

**The Federal Republic of Nigeria  
Federal Ministry of Power (FMP)  
National Power Training Institute of Nigeria (NAPTIN)  
Abuja Electricity Distribution Plc (AEDC)**

**The Project  
for  
Capacity Development of Power Distribution**

**Project Completion Report**

**FEBRUARY 2026**

**JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)  
YACHIYO ENGINEERING CO., LTD.  
KANSAI TRANSMISSION AND DISTRIBUTION, INC.**

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## Summary

### ① Background

The Federal Republic of Nigeria (hereinafter referred to as "Nigeria") is a major power boasting the largest economy and population in Africa. Its medium-term national development plan, the "National Development Plan 2021-2025," aims for an average economic growth of 4.6% per year by 2025. Alongside this economic growth, potential electricity demand in Nigeria is also increasing. However, due to a chronic shortage of power supply capacity, scheduled blackouts occur frequently in both urban and rural areas, and this situation is considered one of the factors hindering economic growth.

In Nigeria, following the enactment of the Electric Power Sector Reform Act in 2005, NEPA (National Electric Power Authority), which was a vertically integrated state-owned power company, was unbundled into generation, transmission, and distribution sectors via the holding company PHCN (Power Holding Company of Nigeria). In 2013, the generation and distribution sectors were privatized. It is the role of the distribution companies to collect electricity tariffs from end-users and return funds to the upstream sectors such as generation and transmission. However, the tariff collection rate in the distribution sector is low. The Aggregate Technical, Commercial and Collection (ATC&C) Loss averaged 50% across the 11 distribution companies in the second quarter of 2021. (Source: Nigerian Electricity Regulatory Commission (NERC) report) Due to such large losses in the distribution sector, the flow of funds throughout the entire power sector has stagnated, leading to deterioration in the management of power operators and stagnation in capital investment, causing the Nigerian power sector to fall into a negative spiral.

To improve the above situation, the Nigerian government, based on the Power Sector Recovery Program (2017-2021), has been conducting activities to clear the accumulated debt of the power sector and improve power supply, but sufficient results have not been obtained. In 2023, the Electric Power Sector Reform Act of 2005 was repealed, and the new Electricity Act (Electricity Act 2023) was enacted. A major reform is granting states the authority to manage electricity within their own territories and the establishment of the Nigerian Independent System Operator (NISO).

Under these circumstances, the Federal Ministry of Power (FMP) of Nigeria requested technical cooperation from Japan aimed at improving the distribution sector, with the National Power Training Institute of Nigeria (NAPTIN) and the Abuja Electricity Distribution Plc (AEDC) as counterparts. It was agreed to aim specifically for the improvement of technical losses.

Consequently, "The Project for Capacity Development of Power Distribution" was implemented for 47 months (April 2022 - February 2026).

### ② Overall Goal and Project Purpose

#### 【Overall Goal】

To improve Nigerian Distribution Companies' (hereinafter referred to as "Disco") business operations

capabilities

【Project Purpose】

To improve the capabilities of engineers in the power distribution department

【Expected Outputs】

Output 1: Development and implementation of training for loss reduction measures

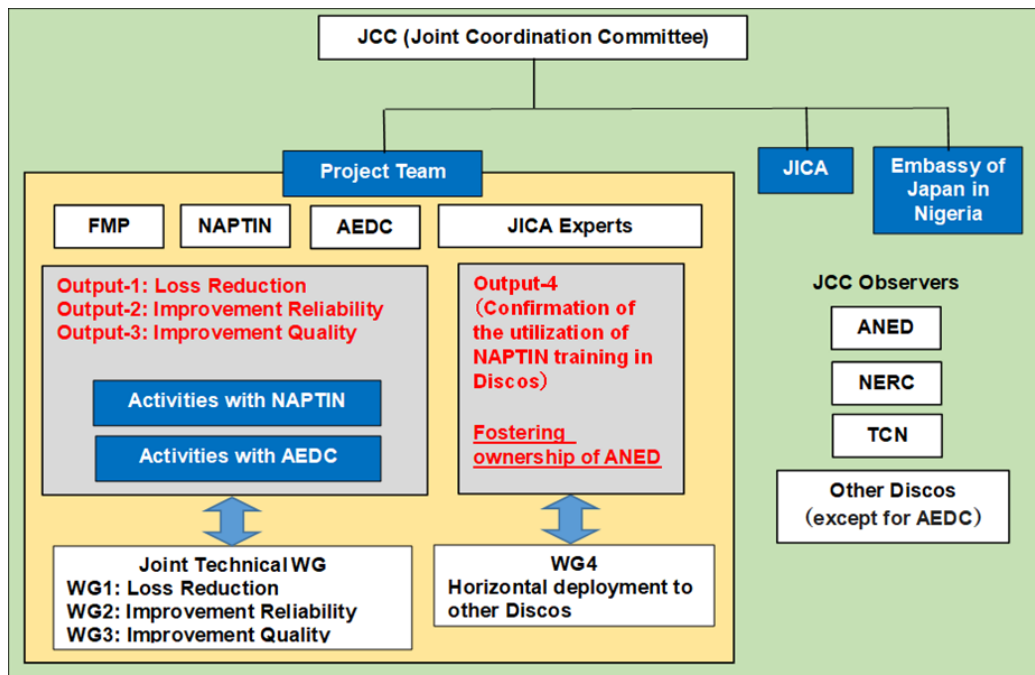
Output 2: Development and implementation of training to improve reliability

Output 3: Development and implementation of training for quality improvement

Output 4: Confirmation of the utilization of NAPTIN training in Discos

③ Project Implementation Structure

The implementing agencies are NAPTIN and AEDC, and the implementation structure of this project is shown below.



