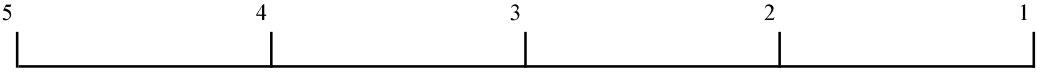
5 4 3 2 1



10) Percent impedance

having perfectly — having roughly — having poorly

5 4 3 2 1

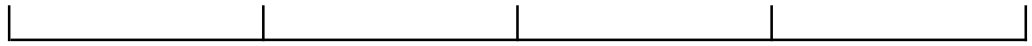


(7) Do you have knowledge of the following operational policies on the power system?

1) Online generation units (Peak / Off-peak)

having perfectly — having roughly — having poorly

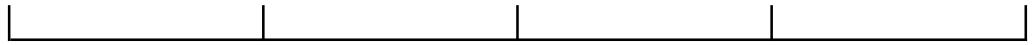
5 4 3 2 1



2) The points of normally open switches or breakers

having perfectly — having roughly — having poorly

5 4 3 2 1



3) How to operate double bus bars (RAMU system)

having perfectly — having roughly — having poorly

5 4 3 2 1

2. Request to JICA`s Technical Assistance

（1）Please fill in the knowledge or technology you want to learn in this technology transfer.

- .....

- .....

- .....

(2) Please fill in anything you request to JICA`s technical cooperation project.

- .....

That's all of our questionnaires. Thank you for your cooperation.

Questionnaires (Baseline Survey)

Working Group Name: Human Resource Development (HRD)

Name: _____ Age _____

Occupation: _____

Position: _____

Division: _____

Department / Enterprise: _____

1. Problems in Human Resource Development

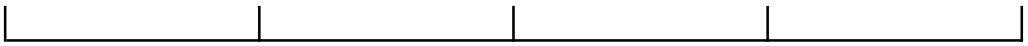
(1) How do you feel about HRD in PPL ?

1) Clarity of HRD policy

very satisfied (5) — somewhat satisfied (4) — neither (3) — somewhat dissatisfied (2) — very dissatisfied (1)

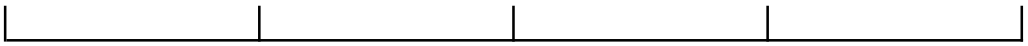
2) Budget

very satisfied (5) — somewhat satisfied (4) — neither (3) — somewhat dissatisfied (2) — very dissatisfied (1)



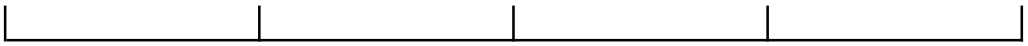
3) Structure of organization

very satisfied (5) — somewhat satisfied (4) — neither (3) — somewhat dissatisfied (2) — very dissatisfied (1)



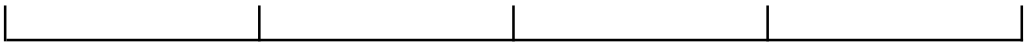
4) Number of employees

very satisfied (5) — somewhat satisfied (4) — neither (3) — somewhat dissatisfied (2) — very dissatisfied (1)



5) Recruitment about expecting employees

very satisfied (5) — somewhat satisfied (4) — neither (3) — somewhat dissatisfied (2) — very dissatisfied (1)



(2) How do you feel about an existing training system ?

1) Does PPL have training system for TECHNICIANS?

Yes No

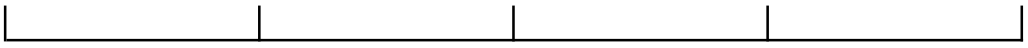
2) Does PPL have training system for ENGINEERS?

Yes No

3) How do you think about making a training schedule considering employees' working schedule?

very satisfied somewhat satisfied neither somewhat dissatisfied very dissatisfied

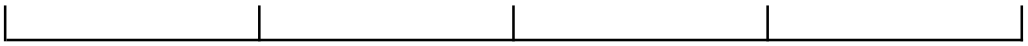
5 4 3 2 1



4) Contents of existing training

very satisfied somewhat satisfied neither somewhat dissatisfied very dissatisfied

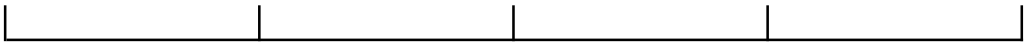
5 4 3 2 1



5) Learning achievement of trainees

very satisfied somewhat satisfied neither somewhat dissatisfied very dissatisfied

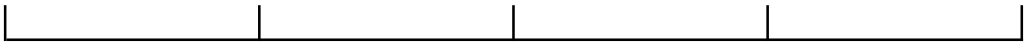
5 4 3 2 1



6) Existing documents (manual, procedure, etc)

very satisfied somewhat satisfied neither somewhat dissatisfied very dissatisfied

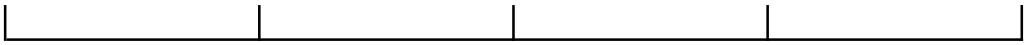
5 4 3 2 1



7) Motivation of trainers in terms of teaching skills

very satisfied somewhat satisfied neither somewhat dissatisfied very dissatisfied

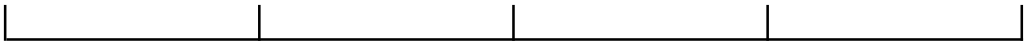
5 4 3 2 1



8) Motivation of trainees in terms of improving their skills

very satisfied somewhat satisfied neither somewhat dissatisfied very dissatisfied

5 4 3 2 1



(3) How do you feel about an existing evaluation system ?

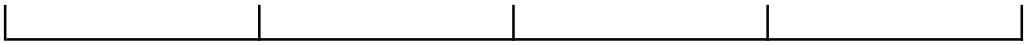
1) Do you have an existing evaluation system for technicians and engineers?

the both only technicians only engineers neither

2) How do you feel about an existing evaluation system for TECHNICIANS ?

very satisfied somewhat satisfied neither somewhat dissatisfied very dissatisfied

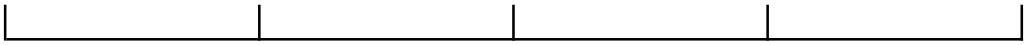
5 4 3 2 1



3) How do you feel about an existing evaluation system for ENGINEERS ?

very satisfied somewhat satisfied neither somewhat dissatisfied very dissatisfied

5 4 3 2 1



4) Does PPL have an opportunity of periodical evaluations

Yes No

5) Does PPL have clarity on an ability evaluation criteria in each position ?

Yes No

2. Request to JICA`s Technical Assistance

(1) Please fill in specific problems or concerns you feel in this technology transfer.

- .....
- .....
- .....

(2) Please fill in anything you request to JICA`s technical cooperation project.

- .....

That's all of our questionnaires. Thank you for your cooperation.

Appendix4

WG1-1

No			01	02	03
Division			Power System Engineering	Power System Engineering	Power System Engineering
Department/ Enterprise			National System Operations	National System Operations	Strategic Business Development & Government Relations
1.Seif-Evaluation Knouwledge possession situation regarding Power System Planning	(1)	1)	1	1	3
		2)	1	2	5
	(2)		1	1	3
	(3)		2	2	4
	(4)		2	1	4
	(5)		2	1	5
	(6)		1	2	5
	(7)		1	1	3
	(8)		1	2	2
	(9)	1)	2	2	3
		2)	2	2	3
		3)	2	2	2
	Average Score		**1.5**	**1.6**	**3.5**
2. Request to JICA's Technical Assistance	(1)		**・ Economic Dispatch Planning ・ Generation, Transmission & Distribution Outage Planning ・ Dynamic Stability Calculation**	**・ Work flow, procedures and processes of system planning ・ Power system analysis procedures and processes**	**Use Power System analysis using PSS/E for grid impact studies Use power system analysis together with GIS tools for proper planning. Do power business analysis or cost related analysis for planed projects**
	(2)		**・ Build Dynamic Model of POM Grid**	**・ Create Procedures for system planning**	Engineers to be sent abroad for proper training for months or even 1-2 years instead of 1-2 weeks training for capacity building.
4. JICA Expert's Evaluation	Knowledge		2.0	3.0	4.0
	Work experience		2.0	3.0	4.0
	Average Score		**2.0**	**3.0**	**4.0**

WG1-1

No			01	02	03	04	05	06	07
Division			System control	Asset management	Programme office	Finance	Asset management BU	SBD BGR	SBD BGR
Department/			National System Operations				Chief operating officer		
1.Seif-Evaluation Experience of and knowledge about economic andfinancial analysis	(1)	1)	2	1	2	5	2	5	2
		2)	2	1	2	4	1	5	1
		3)	1	1	1	3	1	5	1
	(2)	1)	1	1	2	4	1	4	1
		2)	1	1	2	3	2	3	1
		3)	1	1	1	5	1	4	1
	(3)	1)	1	1	1	5	1	5	2
		2)	1	1	1	3	1	5	1
		3)	1	1	1	4	1	5	1
	(4)	1)	2	1	1	4	1	5	1
		2)	1	1	2	4	1	4	1
		3)	1	1	1	4	2	5	1
	(5)	1)	3	1	1	4	4	4	3
		2)	5	3	5	4	3	3	4
		3)	5	5	5	4	4	3	3
2.Seif-Evaluation Knowledge about technical terms related to economics and finances	(1)	1)	2	2	3	4	4	5	4
		2)	1	1	1	4	3	5	3
		3)	1	1	1	4	2	5	2
		4)	1	1	2	4	4	5	2
		5)	1	1	2	4	3	5	1
	(2)	1)	1	1	1	5	2	5	3
		2)	1	1	1	5	2	5	3
		3)	1	2	1	5	3	5	3
	(3)	1)	1	3	2	5	4	5	2
		2)	1	3	3	5	4	5	2
		3)	1	1	2	4	3	5	2
		4)	1	1	2	5	4	5	2
	(4)	1)	1	1	1	4	3	5	2
	Avarage Score		**1.5**	**1.4**	**1.8**	**4.2**	**2.4**	**4.6**	**2.0**
3. Request to JICA's Technical Assistance	(1)		・ As an electrical engineer and being a Senior Managers, I need to learn Financial.	・ Financial & Economic planning & nalysis ・ Human resource development ・ Risk management	・ How to ○○ a program is socioeconomically justified? ・ How to asses non-qualified benefits to applied? ・ Make sound investment decisions for the company & people's best interests.	・ Technical knowledge on procedure analysis ・ Skills upgrade on how to judge an investment project with PPL ・ Understanding the economic viability of a project	・ Improving financial Performance-WACC/RR/RoI ・ Asset Investment Decisions ・ Life cycle costing	- Econimic/Financial forecasting tools must be developed for projects - Corporate Financial model for PNG power is required - Cognitive and analytical skills and technical must be properly taught with realistic demonstration	- The calculation of Levelized cost of energy(LCOE) - The analytics of Finantial Statements - Sensitivity and Risk Analysis (How to make investinment decision)
	(2)		・ I want a case study exercise on PPL's financials etc.	・ Management & leadership	-	・ More practical training required to enhance our skills	・ Conduct the training using case studies and scenarios for PNG Power projects	-	
4. JICA Expert's Evaluation	Knowledge		1.7	1.0	1.7	5.0	1.8	5.0	2.0
	Work experience		1.7	1.0	1.7	5.0	1.8	5.0	1.5
	Average Score		**1.7**	**1.0**	**1.7**	**5.0**	**1.8**	**5.0**	**1.8**

WG2			WG2-1					WG2-2				
No			01	02	03	04	05	06	07	08	09	10
Division			TRANSMISSION & DISTRIBUTION	Transmission & Distribution	RAMU	Asset Management	ASSET INFATUATION MANAGEMENT	INFORMARIONS & ENGINEERING	TRANSMISSION & SUBSTATIONS	T&D	T&D	RELIABILITY ENGINEERS & CONDITION MONITORS
Department/ Enterprise			PNG POWER LTD	Transmission Maintenance POM	TRANSMISSION & DISTRIBUTION	PNG POWER LTD	ASSET MANAGEMENT	ASSET MANAGEMENT	PNG POWER LTD	T&D SPECIALIST OFFICE	PNG POWER LTD	ASSET MANAGEMENT
1.Seif-Evaluation Experience	(1)	1)	3	5	3	1	5	3	3	2	4	3
		2)	3	5	3	1	4	3	3	2	4	3
		3)	3	2	3	3	3	4	3	brank	4	3
2.Seif-Evaluation Knowledge	(1)		3	3	4	2	4	4	3	1	5	4
	(2)	1)	3	4	4	2	5	4	3	1	5	4
		2)	3	4	4	4	5	4	3	2	4	4
	(3)		4	4	4	4	4	4	3	3	5	4
	(4)	1)	4	4	4	3	5	3	3	2	4	4
		2)	3	3	4	1	4	3	3	3	4	4
		3)	4	4	4	3	5	4	3	3	4	4
		4)	3	3	3	1	4	4	3	2	5	4
		5)	3	5	4	4	5	4	3	3	4	4
	(5)		3	4	4	1	3	4	3	3	4	3
	(6)	1)	2	3	4	1	4	3	3	2	4	4
		2)	2	3	4	2	3	3	3	2	4	4
	(7)		3	4	4	2	5	4	3	2	5	4
	(8)		5	5	5	5	5	5	3	5	5	5
	Avarage Score		**3.2**	**3.8**	**3.8**	**2.4**	**4.3**	**3.7**	**3.0**	**2.4**	**4.4**	**3.8**
3.Want to learn			· TRANSMISSION LINES MAINTENANCE · SUBSTATION MAINTENANCE	· Designing Transmission Line, Patrol / Inspection · Quality Checks, Measurering instruments, Drone Inspection · Bidding / Tendering, Safety, Thermal Imaging	· Know different types of towers with voltages ranges. · Voltage drops in conductor on transmission lines. · Thermal imaging of transmission lines.	· Standard preventative maintenance for transmission and substation assets. · Asset management practices for transmission and substation assets. · Transmission and substation assets function.	· Facility information management · Maintenance works - Fault data want cpwealt · Asset management systems	· Transmission & substation asset condition monitoring · Asset management planning	· How to do inspections/checks on power tarnsformers/CBs/CTs/STATCOM and au power equipments. · Period of manitenance on effect equipments	· Transmission line design · Substation equipment design · Fault studies & Power flow studies	· AUTOCADS, STATCOM MAINTENANCE, SUBSTATION · Maintenance of au substation equipments, maintenance · Protects, P/transformer tap change (OLTC) maintenance	· Conditions monitors testings of substation equipment · New maintenance techniqes for substation · Improve on all questions in the questionare
4. Request			· Train us on ant software used fot maintenance if that will be used in this JICA WG PROJECT	· I would like to involve in a project starting from design, construction, testing to commissioning.	· Tower construction to management of lines	· We are currently building our maintenance management system. I would like to see how Kansai's MMST asset hierarchies are organized	· Distribution automation and dorone inspection on transmission lines.	· Transformer & circuit broken condition monitoring	· Assess substation capacity against load for possible upgrade · Trouble shooting techniques · N-1 contingency for transmission lines & transformers	· Asset information models	· Distribution automation, ~~,~,solar energy technical assistance (design < installation)	· Please provide condition monitoring techniques used by Kansai on substation equipment & transmission lines
5. JICA Expert's Evaluation	Knowledge		3.3	2.8	2.3	3.3	3.0	3.7	3.0	3.7	3.0	2.7
	Work experience		3.5	3.0	2.3	3.0	3.0	3.7	3.3	3.7	3.3	3.0
	Average Score		**3.4**	**2.9**	**2.3**	**3.1**	**3.0**	**3.7**	**3.2**	**3.7**	**3.2**	**2.8**

WG3

No			01	02
Division			National System Operation	National System Operation
Department/ Enterprise				
1.Seif-Evaluation Knouwledge possession situation regarding Protection Coordination	(1)	1)	3	3
		2)	3	3
	(2)		3	3
	(3)		3	3
	(4)		3	3
	(5)	1)	2	1
		2)	3	3
		3)	3	3
	(6)	1)	3	3
		2)	3	3
		3)	3	3
		4)	3	3
		5)	3	3
		6)	3	2
		7)	3	2
		8)	4	3
		9)	4	3
		10)	4	3
	(7)	1)	3	3
		2)	3	3
		3)	3	3
	Avarage Score		**3.1**	**2.8**
2. Request to JICA's Technical Assistance	(1)		**Use of protection software application - Protection coordination studies Interfacing protections to SCADA systems for data record analysis Learn fundamental principle of Power Protection System engineering with application of new technology.**	**To be able to do more analysis based on software Adapt new protection schemes especially for transmission lines**
	(2)		**I wish also to learn about automation and control system.**	**Provide resources such a best practices adapted in Japan in the area of proteciton**
4. JICA Expert's Evaluation	Knowledge		2.3	4.3
	Work experience		2.3	4.3
	Average Score		**2.3**	**4.3**