④ Actual Inputs and Activities

I. Input by the Japanese side (Planned and Actual)

[Dispatch of JICA Experts]

The Japanese side dispatched nine experts, shown in the table below, for 99.16 months.

| Name              | Task in charge                                  | Period              | Plan (months) | Actual (months) |       |       |
|-------------------|-------------------------------------------------|---------------------|---------------|-----------------|-------|-------|
|                   |                                                 |                     | Total         | Nigeria         | Japan | Total |
| Kyoji FUJII       | Leader / Distribution Business Operation        | Apr 2022 - Feb 2026 | 13.35         | 10.70           | 5.30  | 16.00 |
| Akihiro KASHIWAGI | Distribution Planning                           | Apr 2022 - Feb 2026 | 13.12         | 8.47            | 5.95  | 14.42 |
| Kazuhiko KOEDA    | Distribution Design                             | Apr 2022 - Feb 2026 | 13.30         | 9.93            | 5.84  | 15.77 |
| Seiro NISHIKI     | Distribution Maintenance and Management         | Apr 2022 - Feb 2026 | 13.15         | 8.50            | 6.22  | 14.72 |
| Hiroki AOYAGI     | Pilot Project 1 (Procurement Survey)            | Apr 2022 - Feb 2026 | 7.50          | 6.83            | 4.02  | 10.85 |
| Hiroyuki TOYOKAWA | Pilot Project 2 (Construction Supervision)      | Apr 2022 - Apr 2023 | 7.00          | 0.00            | 1.75  | 1.75  |
| Michinori YASUI   | Pilot Project 2 (Construction Supervision)      | May 2023 - Feb 2025 | 0             | 1.43            | 1.40  | 2.83  |
| Kazunori DOI      | Training Courses Planning                       | Apr 2022 - Feb 2026 | 11.77         | 5.00            | 7.87  | 12.87 |
| Ruriko SUEZAWA    | Project Coordination and Monitoring /Evaluation | Apr 2022 - Feb 2026 | 12.50         | 5.50            | 4.45  | 9.95  |
| Total (month)     |                                                 |                     | 91.69         | 56.36           | 42.80 | 99.16 |

### [Training in Japan]

The Japanese side dispatched five experts, shown in the table below, for 1.31 months.

| Name              | Task in charge                           | Period              | Plan (months) | Actual (months) |
|-------------------|------------------------------------------|---------------------|---------------|-----------------|
| Kyoji FUJII       | Leader / Distribution Business Operation | Jul 2023 – Aug 2023 | 0.15          | 0.15            |
| Akihiro KASHIWAGI | Distribution Planning                    | Jul 2023 – Aug 2023 | 0.38          | 0.38            |
| Kazuhiko KOEDA    | Distribution Design                      | Jul 2023 – Aug 2023 | 0.20          | 0.20            |
| Seiro NISHIKI     | Distribution Maintenance and Management  | Jul 2023 – Aug 2023 | 0.35          | 0.35            |
| Kazunori DOI      | Training Courses Planning                | Jul 2023 – Aug 2023 | 0.23          | 0.23            |
| Total             |                                          |                     | 1.31          | 1.31            |

### [Equipment procurement]

The necessary equipment and materials for carrying out this project's activities were provided to each counterpart (AEDC, NAPTIN). Procurement was handled by the Japanese side, and installation work was carried out by the Nigeria side. The provided items included materials necessary for



installing the distribution training facilities and equipment used for training (cable fault locator, etc.), as well as materials for installing power distribution lines of the pilot project and for improving reliability. Refer to the text for the list of equipment provided.

## **II. Input by the Nigeria side (Planned and Actual)**

The input by the Nigeria side was implemented as originally planned, except for budgetary measures and installation work, as shown in the table below.

| <b>Input by the Nigeria side</b>          | <b>Planned</b>                                                                                                                                 | <b>Actual</b>                                                                                                                                                                                                                       |
|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Budgetary Measures                        | Budget allocated for project implementation                                                                                                    | Regarding the installation costs for the distribution training facility, the budgeting process by NAPTIN was delayed by approximately one year compared to the original plan.                                                       |
| Provision of offices and other facilities | Provision of office space, equipment, electricity, water, etc.                                                                                 | Office space, equipment, electricity, water, etc. were provided.                                                                                                                                                                    |
| Required permits and tax exemptions       | Acquisition of permits and licenses necessary for project implementation and tax exemption measures for procurement of materials and equipment | Although procedural delays occurred, the necessary permits (FCDA, NEMSA) and tax exemption measures were completed.                                                                                                                 |
| Installation work                         | Installation work for equipment and materials provided by Japan                                                                                | Implemented by NAPTIN (Distribution training facilities) and AEDC (Pilot Project), but significant delays occurred due to budget delays, inadequate construction systems, accidents, etc., impacting the project evaluation period. |

### III. Project Achievements

The outline of the plan and actual performance of each activity is shown in the figure below. The PO (Plan of Operation) showing the activity plan and actual performance is as shown in Annex-3.

| Activities                                                                             |        | Year | 2022 |    |     |    | 2023 |    |     |    | 2024 |    |     |    | 2025 |    |     |    |
|----------------------------------------------------------------------------------------|--------|------|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|
| Sub-Activities                                                                         |        |      | I    | II | III | IV | I    | II | III | IV | I    | II | III | IV | I    | II | III | IV |
| <b>Output 1-3 : 1-5 with NAPTIN, 6-7 with AEDC</b>                                     |        |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| 1 Planning training courses, teaching materials preparation, TOT                       | Plan   |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| 2 Conducting training course                                                           | Plan   |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| 3 Evaluating training courses and giving feedback                                      | Plan   |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| 4 Incorporating pilot results into training(Considering training improvement)          | Plan   |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| 5 Design and construction of training equipment for demonstration                      | Plan   |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| 6 Field survey, Extracting issues in business operations                               | Plan   |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| 7 Consideration and implementation of pilot proposal                                   | Plan   |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| 8 Incorporate pilot results into business operations (revising technical standards)    | Plan   |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| <b>Output 4:</b>                                                                       |        |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| 4.1 Collecting information, analysis, and presentation of improvement plans for Career | Plan   |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| 4.2 Creating dissemination plans for other Discos                                      | Plan   |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| <b>Training in Japan</b>                                                               |        |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| Training in Japan                                                                      | Plan   |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| <b>Public Relations</b>                                                                |        |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| Public Relation Activities                                                             | Plan   |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| <b>Monitoring</b>                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| Joint Coordinating Committee                                                           | Plan   |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| Submission of Monitoring Sheet                                                         | Plan   |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| <b>Field Work in Nigeria</b>                                                           |        |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| Field Work in Nigeria                                                                  | Plan   |      | ①    | ②  |     |    | ③    | ④  | ⑤   |    | ⑥    | ⑦  |     |    |      |    |     |    |
|                                                                                        | Actual |      | ①    | ②  |     |    | ③    |    |     |    | ④    |    |     | ⑤  |      | ⑥  | ⑦   |    |

### IV. Project Outcomes and Indicators

The achievement status of individual output indicators and major deliverables of this project are shown in the table below. The major deliverables of this project are shown in Annex-1.