ANNEX6

トレーニングレコード

パプアニューギニア国
電力系統計画・運用能力向上
プロジェクト

トレーニングレコード

表 1. WG1-1 トレーニング内容（オンライン）

日時	内容	受講者
2022/8/22 10:00-11:00	- 基幹系統における系統計画の基本的な考え方 - 日本における系統開発の歴史	Benedicta Savage Charlie Enos
2022/10/3 10:00-11:00	- STATCOM 技術について - 日本における電力市場改編の歴史 - 設備構成の考え方	Benedicta Savage Charlie Enos Haidi Wanya
2022/12/1 12:30 - 13:30	需給計画 -電力系統と系統運用 -経済合理性の追求 資産管理システム -関西電力送配電の資産管理システム 資産管理のための他の手法	Benedicta Savage Charlie Enos Haidi Wanya
2022/1/24 9:00 - 10:00	系統計画のコンセプトと系統解析事例 -系統計画の概要 -系統解析 PSSE を用いた系統解析事例	Benedicta Savage Charlie Enos Haidi Wanya
2023/4/26 10:00 - 11:00	需給制御 -需要曲線 -需給制御 -翌日計画 -周波数制御	Benedicta Savage Charlie Enos Haidi Wanya
2023/6/2 13:15 - 14:15	中部と西日本の系統接続における運用ルール -制御方法 -会社間接続 -周波数品質 -地域間連携 -品質評価	Benedicta Savage Charlie Enos Haidi Wanya
2023/10/10 9:00 - 10:00	再生可能エネルギーの普及拡大に伴う電力系統への影響と課題 -逆潮流の問題と現状 -問題の緩和のための設備対策 -逆潮流の判定方法 -逆潮流の判定業務フロー	Benedicta Savage Charlie Enos Haidi Wanya

表 2.　WG1-1　トレーニング内容（本邦）

日時	内容	受講者
2023/7/25 9:30 - 12:00	（議論）系統連系業務の実態 -PNG のグリッドコード -PPL の業務フロー	Benedicta Savage Charlie Enos Haidi Wanya
2023/7/26 9:30 - 12:00	（講義）系統解析理論 -安定度の概念 -同期安定度 -電圧安定度 -単位法 -Δ-Y 変換 -演習問題	Benedicta Savage Charlie Enos Haidi Wanya
2023/7/27 9:30 - 12:00	（演習）PSS/E を用いた系統解析 -潮流計算 -過渡安定度 -短絡電流	Benedicta Savage Charlie Enos Haidi Wanya
2023/8/1 9:30 - 12:00 13:00 - 16:00	世界銀行の最小費用開発計画の評価 パート 1 -Executive Summary -Background	Benedicta Savage Charlie Enos Haidi Wanya
2023/8/2 9:30 - 12:00 13:30 - 16:00	世界銀行の最小費用開発計画の評価 パート 2 -Updated Least-cost Generation Expansion Study -Main Findings and Recommendations	Benedicta Savage Charlie Enos Haidi Wanya
2023/8/3 10:30 - 12:00 13:00 - 16:00	世界銀行の最小費用開発計画の評価 パート 3 -Major Assumptions for Updating the Least-cost Generation Expansion Study -Load Assumptions Used for the Least-cost Transmission Expansion Study -Transmission Investment Projects	Benedicta Savage Charlie Enos Haidi Wanya

表 3. WG1-1 トレーニング内容（現地）

日時	内容	受講者
2023/2/27 11:00 - 12:00	系統解析 part1 -定態安定度のコンセプト -過渡安定度のコンセプト	Benedicta Savage Charlie Enos Haidi Wanya
2023/2/28 15:00 - 16:00	系統解析 part2 -システム不安定性による大規模停電 -電圧不安定性による停電	Benedicta Savage Haidi Wanya
2023/3/1 13:20 - 14:00	系統解析 part3 -関西電力送配電での系統運用の原則 -500kV 送電線の運用のためのフェンス潮流の制限	Benedicta Savage Charlie Enos Haidi Wanya
2023/3/2 14:00 - 15:00	系統解析 part4 -電力遮断による系統安定度の改善 -SVG を用いた系統安定度の改善 -様々な系統解析手法	Benedicta Savage Charlie Enos Haidi Wanya
2023/11/01 10:00-12:00	- 本渡航目的の説明 - オペレーショナルマニュアル案に関するディスカッション	Benedicta Savage Haidi Wanya
2023/11/02 10:00-12:00	- オペレーショナルマニュアル案に関するディスカッション	Benedicta Savage Charlie Enos Haidi Wanya
2023/11/03 10:00-12:00	- トレーニングマニュアルで使用する PPL の概要紹介資料に関するディスカッション	Benedicta Savage Charlie Enos Haidi Wanya
2023/11/06 10:00-12:00	- トレーニングマニュアルで使用する PPL の概要紹介資料に関するディスカッション	Benedicta Savage Haidi Wanya
2023/11/07 10:00-12:00	- トレーニングマニュアルの内容説明の実施及び修正事項の確認	Benedicta Savage Charlie Enos Haidi Wanya
2023/11/08 10:00-12:00	- IPP（Edevu Hydro Power）が連系する変電所の現地視察	Benedicta Savage Charlie Enos Haidi Wanya
2023/11/09 14:00-16:00	- トレーニングマニュアルの内容説明の実施及び修正事項の確認	Benedicta Savage Haidi Wanya
2023/11/10	- トレーニングマニュアルの内容説明の実施及	Haidi Wanya

10:00-12:00	び修正事項の確認	
2024/2/19 14:00-15:30	- 第 3 回 JCC の概要説明 - 本渡航期間での WG 活動内容の説明	Benedicta Savage Charlie Enos Haidi Wanya
2024/2/21 10:00-12:00	- PSS/E に関するトレーニング (潮流解析、短絡事故解析)	Benedicta Savage Charlie Enos Haidi Wanya
2024/2/23 10:00-12:00	- PSS/E に関するトレーニング (潮流解析、短絡事故解析、動的安定性に関する解析) - POM 系統モデル作成に関するディスカッション	Benedicta Savage Charlie Enos Haidi Wanya
2024/2/28 14:00-15:00	- 次回渡航時期と実施内容に関するディスカッション	Benedicta Savage Charlie Enos Haidi Wanya
2024/7/2 10:00~11:30	- 本渡航期間での TOT の実施内容説明、スケジュールの確認	【トレーナー】 Charlie Enos, Haidi Wanya 【受講生】 Roland Tabu, Gideon Azongni, Heau Samo
2024/7/3 10:00~12:00 14:00~15:00	- ワークショップの概要説明 - ワークショップ資料の確認	Benedicta Savage, Charlie Enos, Haidi Wanya
2024/7/4 14:00~15:30	- トレーナーから受講生への講義 講義内容 「Introduction of PPL」、「Supply and demand planning for economic efficiency」	【トレーナー】 Charlie Enos, Haidi Wanya 【受講生】 Roland Tabu, Gideon Azongni, Heau Samo
2024/7/5 14:00~15:30	- トレーナーから受講生への講義 講義内容 「Concept of Power System Planning」	【トレーナー】 Charlie Enos, Haidi Wanya 【受講生】 Roland Tabu, Gideon Azongni, Heau Samo

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2024/7/8 14:00~15:30	- トレーナーから受講生への講義 講義内容 「Supply and Demand Control」	【トレーナー】 Charlie Enos, Haidi Wanya 【受講生】 Roland Tabu, Gideon Azongni, Heau Samo
2024/7/9 10:00~11:30 14:00~15:30	- ワークショップリハーサル実施	Benedicta Savage, Charlie Enos, Haidi Wanya
2024/7/10 14:00~15:00	- トレーナーから受講生への講義 講義内容 「Influence and Challenges on Power Grid Operation with high Penetration of Renewable Energy」	【トレーナー】 Charlie Enos, Haidi Wanya 【受講生】 Roland Tabu, Heau Samo
2024/7/11 14:00~16:00	- トレーナーから受講生への講義 講義内容 「Asset Management System」 - 理解度確認テスト、アンケート回答	【トレーナー】 Charlie Enos, Haidi Wanya 【受講生】 Roland Tabu, Gideon Azongni, Heau Samo
2024/7/12 終日	- ワークショップ	
2024/7/15 10:00~12:00	- PSS/E 使用方法の復習 - POM 系統の作成に関する演習	Charlie Enos, Haidi Wanya
2024/7/16 10:00~12:00	- 日本の系統計画策定基準の紹介	Benedicta Savage, Charlie Enos, Haidi Wanya
2024/7/17 10:00~12:00	- PPL の系統計画策定基準案の作成演習	Benedicta Savage, Charlie Enos, Haidi Wanya