| Output in PDM | Activity Plan                                               | Activity Actual and Achievement Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Major Deliverables |
|---------------|-------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------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|               | [0-1]<br>Baseline survey (field survey, update information) | <ul style="list-style-type: none"><li>A baseline survey was conducted during the first field work period from mid-May to the end of June 2022, and the survey results were reported to JICA and the JCC by the 1st JCC (September 13, 2022).</li></ul> <p><b>[Achievement Level] 100%</b></p> 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| Output in PDM | Activity Plan                                                                                                                       | Activity Actual and Achievement Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Major Deliverables                                                                                                                                                                                |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|               | [X-3] Evaluating training courses and giving feedback                                                                               | <ul style="list-style-type: none"> <li>Summarized evaluation results using pre-prepared trainee questionnaires and provided feedback to instructors.</li> <li>Instructors improved Reference Manuals, Training Materials, and teaching methods based on the evaluation results.</li> </ul> <p><b>[Achievement Level] 100%</b></p>                                                                                                                                                                                                              | <ul style="list-style-type: none"> <li>Comments table for classroom training demonstration lecture and practical training demonstration session (Attachment-1 No.11)</li> </ul>                   |
|               | [X-4] Incorporating pilot results into training (Considering training improvement plans)                                            | <ul style="list-style-type: none"> <li>Due to delays in the installation work for the AEDC pilot project, it was not possible to secure a period to evaluate the results after construction. Consequently, only the loss reduction effects were grasped and incorporated into the "Loss Reduction" Reference Manual.</li> </ul> <p><b>[Achievement Level] 70%</b></p>                                                                                                                                                                          | <ul style="list-style-type: none"> <li>"Loss Reduction" Reference Manual and Training Material (Attachment-1 No.1-2)</li> </ul>                                                                   |
|               | [X-5] Design and construction of training equipment for demonstration                                                               | <ul style="list-style-type: none"> <li>Designed the distribution training facilities from July 2022 to January 2023, and conducted installation work from October 2024 to December 2024.</li> </ul> <p><b>[Achievement Level] 100%</b></p>                                                                                                                                                                                                                                                                                                     | <ul style="list-style-type: none"> <li>Distribution training facilities design documents (Attachment-1 No.7)</li> </ul>                                                                           |
|               | [X-6] Field survey, Extracting issues in business operations                                                                        | <ul style="list-style-type: none"> <li>Conducted a baseline survey during the first field work period from mid-May to the end of June 2022, identified issues in business operations (such as improvement of Outage Management), and reported the survey results to JICA and the JCC by the 1st JCC (September 13, 2022).</li> </ul> <p><b>[Achievement Level] 100%</b></p>                                                                                                                                                                    | <ul style="list-style-type: none"> <li>Baseline survey report</li> </ul>                                                                                                                          |
|               | [X-7] Consideration and implementation of pilot proposal                                                                            | <ul style="list-style-type: none"> <li>Considered and designed the AEDC pilot project from July 2022 to January 2023, and conducted installation work from June 2023 to December 2025.</li> <li>Conducted data analysis regarding the improvement of Outage Management and made recommendations to AEDC.</li> </ul> <p><b>[Achievement Level] 100%</b></p>                                                                                                                                                                                     | <ul style="list-style-type: none"> <li>AEDC pilot project related materials (Attachment-1 No.12-1 to 12-8)</li> <li>Outage Management related materials (Attachment-1 No.13-1 to 13-4)</li> </ul> |
|               | [X-8] Incorporate pilot results into business operations (revising technical standards, SOPs (Standard Operating Procedures), etc.) | <ul style="list-style-type: none"> <li>Due to delays in the installation work for the AEDC pilot project, it was not possible to secure a period to evaluate the results after construction, so only the loss reduction effects were grasped. Although the plan was to grasp the effects of voltage drop improvement and forced outage time improvement, this was not possible.</li> <li>Planning documents and effect assessment materials for the pilot project have been provided to AEDC.</li> </ul> <p><b>[Achievement Level] 70%</b></p> | <ul style="list-style-type: none"> <li>"Loss Reduction" Reference Manual (Attachment-1 No.1)</li> </ul>                                                                                           |

| Output in PDM                                                              | Activity Plan                                                                                                                                    | Activity Actual and Achievement Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Major Deliverables                                                                                                                                                                    |
|----------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [Output 4]<br>Confirmation of the utilization of NAPTIN training in Discos | [4-1]<br>Collecting information, analysis, and presentation of improvement plans for Career framework in AEDC and application of NAPTIN training | <ul style="list-style-type: none"> <li>Proposed incorporating the NAPTIN training courses developed in this project into AEDC's training plan. AEDC has included 4 NAPTIN training courses (3 of which were developed in this project) in its 2025 Training Plan.</li> </ul> <b>[Achievement Level] 100%</b> <div> <div></div> <div>0</div> <div>50%</div> <div>100%</div> <div></div> </div>                                                                                                                    |                                                                                                                                                                                       |
|                                                                            | [4-2]<br>Creating dissemination plans for other Discos                                                                                           | <ul style="list-style-type: none"> <li>Held an online workshop on January 31, 2025, to introduce the classroom training courses developed in this project to other Discos.</li> <li>Formulated a plan to convert the classroom training courses developed in this project into e-learning (currently being created using AFD project budget). Video recording began in October 2025.</li> </ul> <b>[Achievement Level] 100%</b> <div> <div></div> <div>0</div> <div>50%</div> <div>100%</div> <div></div> </div> | <ul style="list-style-type: none"> <li>Presentation Materials for Online workshop (Attachment-1 No.14-5)</li> <li>WG4 related materials (Attachment-1 No.14-1 to 14-4)</li> </ul>     |
| Training in Japan                                                          |                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                       |
|                                                                            | Conduct training in Japan for about 2 weeks for a total of 10 people from NAPTIN and AEDC.                                                       | <ul style="list-style-type: none"> <li>Conducted training in Japan from July 25 (Tue) to August 3 (Thu), 2023 (excluding travel days), for a total of 13 participants from NAPTIN, AEDC, NERC, and FMP.</li> <li>Submitted the implementation report to JICA.</li> </ul>                                                                                                                                                                                                                                         | <ul style="list-style-type: none"> <li>The Project for Capacity Development of Power Distribution in Nigeria (1st Technical Training) Implementation Report (Attachment-2)</li> </ul> |
| Public Relations                                                           |                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                       |
|                                                                            | Hold a seminar regarding the implementation details of this project.                                                                             | <ul style="list-style-type: none"> <li>Held on May 31, 2023 (Wed) with in-person participation from FMP, AEDC, NAPTIN, and ANED, and online participation from 10 Discos other than AEDC.</li> </ul>                                                                                                                                                                                                                                                                                                             | <ul style="list-style-type: none"> <li>Presentation Materials for the Seminar (Public Relations) (Attachment-1 No.14-7)</li> </ul>                                                    |

## V. Project Purpose and Indicators

The achievement status of the project purpose is shown in the table below.

| Project Purpose                                                               | Objectively Verifiable Indicators                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Achievement Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| To improve the capabilities of engineers in the power distribution department | <ol style="list-style-type: none"> <li>1. 70% or more participants in the training demonstration will be evaluated that they acquired correct knowledge about reducing technical loss.</li> <li>2. 70% or more participants in the training demonstration will be evaluated that they acquired correct knowledge about improving reliability.</li> <li>3. 70% or more participants in the training demonstration will be evaluated that they acquired correct knowledge about quality improvement.</li> <li>4. A training system (curriculum, teaching materials, training equipment, instructors, budget measures, etc.) will be established.</li> </ol> | <p>[Indicator 1-3]<br/>Status: Achieved</p> <ul style="list-style-type: none"> <li>• New classroom training courses for technical loss reduction, reliability improvement, and quality improvement were achieved.</li> <li>• Even though new classroom training developed through the project have already been released by NAPTIN, there were no participants in the training. However, judging from the feedback of model trainees who participated in training demonstration, the training provided relevant and necessary information and the materials and teaching method were good enough for them to understand well.</li> </ul> <p>[Indicator 4]<br/>Status: Achieved</p> <ul style="list-style-type: none"> <li>• New classroom training courses have been developed. NAPTIN has released 2025 official training calendar including the newly developed training courses. (100% completed)</li> <li>• Teaching materials for new classroom training courses have been completed. (100% completed)</li> <li>• New practical training courses have been developed. (100% completed)</li> <li>• Teaching materials for new practical training courses have been completed. (100% completed)</li> <li>• Installation of distribution training facilities has been completed. (100% completed)</li> <li>• Instructors' capacity has been developed. (100% completed)</li> <li>• Formulated a plan to convert the classroom training courses developed in this project into e-learning using AFD funding. (100% completed)</li> </ul> |

## VI. General comments on activities

Through the activities for Outputs 1 to 4, the project goal "To improve the capabilities of engineers in the power distribution department" was achieved. However, the overall evaluation of the activities is as follows:

### (1) Outputs 1–3

- The development of classroom training courses (Loss Reduction, Reliability Improvement, Quality Improvement) was delayed by approximately 8 months due to reasons such as the inability to secure sufficient working time for NAPTIN instructors. However, the content was completed as planned, finalized through two training demonstration lectures, and the release of the training courses was completed. Nevertheless, no applications were submitted to participate in the training course, so the participants could not evaluate the training content, but their

understanding of the training demonstration lecture reached the target value. The quality of the teaching materials was also well evaluated.

- The securing of the budget for the installation of distribution training facilities at NAPTIN was delayed by approximately one year compared to the plan, which caused a delay of approximately one year in the installation work of the distribution training facilities. Consequently, the development of practical training courses was also delayed by approximately one year. Although two training demonstration sessions were conducted, the release of the training courses could not be completed. Additionally, regarding the "Phase Comparison" developed as a practical training course, it was planned in consultation with NAPTIN to conduct part of the training (operation check of phase detectors) using energized substation equipment from the Agence Française de Développement (AFD) project. However, due to delays in the substation construction work by the AFD project, training demonstration session on energized equipment was not possible, they were conducted only on the de-energized distribution training facilities. The level of understanding of the participants in the training demonstration lecture reached the target value, and the quality of the teaching materials was also well evaluated. Some improvement effects for training could not be incorporated, yet planning, installation, and operation methods of the AEDC pilot project could be incorporated and disseminated to other Discos.
- Due to a delay of approximately two years in the installation work and start of operation of the AEDC pilot project compared to the plan, it was not possible to secure a period to evaluate the results after construction. Regarding loss reduction effects only, it was possible to estimate the effects using simplified grid data and incorporate them into the NAPTIN's training courses, but the effects of voltage drop improvement and forced outage time improvement could not be incorporated into the training.
- Although the introduction of conductor covers for overhead distribution lines was proposed as a measure for reliability improvement, the installation of conductor covers was abandoned because burning and melting of the covers occurred. The results of the conductor cover installation trial in Nigeria were shared with relevant parties.
- Regarding the "Improvement of Outage Management," which was identified as an operational issue through the baseline survey, the importance of data entry, such as causes of forced outages, was regularly conveyed to AEDC. However, sufficient data to formulate effective equipment measures was not provided. Thus concrete improvement methods could not be recommended to AEDC. The value in data accumulation was understood by AEDC.

## (2) Output 4

- The conversion of classroom training courses to e-learning was selected as a means to promote participation of Discos in NAPTIN training. Consequently, specific implementation methods and points for improvement were formulated within these project activities.

### (3) Others

- Training in Japan was conducted as planned, and the training effects on participants were also good.
- Public relations activities were also conducted as planned; participants asked active questions, indicating high interest.

## ⑤ Challenges and Lessons Learnt in Project implementation

The challenges, solution, and lessons learnt through the training are shown in the table below.