表 4. WG1-2 経済財務分析 WG のトレーニング内容 （オンライン）

日時	内容	参加者
2022/11/8（火） 13:30 - 15:00	PPL の財務諸表を使った財務分析の演習 ・利益率（粗利、EBIT、最終利益）	Keith Kalama, Beda Kuglame, Cathy Kutkue, Vera Lama
2022/11/9（水） 13:30 - 15:00	PPL の財務諸表を使った財務分析の演習 ・利益率（粗利、EBIT、最終利益） ・自己資本利益率（ROE） ・総資本利益率（ROA）	Keith Kalama, Beda Kuglame, Cathy Kutkue, Vera Lama
2022/11/10（木） 13:30 - 15:00	PPL の財務諸表を使った財務分析の演習 ・負債比率（D/E レシオ） ・インタレスト・カバレッジ・レシオ（ICR）	Keith Kalama, Beda Kuglame, Cathy Kutkue, Vera Lama
2022/11/15（火） 10:3 - 12:00	ソロモン電力の財務諸表を使った財務分析の演習 ・粗利、EBIT、最終利益、ROE、ROA ・D/E レシオ、ICR	Beda Kuglame, Cathy Kutkue, Vera Lama
2022/11/16（水） 13:30 - 15:00	トンガ電力の財務諸表を使った財務分析の演習 ・粗利、EBIT、最終利益、ROE、ROA ・D/E レシオ、ICR	Beda Kuglame, Cathy Kutkue, Vera Lama
2023/1/17（火） 13:30 - 15:00	フィジー電力とインドネシア PLN の 2 社の財務諸表を使った財務諸表分析の演習	Jonah David, Beda Kuglame, Cathy Kutkue
2023/1/18（水） 13:30 - 15:00	同上	Beda Kuglame, Cathy Kutkue, Vera Lama
2023/1/19（木） 13:30 - 15:00	同上	Beda Kuglame, Vera Lama
2023/3/22（水） 13:00 - 15:00	財務分析の演習（PPL の加重平均資本コストの推定と簡単なモデルを使った投資分析）。	Jonah David, Keith Kalama, Beda Kuglame, Cathy Kutkue,
2023/3/23（木） 10:00 - 12:00	財務分析の演習の続き。	Jonah David, Cathy Kutkue
13:00 - 15:00	同上	Beda Kuglame
2023/3/24（金） 10:00 - 11:00	財務分析の演習の続き。	Cathy Kutkue
13:00 - 15:00	財務分析の演習（PPL の加重平均資本コ	Vera Lama

	ストの推定と簡単なモデルを使った投資分析）。	
2023/3/28（火） 13:00 - 15:00	財務分析の演習の続き。	Keith Kalama
2023/3/31（金） 13:00 - 15:00	同上	Vera Lama
2023/4/19（水） 10:00 - 11:30 13:00 - 14:30	エクセルのゴールシークの使い方について講義。 同上	Beda Kuglame, Cathy Kutkue Keith Kalama
2023/4/20（木） 10:00 - 11:30	IRR、NPV を使ったプロジェクト評価の演習	Keith Kalama, Beda Kuglame
13:00 - 14:30	エクセルのゴールシークの使い方について講義。	Vera Lama
2023/4/21（金） 10:00 - 11:30	IRR、NPV を使ったプロジェクト評価の演習の続き。	Keith Kalama, Beda Kuglame
13:00 - 16:30	同上	Cathy Kutkue, Vera Lama
2023/4/24（月） 13:00 - 15:00	エクセルのゴールシークの使い方について講義。	Jonah David
2023/4/26（水） 13:00 - 15:00	IRR、NPV を使ったプロジェクト評価の演習。	Jonah David
2023/5/24（水） 10:00 - 11:30	プロジェクト IRR とエクイティ IRR の違いについて講義。	Jonah David, Cathy Kutkue
13:30 - 15:30	同上	Keith Kalama, Beda Kuglame
2023/5/25（木） 10:00 - 11:30	同上	Vera Lama
13:30 - 15:30	金利と元金返済額の計算について、エクセルとその関数の使い方を講義。その後、演習を実施。	Keith Kalama, Beda Kuglame, Vera Lama
2023/5/26（金） 10:00 - 12:00	同上	Cathy Kutkue
13:00 - 15:00	演習の続き。	Cathy Kutkue
2023/5/30（火） 10:00 - 12:00	金利と元金返済額の計算について、エクセル関数の使い方を講義（補講）．その後、演習を実施。	Jonah David
13:30 - 15:30	演習の続き。	Keith Kalama, Beda Kuglame, Vera Lama

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2023/5/31（水） 10:00 - 12:00	同上（補講）	Jonah David
13:00 - 14:00	同上（補講）	Beda Kuglame
2023/6/13（火） 10:00 - 12:00	演習として不動産とインフラ投資を例にプロジェクトIRRとエクイティIRRを計算。	Cathy Kutkue
13:00 - 15:00	同上	David Jonah, Keith Kamala Beda Kuglame
2023/6/14（水） 10:00 - 12:00	同上	Keith Kamala, Beda Kuglame
13:00 - 15:00	同上	Cathy Kutkue
2023/6/15（木） 13:00 - 15:00	同上	Keith Kalama
2023/6/20（火） 13:30 - 15:30	同上	Vera Lama
2023/6/22（木） 12:00 - 14:00	同上	Jonah David
14:00 - 16:00	同上	Vera Lama
2023/7/17（月） 13:00 - 15:00	同上	David Jonah
2023/9/13（水） 10:00 - 12:00	プロジェクト財務分析の演習	Beda Kuglame, Cathy Kutkue
13:30 - 15:30	同上	Keith Kamala, Vera Lama
2023/9/14（木） 10:00 - 12:00	同上	Beda Kuglame
2023/9/21（木） 10:00 - 12:00	同上	Vera Lama
13:00 - 15:00	同上	Beda Kuglame
2023/9/22（金） 10:00 - 12:00	同上	Cathy Kutkue
2023/9/25（月） 10:00 - 12:00	同上	Beda Kuglame
13:00 - 15:00	同上	Keith Kamala
2023/9/28（木） 10:00 - 12:40	同上	Cathy Kutkue

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13:00 - 15:00	同上	Beda Kuglame
2023/9/29（金） 10:00 - 12:00	同上	Keith Kamala
13:00 - 15:00	同上	Cathy Kutkue
2023/10/2（月） 10:00 - 12:00	同上	Vera Lama
2023/10/6（金） 14:00 - 17:00	同上	Keith Kamala
2023/10/9（月） 13:00 - 16:30	同上	Keith Kamala
2023/10/18（水） 13:30 - 15:30	同上	Vera Lama
2024/3/6（水） 10:00 - 12:00	電力会社の財務諸表を使った分析の演習	Beda Kuglame*, Cathy Kutku*, Belinda Amo, Lillian Amu, Lisoh Masu
2024/3/8（金） 13:30-15:30	同上	Beda Kuglame*, Belinda Amo、Lillian Amu, Samuel Saulep
2024/3/11（月） 13:30-15:30	同上	Beda Kuglame*, Belinda Amo、Lillian Amu, Samuel Saulep
2024/3/12（火） 13:30-14:30	同上	Beda Kuglame*, Cathy Kutkue*, Belinda Amo、Lillian Amu, Samuel Saulep
2024/3/15（金） 10:00 - 12:00	同上（補講）	Beda Kuglame*, Lisoh Masu
2024/3/19（火） 13:30 - 15:30	同上	Beda Kuglame*, Cathy Kutkue*, Belinda Amo, Lisoh Masu
2024/3/20（水） 13:30 – 15:30	同上（補講）	Beda Kuglame*, Lillian Amu, Samuel Saulep
2024/3/22（金） 10:00 - 12:00	プロジェクト財務分析について講義	Beda Kuglame*, Cathy Kutkue*, Lillian Amu, Lisoh Masu, Samuel Saulep
2024/3/25（月） 13:30 - 15:30	同上（補講）	Beda Kuglame*, Cathy Kutkue*, Belinda Amo

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2024/3/26（火） 13:30 - 15:30	プロジェクト財務分析の演習	Beda Kuglame*, Cathy Kutkue*, Belinda Amo, Lillian Amu, Lisoh Masu
2024/3/28（木） 10:00 - 12:00	同上（補講）	Cathy Kutkue*, Beda Kuglame, Samuel Saulep
2024/4/9（火） 13:30 - 15:30	同上	Beda Kuglame*, Cathy Kutkue*, Lillian Amu, Lisoh Masu
2024/4/11（木） 13:30 - 15:30	同上（補講）	Beda Kuglame*, Lillian Amu, Lisoh Masu,
2024/4/17（水） 10:00 - 15:30	同上 （昼食休憩 12:00 – 13:30）	Beda Kuglame*, Cathy Kutkue*, Belinda Amo, Samuel Saulep
2024/4/22（月） 13:30 - 15:30	同上	Beda Kuglame*, Cathy Kutkue*, Belinda Amo, Lillian Amu, Lisoh Masu, Samuel Saulep
2024/4/24（水） 13:30 - 15:30	同上	Beda Kuglame*, Cathy Kutkue*, Belinda Amo, Lillian Amu, Lisoh Masu, Samuel Saulep
2024/5/7（火） 10:00 - 12:00	プロジェクト財務分析の演習とゴールシークの使い方について講義	Beda Kuglame*, Cathy Kutkue*, Belinda Amo, Lillian Amu, Lisoh Masu, Samuel Saulep
2024/5/9（木） 10:00 - 12:00	プロジェクト財務分析の演習	Beda Kuglame*, Cathy Kutkue*, Belinda Amo, Lillian Amu, Samuel Saulep
2024/5/13（月） 13:30 - 15:30	同上（補講）	Beda Kuglame*, Lisoh Masu
2024/5/14（火） 10:00 - 12:00	同上	Beda Kuglame*, Cathy Kutkue*,　Lillian Amu, Samuel Saulep
2024/5/16（木） 13:30 - 15:30	プロジェクト IRR とエクイティ IRR の違いについて講義	Beda Kuglame*, Lillian Amu, Lisoh Masu, Samuel Saulep
2024/5/22（水）	PMT 関数の使い方について講義	Beda Kuglame*, Cathy