| Item                                | Challenges/Solution                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Lessons Learnt                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Project Implementation Structure    | [Related to Table 4-1.1: 1-1, 1-2, 2-2, 2-3, 2-4]<br><b>Challenge:</b> Implementation of counterpart (NAPTIN, AEDC) tasks and burden items was delayed due to their prioritization of regular duties and lack of management capacity, etc.<br><br><b>Solution:</b> Held bi-weekly online meetings (Joint Technical WG, TOT meetings) during work in Japan to strive to grasp the status of and follow up on the implementation of counterpart tasks and burden items. | <b>Lesson:</b> While it is common in other donor projects for the donor side to procure materials and equipment and carry out installation work, this project assigned installation work as a counterpart burden. Also, some works were assigned as counterpart tasks for capacity development. <u>The implementing agencies' understanding and cooperation regarding the project implementation structure were insufficient.</u> |
|                                     | [Related to Table 4-1.1: 1-3]<br><b>Challenge:</b> Repeatedly requested budget measures for installation work from NAPTIN, but a delay of about 1 year occurred.<br><br><b>Solution:</b> In addition to raising issues at the JCC and requesting NAPTIN DG, support was requested from FMP and NERC. The JICA Nigeria Office also provided follow-up.                                                                                                                 | For significant counterpart delays in the burden, tenacious progress management via bi-weekly meetings and a multi-layered approach involving related agencies and the JICA office are essential for achieving goals.                                                                                                                                                                                                             |
| Work Process                        | <b>Challenge:</b> At every JCC, confirmation of minutes was requested in advance and signed on the day, but non-fulfillment by NAPTIN and AEDC was frequent, delaying the project schedule.<br><br><b>Solution:</b> Local staff strove to monitor the situation and follow up, but confirmed items at JCC were not conveyed to relevant internal parties, and situations where they were not implemented upon continued.                                              | <b>Lesson:</b> Compliance with JCC confirmed items was not thoroughly recognized within the organizations, and there was a lack of sense of responsibility among JCC minutes signatories and related parties.<br><br>It is necessary for the JICA Expert Team to explain JCC confirmed items in internal organizational meetings, set roles and deadlines for achievement, and follow up.                                         |
| Burning/Melting of conductor covers | [Related to Table 4-1.1: 2-8]<br><b>Challenge:</b> Conductor covers, a material new to Nigeria, were introduced, but burning and melting occurred, so installation in this project was cancelled.<br><br><b>Solution:</b> Investigations into the causes of burning and melting on 33kV and 11kV distribution lines were conducted, and countermeasures and trial results were explained to relevant parties on each occasion.                                        | <b>Lesson:</b> It was found that installing conductor covers on bare wires as a countermeasure against accidents caused by trees carries a high risk of burning and melting.                                                                                                                                                                                                                                                      |
| Tax exemption procedures            | [Related to Table 4-1.1: 3-1]<br><b>Challenge:</b> Tax exemption procedures took about 6 months.                                                                                                                                                                                                                                                                                                                                                                      | <b>Lesson:</b> When problems or delays occur, it is necessary for JICA experts and local staff to directly visit staff handling tax                                                                                                                                                                                                                                                                                               |



| Item | Challenges/Solution                                                                                                                                                                                             | Lessons Learnt                                                                   |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
|      | <b>Solution:</b> A request letter for tax exemption procedures was issued to FMP from the JICA Nigeria Office, and efforts were made to follow up using the specific tax exemption procedures described in 4-1. | exemption procedures at FMP or IDEC to identify the cause and solve the problem. |

## ⑥ For the Achievement of Overall Goal after the Project Completion

### I. Prospects to achieve Overall Goal

Overall Goal: To improve Disco's business operations capabilities

#### (1) Towards Achievement of Overall Goal

Through the activities of this project, it was expected that the capacity of Disco engineers would be improved. By having these engineers with enhanced skills utilize the knowledge gained from training in their practical work, it was anticipated that more reliable and high-quality electricity would be distributed to customers, thereby improving the business operational capacity (on the technical side) of the Discos.

The activities for Outputs 1-3 included improving and developing NAPTIN's classroom and practical training courses, installing distribution training facilities, implementing the AEDC pilot project, and improving Outage Management. Originally, to expand the adoption of the results from the AEDC pilot project into the business operations of other Discos, it was necessary to incorporate the results of the AEDC activities into NAPTIN's training courses. However, various factors caused delays during project implementation, and it was not possible to proceed according to the original schedule. Consequently, there was insufficient time to fully evaluate the results of the AEDC pilot project, and its incorporation into NAPTIN's training courses was inadequate. Moreover, the planning, installation, and operation methods of the AEDC pilot project could be incorporated into the training and disseminated to other Discos. Furthermore, in the activities for Output 4, an expansion plan for Discos was formulated, but this also was insufficient due to delays in the creation of e-learning content. Additionally, NAPTIN's public relations activities for its training courses have been inadequate. Although sufficient results for achieving the overall goal were not obtained during the project implementation period due to operational delays from various factors, it is hoped that FMP, NAPTIN, and AEDC will continue to collaborate in the future to achieve the overall goal.

#### (2) Addressing Hindrances to the Achievement of Overall Goal

A hindrance factor to achieving the overall goal is the inability to secure funds for improving technical losses, reliability, and quality. Capital investment is necessary to improve technical losses, reliability, and quality. Even if the necessity for facilities restoration and configuration is understood through the improvements in NAPTIN's training courses which is an outcome of this project, and planning for it becomes possible, it cannot be executed without securing the necessary funds. In particular, if the financial situation improves, for example by reducing commercial and collection

losses, it might be possible to secure funds for improving technical losses. However, measures are needed to generate these funds. Furthermore, although an initiative to effectively carry out facilities restoration within a limited budget by improving Outage Management was trialed at AEDC, its effectiveness is limited in the current situation where only corrective maintenance is practiced. It is hoped that in the future, a shift to preventive maintenance, such as conducting regular equipment inspections, will be made, allowing for planned and effective implementation of facilities restoration to improve technical losses, reliability, and quality.

## **II. Recommendations for the Nigeria Side**

### **[Recommendations for NAPTIN]**

#### **(1) Proactive Promotion of Training Courses**

Currently, NAPTIN makes its training programs and courses available for viewing on its website (a training portal site) and also disseminates information via social media. However, other proactive promotional activities are not being conducted, and newly developed and improved training courses are not sufficiently publicized to the Discos. It is desirable that NAPTIN carry out more proactive promotional activities (such as sending direct mail) to enhance the capacity of Discos and attract more trainees. Furthermore, although the training portal site is an important source of information for applicants, the information such as course descriptions is often insufficient. Therefore, improvement of the training portal site is desired.

#### **(2) Voluntary Improvement and Development of Training Courses**

Currently, NAPTIN receives support from entities such as AFD and JICA for the improvement and development of its training courses and does not undertake these activities voluntarily. It is necessary for NAPTIN to voluntarily provide training courses that more reflect the opinions and needs of the Discos. The business environment, challenges, and capacity development need of the Discos are not static but are constantly changing. Therefore, NAPTIN is required to take the initiative to voluntarily improve and develop its training courses by actively gathering and analyzing feedback from participants and opinions and requests from Discos at every opportunity. It is also crucial to incorporate case studies and practical exercises into the training courses to make them more practical and effective.

#### **(3) Skill Improvement for NAPTIN Instructors**

Related to point (2) above, it is necessary to develop NAPTIN instructors who are capable of voluntarily improving and developing training courses. The experience gained in this project, where NAPTIN instructors created their own manuals and teaching materials for new course development, was valuable, and it is hoped that they will apply this experience in future efforts in course improvement and development.

Furthermore, in this project, technology was transferred from experienced AEDC engineers to

NAPTIN instructors for the development of practical training courses. While it is difficult for NAPTIN instructors to enhance their skills for practical training courses due to a lack of opportunities to acquire such practical skills, it is necessary to arrange for technology transfer from experienced Disco engineers to NAPTIN instructors as needed.

#### (4) Expansion and Maintenance of Distribution Training Facilities

In this project, distribution training facilities were installed at the NAPTIN headquarters to develop more practical, hands-on training courses. A foundation for discussions within NAPTIN regarding utilization at regional training centers has been formed. Expansion to regional training centers by NAPTIN is expected.

In addition, NAPTIN will need to implement maintenance and management measures for the distribution training facilities and strive for excellent quality training courses.

### **[Recommendations for Discos]**

#### (1) Systematization of the Education System

Each Disco needs to systematize the knowledge, skills, and qualifications necessary for its operations. They can then identify which of these cannot be provided in-house or for which NAPTIN training would be more effective, and then proactively utilize NAPTIN's training courses.

#### (2) Careful Selection of Trainees

When sending their employees for NAPTIN training, each Disco is required to assimilate the potential benefits, such as the knowledge, skills, and qualifications to be obtained. Employees who require such training and for whom the training is expected to yield significant results should be carefully selected.

#### (3) Utilization of NAPTIN Training Outcomes

After completing NAPTIN training, employees should report to their human resources department on how they plan to apply what they have learnt to their jobs. The human resources department is then required to follow up to ensure that the outcomes of the NAPTIN training are being effectively integrated into the company's operational improvements through the trained employees.

#### (4) Feedback for the Improvement of NAPTIN Training

If a Disco finds it difficult to apply the benefits of training to its business implementation improvement processes due to inadequacies in the content of NAPTIN's courses, it is important to provide feedback with suggestions for improvement to NAPTIN.

# **The Project for Capacity Development of Power Distribution Project Completion Report**

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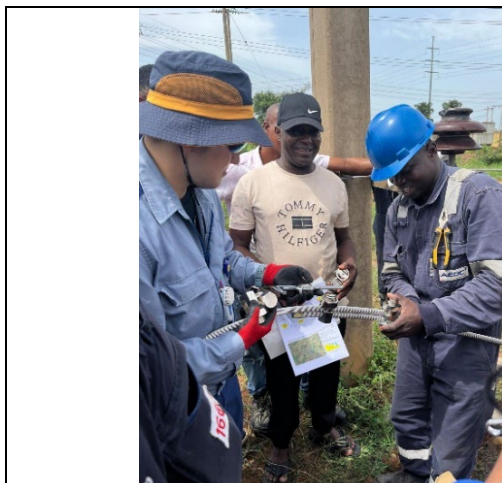
1. List of deliverables
2. Report related to conductor covers burning and melting
3. PDM, PO
4. Minutes of Discussion of JCC meeting
5. Monitoring sheet

#### **Attachment (data only)**

1. Deliverables
2. Implementation Report on the Project for Capacity Development of Power Distribution in Nigeria (1st Technical Training)

(Note) Unless otherwise indicated, the source of all figures and tables is the JICA Expert Team.

## Photos of Activity (1/2)



Lecture on Installation Methods of Conductor Covers, Volt Type Connectors, and Load Braking Switches (22nd May, 2023)



The Seminar (31st May, 2023)



NAPTIN Training Demonstration Lecture  
(Reliability Improvement)  
(23rd January, 2025)



NAPTIN Training Demonstration Lecture  
(Quality Improvement)  
(30th January, 2025)



NAPTIN Online Workshop  
(31st January, 2025)



Pre-work Briefing for Phase Comparison Work  
(Air Pressure Test of Insulating Gloves)  
(5th February, 2025)



Photos of Activity (2/2)



NAPTIN Training Demonstration Lecture  
(Technical Loss Reduction)  
(6th February, 2025)



Handover Ceremony of Distribution Training  
Facilities at NAPTIN  
(12th February, 2025)



TOT on Overhead Line Fault Location at NAPTIN  
(Lecturers dispatched from AEDC)  
(29th June, 2025)



NAPTIN Practical Training Demonstration  
(Underground Cable Fault Location)  
(8th July, 2025)



NAPTIN Practical Training Demonstration  
(Phase Comparison)  
(10th July, 2025)



NAPTIN Practical Training Demonstration  
(Overhead Line Fault Location)  
(10th July, 2025)

## Abbreviation

|            |                                                     |
|------------|-----------------------------------------------------|
| AC         | Alternating Current                                 |
| ACSR       | Aluminum Conductor Steel Reinforced                 |
| AEDC       | Abuja Electricity Distribution Plc                  |
| AFD        | Agence Française de Développement                   |
| ANED       | Association of Nigerian Electricity Distributors    |
| ARC        | Arc reflection technique                            |
| ARM        | Arc reflection measurement                          |
| ASTM       | American Society for Testing and Materials          |
| ATC&C Loss | Aggregate Technical, Commercial and Collection Loss |
| CB         | Circuit Breaker                                     |
| CTO        | Chief Technical Officer                             |
| DC         | Direct Current                                      |
| DECAY      | Voltage Decoupling                                  |
| DG         | Director General                                    |
| Disco      | Distribution Companies                              |
| EERC       | Enugu State Electricity Regulatory Commission       |
| EMI        | Electromagnetic Interference                        |
| FCDA       | Federal Capital Development Authority               |
| FCT        | Federal Capital Territory                           |
| FMP        | Federal Ministry of Power                           |
| HQ         | Headquarters                                        |
| HV         | High Voltage                                        |
| ICE        | Current Decoupling                                  |
| ICT        | Information and Communications Technology           |
| JET        | JICA Expert Team                                    |
| JCC        | Joint Coordination Committee                        |
| JICA       | Japan International Cooperation Agency              |
| LBS        | Load Breaking Switch                                |
| LDF        | Load Distribution Factor                            |
| LLF        | Load loss factor                                    |
| LV         | Low Voltage                                         |



|        |                                                 |
|--------|-------------------------------------------------|
| MV     | Medium Voltage                                  |
| NAPTIN | National Power Training Institute of Nigeria    |
| NEMSA  | Nigerian Electricity Management Services Agency |
| NEPA   | National Electric Power Authority               |
| NERC   | Nigerian Electricity Regulatory Commission      |
| NISO   | Nigerian Independent System Operator            |
| OMA    | Outage Management App                           |
| OMS    | Outage Management System                        |
| PAS    | Pole Air Switch                                 |
| PC&M   | Protection, Control & Metering                  |
| PDM    | Project Design Matrix                           |
| PHCN   | Power Holding Company of Nigeria                |
| PO     | Plan of Operation                               |
| PVC    | Polyvinyl Chloride                              |
| R/D    | Record of Discussions                           |
| S/S    | Substation                                      |
| SNS    | Social Networking Service                       |
| SOP    | Standard Operating Procedure                    |
| T/S    | Transmission Substation                         |
| TCN    | Transmission Company of Nigeria                 |
| TDR    | Time Domain Reflectometry                       |
| TOT    | Training of Trainers                            |
| WG     | Working Group                                   |
| XLPE   | Cross-linked Polyethylene                       |