13:30 - 15:30		Kutkue*, Lillian Amu, Lisoh Masu, Samuel Saulep
2024/5/24（金） 13:30 - 15:30	元金・利払い計算とプロジェクト財務分析の演習	Beda Kuglame*, Cathy Kutkue*, Lillian Amu, Lisoh Masu, Samuel Saulep
2024/6/4（火） 10:00 - 12:00	プロジェクト IRR とエクイティ IRR 計算の演習	Beda Kuglame*, Cathy Kutkue*, Lillian Amu, Lisoh Masu, Samuel Saulep
2024/6/6（木） 13:30 - 15:30	同上	Beda Kuglame*, Lillian Amu, Lisoh Masu, Samuel Saulep
2024/6/11（火） 13:30 - 15:30	プロジェクト IRR とエクイティ IRR の違いについて講義（補講）	Beda Kuglame*, Cathy Kutkue*, Belinda Amo
2024/6/12（水） 13:30 - 14:30	PMT 関数の使い方について講義（補講）	Beda Kuglame*, Cathy Kutkue*, Belinda Amo
2024/6/13（木） 13:30 - 15:30	元金・利払い計算とプロジェクト財務分析の演習（補講）	Beda Kuglame*, Cathy Kutkue*, Belinda Amo
2024/6/14（金） 13:30 - 14:30	同上	Beda Kuglame*, Cathy Kutku*e, Belinda Amo
2024/6/19（水） 13:30 - 15:45	プロジェクト財務分析の演習	Beda Kuglame*, Belinda Amo, Lillian Amu, Samuel Saulep
2024/6/20（木） 10:00 - 10:40	同上（補講）	Beda Kuglame*, Lisoh Masu,
13:30 - 15:30	同上	Beda Kuglame*, Belinda Amo, Lillian Amu, Lisoh Masu, Samuel Saulep
2024/6/25（火） 13:30 - 15:30	同上	Beda Kuglame*, Belinda Amo, Lillian Amu, Lisoh Masu
2024/6/26（水） 13:30 - 15:30	同上	Beda Kuglame*, Belinda Amo, Lillian Amu, Lisoh Masu, Samuel Saulep
2024/7/3（水） 13:30 - 15:30	If 関数の使い方の講義	Beda Kuglamev, Cathy Kutkue*, Belinda Amo, Lillian Amu, Lisoh Masu, Samuel Saulep
2024/7/5（金） 10:00 - 12:00	プロジェクト財務分析の演習	Beda Kuglame*, Cathy Kutkue*, Belinda Amo, Lillian

		Amu, Lisoh Masu, Samuel Saulep
2024/7/9（火） 13:30 - 15:30	同上	Beda Kuglame*, Cathy Kutkue*, Belinda Amo, Lillian Amu, Lisoh Masu, Samuel Saulep
2024/7/11（木） 13:30 - 15:30	同上	Beda Kuglame*, Cathy Kutkue*, Belinda Amo, Lillian Amu, Lisoh Masu
2024/7/18（木） 13:30 - 15:30	同上	Beda Kuglame*, Cathy Kutkue*, Belinda Amo, Lillian Amu, Lisoh Masu
2024/7/19（金） 13:30 - 15:30	同上	Beda Kuglame*, Cathy Kutkue*, Belinda Amo, Lillian Amu, Lisoh Masu
2024/7/24（水） 13:30 - 15:30	同上（補講）	Beda Kuglame*, Cathy Kutkue*, Samuel Saulep
2024/7/25（木） 13:30-15:30	同上（補講）	Beda Kuglam*e, Cathy Kutkue*, Samuel Saulep
2024/7/31（水） 13:30-15:30	同上	Beda Kuglame*, Cathy Kutkue*, Belinda Amo, Lillian Amu, Lisoh Masu, Samuel Saulep
2024/8/7（水） 13:30 - 15:30	同上	Beda Kuglame*, Cathy Kutkue*, Belinda Amo, Lillian Amu, Lisoh Masu
2024/8/8（木） 13:30 - 15:30	同上	Beda Kuglame*, Cathy Kutkue*, Lillian Amu
2024/8/9（金） 13:30 - 15:30	同上	Beda Kuglame*, Belinda Amo, Lillian Amu, Lisoh Masu
2024/8/13（火） 13:30 - 15:30	同上	Beda Kuglame*, Cathy Kutkue*, Belinda Amo, Lillian Amu, Lisoh Masu
2024/8/15（木） 13:30 - 14:10	同上	Beda Kuglame*, Belinda Amo, Lillian Amu
2024/8/27（火）	ADB のガイドラインに従った財務分析	Beda Kuglame*, Belinda Amo,

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13:30 - 15:20	の講義	Lillian Amu, Lisoh Masu
2024/8/29（木） 13:30 - 15:45	ADB のガイドラインに従った財務分析の演習	Beda Kuglame*, Cathy Kutkue*, Belinda Amo, Lillian Amu, Lisoh Masu
2024/9/4（水） 13:30 - 15:30	同上	Beda Kuglame*, Cathy Kutkue*, Belinda Amo, Lillian Amu, Lisoh Masu
2024/9/5（木） 13:30 - 15:30	プロジェクト財務分析の演習（補講）	Beda Kuglame*, Cathy Kutkue*, Samuel Saulep
2024/9/6（金） 13:30 - 15:30	ADB のガイドラインに従った財務分析の演習	Beda Kuglame*, Cathy Kutkue*, Belinda Amo, Lillian Amu, Lisoh Masu

*/　講師

表 5.　WG1-2 経済財務分析 WG のトレーニング内容　（日本研修）

日時	内容	受講者
2023/7/24（月） 15:00 - 18:00	研修工程についての概略説明	David Jonah Keith Kamala Beda Kuglame Cathy Kutkue Vera Lama
2023/7/25（火） 9:00 - 12:00	プロジェクト財務分析の演習	
2023/7/26（水） 9:00 - 12:00	同上	
2023/7/27（木） 9:00 – 12:00	if 関数の使い方について講義 モデルに if 関数を組み込んだプロジェクト財務分析の演習	
2023/7/31（月） 13:00 - 15:00	報告書作成の説明	
2023/8/1（火） 13:00 - 16:00	研修報告書案の作成	
2023/8/2（水） 13:45 - 16:00	研修報告書の完成	
2023/8/3（木） 10:30 - 16:30	モデル上で複雑な条件を判断させるために、複数の if 関数を組み込むことの演習	

表 6. WG1-2 経済財務分析 WG のトレーニング内容 （現地）

日時	内容	参加者
2022/10/14（金） 9:30-11:00	財務諸表について講義 ・財務諸表の重要性 ・仕分け ・利益とキャッシュフロー	David Jonah, Keith Kalama, Cathy Kutkue, Vera Lama
11:00-12:00	同上	Beda Kuglame, Jimmy Yareba
2022/10/17（月） 14:00-15:00	財務諸表について講義 ・貸借対照表	David Jonah, Cathy Kutkue
15:00-16:00	財務諸表について講義 ・貸借対照表 ・損益計算書	Keith Kalama, Beda Kuglame
2022/10/18（火） 11:00-12:00	同上	Vera Lama
13:30-15:00	財務諸表について講義 ・キャッシュフロー	Keith Kalama, Cathy Kutkue, Beda Kuglame
2022/10/19（水） 11:00-12:00	同上	David Jonah, Vera Lama
13:30-15:00	財務諸表の分析について講義 ・利益率 ・ROE、ROA ・ICR	David Jonah, Keith Kalama, Beda Kuglame, Cathy Kutkue, Vera Lama
2023/2/20（月） 13:30 - 15:00	投資プロジェクトの財務分析について講義。分析で使う用語としてキャッシュフロー、割引率、現在価値（PV）などの概念を説明。	Jonah David
2023/2/21（火） 10:00 - 12:00	同上	Beda Kuglame, Cathy Kutkue
13:30 - 15:00	同上	Vera Lama
2023/2/22（水） 10:00 - 12:00	引き続き投資プロジェクトの財務分析について講義。正味現在価値（NPV）の計算方法とエクセルの組み込み関数の使い方を説明し、演習を実施。	Beda Kuglame, Cathy Kutkue
13:30 - 15:00	同上	Jonah David, Vera Lama