# **Chapter 1 Basic Information of the Project**

# **Chapter 1 Basic Information of the Project**

## **1-1 Country**

The Federal Republic of Nigeria

## **1-2 Title of the Project**

The Project for Capacity Development of Power Distribution

## **1-3 Project Duration**

47 months (April 2022 - February 2026)

## **1-4 Background**

The Federal Republic of Nigeria (hereinafter referred to as "Nigeria") is a major power boasting the largest economy and population in Africa. Its medium-term national development plan, the "National Development Plan 2021-2025," aims for an average economic growth of 4.6% per year by 2025, and it is believed that economic growth will continue further in the future. Alongside this economic growth, potential electricity demand in Nigeria is also increasing. However, due to a chronic shortage of power supply capacity, scheduled blackouts occur frequently in both urban and rural areas, and this situation is considered one of the factors hindering economic growth.

In Nigeria, following the enactment of the Electric Power Sector Reform Act in 2005, NEPA (National Electric Power Authority), which was a vertically integrated state-owned power company, was unbundled into generation, transmission, and distribution sectors via the holding company PHCN (Power Holding Company of Nigeria). In 2013, the generation and distribution sectors were privatized.

The flow of funds in the power sector after the unbundling of generation, transmission, and distribution is shown in Figure 1-4.1. It is the role of the distribution companies to collect electricity tariffs from end-users and return funds to the upstream sectors such as generation and transmission. However, the tariff collection rate in the distribution sector is low. As shown in Figure 1-4.2, the Aggregate Technical, Commercial and Collection (ATC&C) Loss—the combined total of technical, commercial, and collection losses—averaged 50% across the 11 distribution companies (All Discos) in the second quarter of 2021. Furthermore, low customer satisfaction and low installation rates of electricity meters are also causes for the low tariff collection rate from end-users. Due to such large losses in the distribution sector, the flow of funds throughout the entire power sector has stagnated, leading to deterioration in the management of power operators and stagnation in capital investment, causing the Nigerian power sector to fall into a negative spiral.

To improve the above situation, the Nigerian government, based on the Power Sector Recovery Program (2017-2021), has been conducting activities to clear the accumulated debt of the power sector and improve power supply, but sufficient results have not been obtained.

Under these circumstances, in February 2022, the Federal Ministry of Power (FMP) of Nigeria

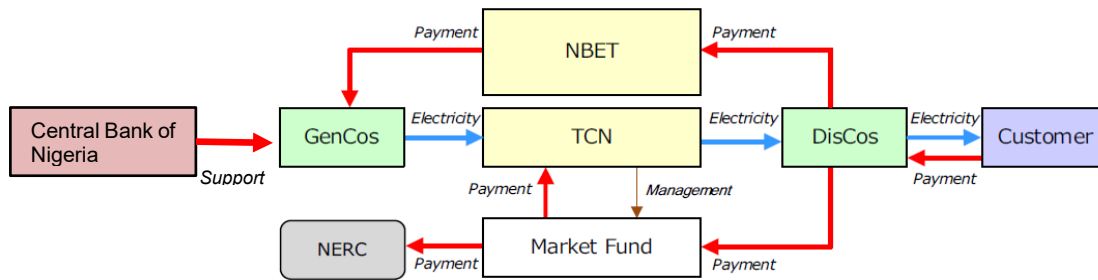
requested technical cooperation from Japan aimed at improving the distribution sector, with the National Power Training Institute of Nigeria (NAPTIN) and the Abuja Electricity Distribution Plc (AEDC) as counterparts. It was agreed to aim specifically for the improvement of technical losses.

In 2023, the Electric Power Sector Reform Act of 2005 was repealed, and the new Electricity Act (Electricity Act 2023) was enacted. This Electricity Act consolidates laws regarding the Nigerian electricity supply industry and provides a comprehensive legal and institutional framework in areas such as generation, transmission, system operation, distribution, and consumer contracts. It also stipulates integrated resource planning and policies that recognize all power sources, including the integration of renewable energy, and aims to attract investment. A major reform is granting states the authority to manage electricity within their own territories. As of July 2025, out of all 36 states, 12 have enacted their own state electricity laws, 9 have formally notified the Nigerian Electricity Regulatory Commission (NERC), and 3 states (Enugu, Ekiti, Ondo) are already managing their state electricity markets. This decentralization aims to bring regulation closer to local needs and implement region-specific solutions. Additionally, as a significant structural reform, the Nigerian Independent System Operator (NISO) was established, formally separating system operation from transmission asset management. As a result, the Transmission Company of Nigeria (TCN) focuses on managing physical infrastructure, while NISO is responsible for operating the power system more efficiently and in accordance with established standards. This aims to enhance industry reliability and operate a competitive power market based on contracts and rules.