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2023/2/28（火） 10:00 - 12:00	内部収益率（IRR）およびハードルレートと加重平均資本コスト（WACC）の概念とその計算方法について講義。その後、演習を実施。	Jonah David, Beda Kuglame, Cathy Kutkue, Vera Lama
2023/3/1（水） 10:00 - 12:00	元利金返済カバー率（DSCR）、インタレスト・カバレッジ・レシオ（ICR）、負債資本倍率（D/E レシオ）および二つの IRR（エクイティ IRR とプロジェクト IRR）についてその考え方を講義。その後、演習を実施。	Jonah David, Beda Kuglame, Cathy Kutkue, Vera Lama
13:30 - 15:30	同上	Jonah David
2023/3/2（木） 10:00 - 12:00	投資分析についての演習	Jonah David, Beda Kuglame, Cathy Kutkue, Vera Lama
2023/10/31（火） 10:00 - 12:00	ADB の財務分析ガイドラインの講義	Keith Kamala, Beda Kuglame
2023/11/1（水） 10:00 - 12:00	同上	Cathy Kutkue
15:30 - 17:00	同上	Vera Lama
2023/11/2（木） 10:00 - 12:00	ADB ガイドラインに従った財務分析の演習	Cathy Kutkue
14:00 - 16:00	同上	Keith Kamala, Vera Lama
2023/11/3（金） 10:00 - 13:00	同上	Cathy Kutkue
13:00 - 16:00	同上	Keith Kamala, Beda Kuglame Vera Lama
2023/11/6（月） 10:00 - 12:00	同上	Beda Kuglame, Cathy Kutkue
14:00 - 16:00	同上	Keith Kamala, Beda Kuglame
2023/11/7（火） 10:00 - 12:00	同上	Keith Kamala, Beda Kuglame
14:00 - 16:00	同上	Keith Kamala, Beda Kuglame Vera Lama
2023/11/8（水） 10:00 - 12:00	同上	Beda Kuglame, Cathy Kutkue

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2023/11/9（木） 10:00 - 12:00	同上	Beda Kuglame
14:00 - 16:00	ADB の経済分析ガイドラインの講義	David Jonah, Keith Kamala Beda Kuglame, Cathy Kutkue Vera Lama
2023/11/10（金） 10:00 - 12:00	ADB の財務分析ガイドラインの講義	David Jonah
14:00 - 17:00	ADB ガイドラインに従った経済分析の演習	David Jonah, Keith Kamala Beda Kuglame, Cathy Kutkue Vera Lama
2023/11/13（月） 10:00 - 12:00	同上	David Jonah, Vera Lama
14:00 - 16:30	同上	Keith Kamala, Beda Kuglame Cathy Kutkue
2023/11/14（火） 10:00 - 11:00	同上	Keith Kamala, Beda Kuglame Cathy Kutkue
14:00 - 15:00	研修マニュアル、研修資料およびシラバスの説明	David Jonah, Keith Kamala Beda Kuglame, Cathy Kutkue Vera Lama
2023/11/15（水） 10:00 - 12:00	ADB ガイドラインに従った財務分析の演習	David Jonah
14:00 - 16:30	同上	David Jonah
2024/2/16（金） 10:00 - 11:30	新講師に対する第 3 年次研修の全体説明と意見交換	Beda Kuglame*, Cathy Kutkue*, Keith Kalama
2024/2/19（月） 11:00 - 15:30	講義と演習の進め方についての意見交換 （昼食休憩 12:00 – 13:30）	Beda Kuglame*, Cathy Kutkue*
2024/2/20（火） 10:00 – 10:30	オリエンテーション打合せ	Beda Kuglame
14:00 - 15:30	新研修生に対するオリエンテーションの実施	Beda Kuglame*, Cathy Kutkue*, Belinda Amo, Lillian Amu, David Ngayam
2024/2/21（水） 10:30 - 11:15	講義打合せ	Beda Kuglame*
14:00 - 16:00	財務諸表について講義	Beda Kuglame*, Cathy Kutkue*, Belinda Amo, Lillian

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		Amu, Ngayam David, Lisoh Masu, Samuel Saulep
2024/2/22（木） 14:00 - 16:00	同上	Beda Kuglame*, Cathy Kutkue*, Belinda Amo, Lillian Amu, Ngayam David, Samuel Saulep, Lisoh Masu
2024/2/23（金） 13:30 - 15:30	財務諸表分析について講義	Beda Kuglame*, Cathy Kutkue*, Belinda Amo, Lillian Amu, Lisoh Masu, Samuel Saulep,
2024/2/28（火） 10:00-11:30	同上	Beda Kuglame*, Ngayam David
14:00 - 15:00	同上	Beda Kuglame*, Cathy Kutkue*, Belinda Amo, Lillian Amu, Ngayam David, Lisoh Masu, Samuel Saulep
2024/2/29（水） 13:30 - 15:30	同上	Beda Kuglame*, Cathy Kutkue*, Belinda Amo, Lillian Amu, Ngayam David, Lisoh Masu, Samuel Saulep

*/　講師

表 7.　WG2-1　送電 WG のトレーニング内容（オンライン）

日時	内容	参加者
2022/9/1 14:00 - 16:00	・架空送電線の保守	Chris Luther, Ben Kaum Deanne Kilamanu-Naime Esorom Passingan
2022/11/25 13:00 - 15:00	・鉄塔および基礎の設計思想	Chris Luther, Ben Kaum Deanne Kilamanu-Naime Esorom Passingan
2022/12/20 13:00 - 15:00	・理解度確認テスト解説 ・絶縁設計の考え方 ・理解度確認テスト	Chris Luther, Ben Kaum Deanne Kilamanu-Naime
2023/2/2 10:00 - 12:00	・架空送電線の設備異常評価と点検について ・関西送配電と PPL のメンテナンスオフィスの比較	Chris Luther, Ben Kaum Deanne Kilamanu-Naime Esorom Passingan
2023/4/13 10:00 - 12:00	・アセットマネジメントシステムについて ・グリッドマップの効果的な活用方法	Chris Luther, Ben Kaum Esorom Passingan
2023/6/21 10:00 - 12:00	・架線張力計算方法 ・電線弛度の計算方法	Chris Luther, Ben Kaum Esorom Passingan
2023/6/28 10:00 - 12:00	・鉄塔設計書から確認できるポイント	Chris Luther, Ben Kaum Esorom Passingan
2023/9/21 10:00 - 12:00	・電線張力・弛度計算プログラムの使用方法	Chris Luther, Ben Kaum Esorom Passingan
2024/4/11 10:00 - 12:00	・送電設備管理の手法に関するトレーニング	Chris Luther, Ben Kaum Esorom Passingan Deanne Kilamanu-Naime
2024/4/25 10:00 - 12:00	・送電設備保守に関する演習形式のトレーニング	Chris Luther, Ben Kaum Esorom Passingan Deanne Kilamanu-Naime

表 8.　WG2-1　トレーニング内容（本邦）

日時	内容	受講者
2023/7/25 9:00 - 12:00	・新入社員訓練状況の視察 （関西電力送配電研修センター）	Chris Luther Ben Kaum Esorom Passingan
2023/7/25 14:00 - 16:00	・500kV 送電鉄塔の視察 （関西電力送配電　猪名川変電所）	Chris Luther Ben Kaum Esorom Passingan
2023/7/26 10:00 - 11:30	・275kV 送電鉄塔建設現場の視察 （関西電力送配電　新加古川線建設現場）	Chris Luther Ben Kaum Esorom Passingan
2023/7/26 13:30 - 16:00	・送変電設備保守センターの視察 （関西電力送配電　野江電力所）	Chris Luther Ben Kaum Esorom Passingan
2023/7/26 10:00 - 12:00	・送電線架線張力および弛度の計算方法 （関西電力送配電本店）	Chris Luther Ben Kaum Esorom Passingan
2023/8/3 10:00 - 12:00	・送電設備巡視点検における着眼点、チェックリストの使用方法 （沖縄電力本店）	Chris Luther Ben Kaum Esorom Passingan

表 9. WG2-1 送電 WG のトレーニング内容（現地）

日時	内容	参加者
2023/2/27 13:30 - 15:30	・送電線に関する巡視点検業務について	Ben Kaum Esorom Passingan Daenne Kilamanu-Naime
2023/2/28 10:30 - 12:00	・理解度確認テスト （１年次内容）	Ben Kaum Esorom Passingan Chris Louger
2023/11/14 10:00 - 15:00	・トレーニングスケジュールの共有 ・トレーニングマニュアルドラフト版の共有	Chris Luther, Ben Kaum Deanne Kilamanu-Naime
2023/11/15 10:00 - 15:00	・巡視点検の実施方法、チェックリストの使い方に関する復習 ・現地鉄塔による巡視・点検の実地トレーニング	Chris Luther, Ben Kaum Deanne Kilamanu-Naime
2023/11/17 10:00 - 15:00	・ロープやプーリーの使用方法	Chris Luther, Ben Kaum Deanne Kilamanu-Naime
2023/11/20 10:00 - 15:00	・長期巡視・点検計画の策定方法	Chris Luther, Ben Kaum Esorom Passingan Deanne Kilamanu-Naime
2023/11/22 10:00 - 15:00	・距離測定器の使用方法に関する実地トレーニング	Chris Luther, Ben Kaum Esorom Passingan Deanne Kilamanu-Naime
2023/11/23 10:00 - 15:00	・距離測定器で測定した距離を用いた電線張力や弛度の計算方法 ・停電時の安全措置方法	Chris Luther, Ben Kaum Esorom Passingan Deanne Kilamanu-Naime
2024/5/29 10:00 - 15:30	・鉄塔・基礎・絶縁設計思想に関するトレーニングの復習	Chris Luther, Ben Kaum Esorom Passingan Deanne Kilamanu-

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		Naime
2024/5/30 10:00 - 15:30	・巡視点検の実施方法、チェックリストの使い方に関する復習 ・現地鉄塔による巡視・点検の実地トレーニング	Chris Luther, Ben Kaum Esorom Passingan Deanne Kilamanu-Naime
2024/6/2 10:00 - 14:00	・タワーホーム、エンジンウィンチの実地トレーニング	Ben Kaum, Some transmission linemen
2024/6/5 13:00 - 15:00	・鉄塔・基礎の設計思想 (講義、演習)	Deanne Kilamanu-Naime, Esorom Passingan
2024/6/6 10:00 - 12:00	・絶縁の設計思想 (講義、演習)	Ben Kaum
2024/6/6 13:00 - 15:00	・電線・ダンパーの設計思想 (講義、演習)	Chris Luther,
2024/6/10 10:00 - 15:00	・巡視点検を通じた架空送電線の保守 (講義、演習)	Chris Luther, Ben Kaum
2024/6/11 10:00 - 15:00	・巡視点検 ・巡視点検結果の報告 (実地トレーニング)	Everyone
2024/6/12 10:00 - 12:00	・工具・機材の使用方法 (実地トレーニング) ・圧縮器の実地トレーニング	Ben Kaum
2024/6/12 14:00 - 15:00	安全管理 (講義)	Ben Kaum
2024/6/13 14:00 - 15:00	架空送電線の設備管理 (講義、討論)	Deanne Kilamanu-Naime Esorom Passingan
2024/6/14 10:00 - 12:00	最終試験	-

表 10.　WG2-2 変電 WG のトレーニング内容（オンライン）

日時	内容	参加者
2022/12/15 9:00-11:00	・関西送配電における制御システムと遠方監視（SCADA）システムについて説明	Simon Deveo, Simon Robert Rawali Rawali, Brian Inamo Terry Naipu, Deanne Kilamanu-Naime
2022/12/15 13:00-15:00	・関西送配電と PPL の設備実態の相違点を明確にした上で、関西送配電における予防保全の考え方と概要について説明	同上
2022/12/16 9:00-11:00	同上	同上
2022/12/16 13:00-15:00	・変圧器の異常診断に係る絶縁油の分析について説明	同上
2023/5/19 10:00-12:00 14:00-16:00	・変圧器の並列運転について ・Ar 漏れ電流測定について ・直流接地探査について	Brian Inamo, Simon Deveo Simon Robert, Tery Neipu Rawali Rawali
2023/6/28 14:00-16:00	マニュアルの作成について - 関西電力送配電（株）における各マニュアルの構成について	Simon Deveo, Simon Robert, Rawali Rawali

表 11. WG2-2 変電 WG のトレーニング内容（本邦）

日時	内容	参加者
2023/7/25 9:00-12:00	関西送配電（株）研修センター視察 - 新入社員研修視察 - 訓練設備視察	Simon Deveo, Simon Robert Rawali Rawali, Brian Inamo Terry Naipu
2023/7/25 14:00-16:00	関西送配電（株）猪名川変電所視察 - 500kV 変電所の概要	同上
2023/7/26 9:00-12:00	（講義）理解度確認テスト - 直流接地事故点探査、避雷器漏れ電流測定の理解度テスト （議論）マニュアル作成について - 関西電力送配電（株）における各マニュアル類について紹介	同上
2023/7/26 14:00-16:00	関西送配電（株）野江電力所（保全拠点）視察 - 関西電力送配電（株）におけるメンテナンス体制の視察 - アセットマネジメントシステム視察	同上
2023/7/27 9:00-12:00	関西送配電（株）事故復旧訓練視察 - 変圧器事故復旧訓練の視察 - 危険予知活動等、安全対策の視察	同上
2023/8/1 9:00-16:00	（講義）変電設備の基礎知識 - 変圧器負荷時タップ切替装置の構造と動作 - ガス遮断器の構造と開閉特性試験	同上
2023/8/2 9:00-16:00	（講義）変電所の構成について - 関西送配電（株）における標準的な変電所構成について	同上
2023/8/3 9:00-12:00	（講義）供与機材の原理と使用方法 - SF6 ガスリーク検出装置 - 絶縁油性能試験器	同上

表 12.　WG2-2 変電 WG のトレーニング内容（現地）

日時	内容	参加者
2023/2/2 10:00-16:00	・Technical Specification と総体的な設計思想 ・変圧器の運転温度と寿命の関係	Simon Robert, Tery Neipu, Rawali Rawali
2023/2/28 10:00-12:00	・日常巡視点検と竣工検査時のチェック項目、留意点	Simon Deveo, Simon Robert Tery Neipu, Rawali Rawali
2023/3/1 10:00-12:00	・遮断器不動作時の調査項目と注意点、様々なケース	Brian Inamo, Simon Deveo Simon Robert, Tery Neipu Rawali Rawali
2023/3/1 10:00-12:00	・蓄電池の劣化と診断方法 ・変圧器 OLTC 故障時の原因調査項目と留意点	Brian Inamo, Simon Deveo Simon Robert, Tery Neipu Rawali Rawali
2023/3/2 10:00-12:00	・変圧器の並列運転条件と注意点 ・ジグザグ変圧器の使用目的と地絡事故検出方法 ・保護リレーシステムの時限協調について(メカ型リレーとディジタルリレーの違い)	Brian Inamo, Simon Robert Tery Neipu
2023/11/14 11:00-15:00	・キックオフミーティング ・変圧器絶縁油の劣化判定試験について	Simon Deveo, Simon Robert, Brian Inamo, Terry Naipu, Rawali Rawali
2023/11/15 10:00-16:00	・パッキンとガスケットの概要 ・ガスケットの施工方法 ・ドアガスケット概要と施工方法 ・変電所の小動物対策について ・巡視点検の項目とチェックポイント、判断基準	Simon Deveo,　Simon Robert, Brian Inamo, Terry Naipu, Rawali Rawali
2023/11/17 10:00-15:00	供与資機材トレーニング（実機） ・バッテリーテスター ・直流接地探査器	Simon Deveo, Simon Robert, Terry Naipu, Rawali Rawali
2023/11/20 10:00-15:30	・巡視点検チェック表の使用方法 ・SOP 作成実習 ・変圧器絶縁油の劣化判定試験に関するペーパーテスト	Simon Deveo, Simon Robert, Terry Naipu, Rawali Rawali
2023/11/22	供与資機材トレーニング（実機）	Simon Deveo, Simon Robert,

10:00-15:00	・絶縁油耐圧試験器 ・絶縁油酸価測定器 ・パテ、コーキング、ガスケット	Terry Naipu, Rawali Rawali
2023/11/23 10:00-12:00	・巡視点検トレーニング（実機）	Simon Robert, Terry Naipu, Rawali Rawali
2024/2/28 10:00-11:00	変電設備点検における管理値（クライテリア）の考え方	Simon Deveo, Rawali Rawali, Deanne Kilamanu-Naime(WG2-1)
2024/2/29 10:00-12:00	・ＥＩＣと部分放電測定 ・移動用設備の運用について ・データの蓄積と不具合対応 ・メンテナンス頻度の見直し（関西送配電における 事例の紹介）	Simon Deveo,　Simon Robert, Brian Inamo, Terry Naipu, Rawali Rawali
2024/5/8 10:00-12:00	Training of Trainer (TOT)の進め方について ・TOT の目的 ・トレーニングの効果、重要性 ・トレーナーの心得と資質 ・第７次渡航でのトレーニングの進め方	Simon Deveo, Rawali Rawali, Terry Naipu ＊欠席者（Simon Rebert, Brian Inamo）については、後日フォローを実施。
2024/6/4 14:00-16:00	・避雷器漏れ電流測定器の原理と使用方法 ・SF6 ガスリークディテクターの使用方法（フォロー）	Simon Deveo, Simon Robert, Rawali Rawali
2024/6/5 14:00-16:00	巡視点検の目的とチェック項目、クライテリア（机上講義）	【トレーナー】Simon Deveo, Rawali Rawali 【受講生】I. Muduka 【参加者】S. Robert
2024/6/10 10:00-16:00	巡視点検の目的とチェック項目、クライテリア（机上講義）	【トレーナー】Simon Robert, Terry Naipu, Braian Inamo 【受講生】Iduhu Muduka , Hitoro Timoji 【参加者】Rawali Rawali

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2024/6/12 10:00-16:00	巡視点検（実機を使用し、模擬的に実施）	【トレーナー】Simon Deveo, Rawali Rawali, Simon Robert, Terry Naipu, Brian Inamo 【受講生】Iduhu Muduka , Hitoro Timoji, Benjyamin Pupu
2024/6/5 10:00-12:00	・直流地絡点探査器の原理と使用方法 (机上講義) ・バッテリーテスタの原理と使用方法 (机上講義)	【トレーナー】Simon Deveo, Rawali Rawali 【受講生】Iduhu Muduka, Benjyamin Pupu 【参加者】Simon Robert
2024/6/6 10:00-12:00	・直流地絡点探査器の原理と使用方法 (現地講義) ・バッテリーテスタの原理と使用方法 (現地講義)	【トレーナー】Simon Deveo, Rawali Rawali 【受講生】Iduhu Muduka, Benjyamin Pupu 【参加者】Simon Robert
2024/6/11 10:00-12:00	・避雷器漏れ電流測定器の原理と使用法（机上講義） ・SF6 ガスリークディテクターの原理と使用方法（机上講義）	【トレーナー】Brian Inamo 【受講生】Iduhu Muduka, Hitoro Timoji 【参加者】Simon Deveo, Simon Robert, Rawali Rawali, Terry Naipu
2024/6/11 14:00-16:00	・避雷器漏れ電流測定器の原理と使用法（現地講義） ・SF6 ガスリークディテクターの原理と使用方法（現地講義）	【トレーナー】Brian Inamo 【受講生】Iduhu Muduka, HirotoTimoji 【参加者】Simon Deveo, Simon Robert, Rawali Rawali, Terry Naipu
2024/6/13 10:00-12:00	・絶縁油酸価測定器の原理と使用方法（机上講義） ・オイルテスターの原理と使用方法（机上講義）	【トレーナー】Simon Robert, Terry Naipu 【受講生】Iduhu Muduka, Hitoro Timoji, Benjyamin Pupu, Kisso Itali, Gabriel Pilat 【参加者】Simon Deveo, Rawali Rawali
2024/6/13 14:00-16:00	・絶縁油酸価測定器の原理と使用方法（現地講義）	【トレーナー】Simon Robert, Terry Naipu

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	・オイルテスターの原理と使用方法（現地講義）	【受講生】Iduhu Muduka, Hitoro Timoji, Benjyamin Pupu 【参加者】Simon Deveo, Rwali Rawali
2024/6/18 10:00-15:30	ワークショップ	Simon Deveo, Simon Robert, Terry Naipu, Rawali Rawali

表 13.　WG3 保護協調 WG のトレーニング内容（オンライン）

日時	内容	受講者
2022/9/14 09:00～10:00	・沖縄の電力系統概要 ・保護リレー概要	Melvin Angi Michael Akep
2022/9/26 09:00～10:30	・保護リレー概要	Melvin Angi Michael Akep
2022/11/18 09:00～10:30	・距離リレー整定 part 1	Melvin Angi Michael Akep
2022/12/7 01:00～02:30	・距離リレー整定 part 2	Melvin Angi Michael Akep
2023/10/20 13:00～14:00	・インピーダンス計算方法(架空送電線)	Melvin Angi Michael Akep
2023/10/20 14:00～15:30	・差動リレー整定方法	Melvin Angi Michael Akep

表 14.　WG3 保護協調 WG のトレーニング内容（本邦研修）

日時	内容	受講者
2023/7/25 09:30～12:00	・CT 比検討方法	Melvin Angi Michael Akep
2023/7/26 09:30～12:00	・インピーダンス計算方法(地中送電線)	Melvin Angi Michael Akep
2023/7/27 09:30～12:00	・事故分析方法	Melvin Angi Michael Akep
2023/8/1 09:30～11:30	・沖縄電力の系統概要	Melvin Angi Michael Akep
2023/8/1 13:30～15:30	・給電指令所の概要	Melvin Angi Michael Akep
2023/8/2 09:30～11:30	・系統安定化システム概要	Melvin Angi Michael Akep
2023/8/2 14:00～15:00	・メガソーラー実証研究	Melvin Angi Michael Akep
2023/8/3 09:30～11:30	・リレー整定技術計算システム概要	Melvin Angi Michael Akep

表 15.　WG3 保護協調 WG のトレーニング内容（現地）

日時	内容	受講者
2023 /2 /20 10:00～12:00	・リレー整定に関する SOP 作成 ・インピーダンスについて	Melvin Angi Michael Akep
2023 /2 /21 14:00～16:00	・事故分析に関する SOP 作成	Michael Akep
2023 /2 /22 10:00～14:30	・事故分析に関する SOP 作成	Melvin Angi Michael Akep
2023 /2 /27 10:00～15:00	・インピーダンス検討に関する SOP 作成 ・インピーダンス管理の必要性	Melvin Angi Michael Akep
2023 /3//1 10:00～12:00	・オンライン研修のフィードバック ・距離リレー整定項目について	Melvin Angi Michael Akep
2023 /11 /1 10:00～12:00	・インピーダンス計算の実務 (架空送電線)	Melvin Angi
2023 /11 /2 14:00～16:30	・インピーダンス計算の実務 (架空送電線)	Melvin Angi Michael Akep
2023 /11/3 10:00～12:00	・インピーダンス計算の実務 (架空送電線) ・CT 比検討に必要な諸元	Melvin Angi Michael Akep
2023 /11 /6 10:00～12:00	・インピーダンス計算に必要な諸元 (架空送電線)	Melvin Angi Michael Akep
2023 /11 /6 14:00～16:00	・CT 比検討の実務	Melvin Angi Michael Akep
2023 /11 /7 14:00～16:00	・インピーダンスマップの活用方法 ・距離リレー整定の実務	Melvin Angi Michael Akep
2023 /11 /9 14:00～16:30	・距離リレー整定の実務	Melvin Angi Michael Akep
2024/7/2 10:00-12:00	・ワークショップに関する調整 ・配電線保護に関するディスカッション	Melvin Angi、 Michael Akep
2024/7/03 13:00-16:00	・マニュアルの加筆修正 ・インピーダンスマップの更新	Melvin Angi、 Michael Akep
2024/7/04 13:30-15:30	・TOT の資料確認 ・インピーダンスマップの更新	Melvin Angi、 Michael Akep
2024/7/05 10:00-12:00	・配電線保護のトレーニング ・ワークショップの資料確認 ・インピーダンスマップの運用説明	Melvin Angi、 Michael Akep

Annex6 トレーニングレコード

2024/7/08 10:00-12:00	・トレーナーから受講生への講義 ・講義内容 「Overview of Protection Relay」	Melvin Angi、 Michael Akep Ian Domikar Ezekiel Joe
2024/7/09 10:00-12:00	・トレーナーから受講生への講義 ・講義内容「CT Study」	Melvin Angi、 Michael Akep Ian Domikar Ezekiel Joe
2024/7/10 14:00-16:30	・トレーナーから受講生への講義 ・講義内容 「Calculation of Impedance (Overhead)」 「Distance Relay setting Part 1」	Melvin Angi、 Michael Akep Ian Domikar Ezekiel Joe
2024/7/11 10:00-13:00	・トレーナーから受講生への講義 ・講義内容 「Distance Relay setting Part 2」 「Differential Relay Setting」	Melvin Angi、 Michael Akep Ian Domikar Ezekiel Joe
2024/7/12 10:00-16:00	・ワークショップの実施	Melvin Angi、 Michael Akep
2024/7/15 10:00-14:30	・距離リレー整定値の確認	Melvin Angi、 Michael Akep
2024/7/16 10:00-12:00	・距離リレー整定値の確認	Melvin Angi、 Michael Akep
2024/7/17 10:00-12:00	・距離リレー整定値の確認	Melvin Angi、 Michael Akep