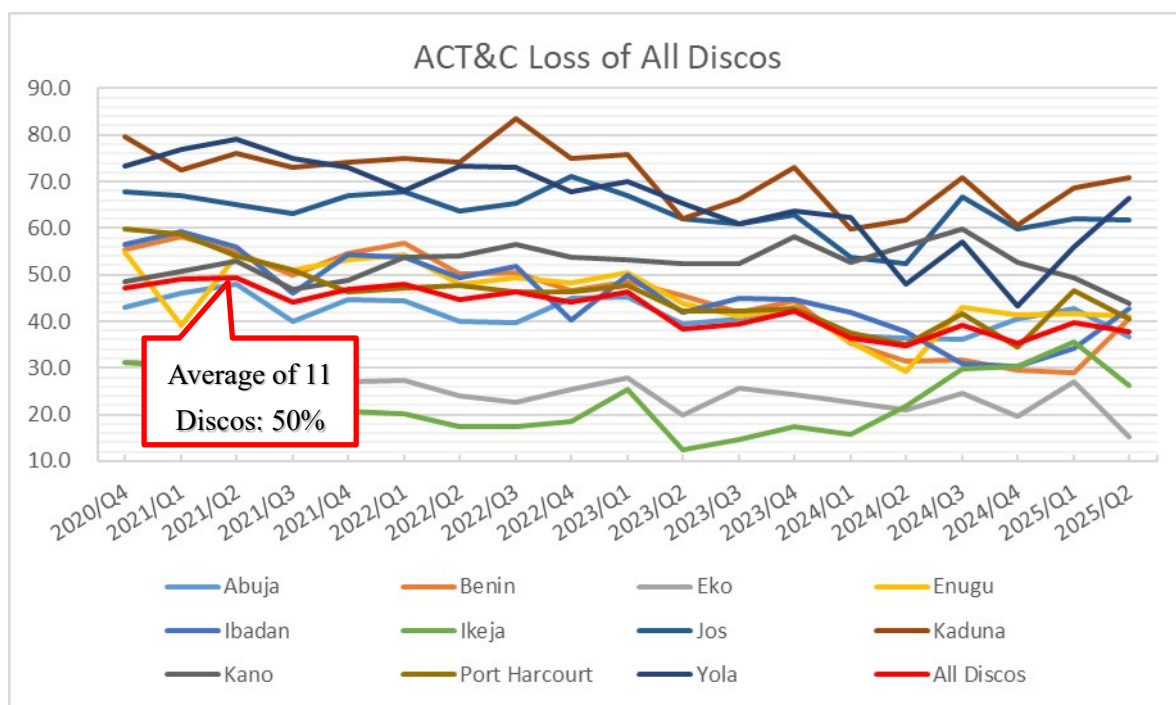
Recent policy discussions have recognized the importance of addressing past subsidy debts, stabilizing foreign exchange rates, and revising electricity tariffs for cost recovery and attracting new investment. The electricity tariff revision in April 2024 significantly raised tariffs for Band-A<sup>1</sup> customers and guaranteed a minimum of 20 hours of power supply per day. This tariff hike invited public backlash, with citizens frustrated by the soaring cost of living staging demonstrations protesting the price increase in various places, but it has shown signs of increasing electricity tariff collection. The intervention in tariffs by the Enugu State Electricity Regulatory Commission (EERC) set electricity rates significantly lower than the federal average based on data-driven audits and cost-reflective pricing, demonstrating a model for decentralized and fair tariff setting.

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<sup>1</sup> Electricity distribution companies in Nigeria have introduced a Performance-Based Tariff, where electricity rates vary depending on the hours of power supply. AEDC's Band A charges the highest rate of 209.5 Naira/kWh in exchange for guaranteeing at least 20 hours of supply per day.



**Figure 1-4.1 Power Supply and Payment Flow Following Power Sector Reform  
(Transitional Electricity Market Stage: TEM Stage)**



[Source] NERC quarterly report 2025Q2

**Figure 1-4.2 Trend of ATC&C Loss of Distribution Companies**

## 1-5 Overall Goal and Project Purpose

[Overall Goal]

To improve Nigerian Distribution Companies' (hereinafter referred to as "Disco") business operations capabilities

[Project Purpose]

To improve the capabilities of engineers in the power distribution department

[Expected Outputs]

Output 1: Development and implementation of training for loss reduction measures

Output 2: Development and implementation of training to improve reliability

Output 3: Development and implementation of training for quality improvement

Output 4: Confirmation of the utilization of NAPTIN training in Discos

A summary of the expected outputs and activities of the project is shown in Table 1-5.1.

**Table 1-5.1 Summary of Outputs and Activities**

| Expected Output                                                                  | Outline of Activities                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Output-1: Development and implementation of training for loss reduction measures | [Preparatory Phase Activities (common to Outputs 1-4)]<br>Baseline survey (field survey, update information)<br>[Activities related to Outputs 1-3] (X corresponds to Outputs 1-3)                                                                                                                                                                                                                                                                                                              |
| Output-2: Development and implementation of training to improve reliability      | <For NAPTIN><br>X-1 Planning training courses, teaching materials preparation, TOT<br>X-2 Conducting training courses                                                                                                                                                                                                                                                                                                                                                                           |
| Output-3: Development and implementation of training for quality improvement     | X-3 Evaluating training courses and giving feedback<br>X-4 Incorporating pilot results into training (Considering training improvement plans)<br>X-5 Design and construction of training equipment for demonstration<br><For AEDC><br>X-6 Field survey, Extracting issues in business operations<br>X-7 Consideration and implementation of pilot proposal<br>X-8 Incorporate pilot results into business operations (revising technical standards, SOPs (Standard Operating Procedures), etc.) |
| Output-4: Confirmation of the utilization of NAPTIN training in Discos           | [Activities related to Output 4]<br>4-1 Collecting information, analysis, and presentation of improvement plans for Career framework in AEDC and application of NAPTIN training<br>4-2 Creating dissemination plans for other Discos                                                                                                                                                                                                                                                            |

The outputs for X-6 and X-7 in Outputs 1-3 will be the input for X-4. The Activities related to Output-4 play an important role in sustaining the results of this project and disseminating them to other Discos.

Implementation of this project is expected to increase customer satisfaction by distributing more electricity to customers with higher reliability and better quality. This will increase the amount of electricity tariff collected from customers, which will contribute significantly to improving the financial condition of the power distribution sector. This improvement in the financial condition of the distribution sector is expected to circulate funds to the transmission and generation sectors and promote investment in the power sector, including in independent power producers. In addition, the promotion of investment in the power sector is expected to lead to the installation and operation of more power facilities, thereby improving the electricity supply shortage in the country as a whole. Thus, improving the operational capacity of the power distribution sector will contribute not only to the power sector but also to the revitalization of the nation's economic activities and improving quality of life.

## **1-6 Project Implementation Structure**

The implementation structure of this project is shown in Figure 1-6.1. The overall activities of this project were implemented with the approval of the Joint Coordination Committee (JCC), and information was shared and reported as appropriate. Activities related to Outputs 1 to 4 were implemented concurrently, and Working Groups (hereinafter referred to as "WGs") corresponding to Outputs 1 to 4 were established as shown in Table 1-6.1. Since Outputs 1 to 3 are highly related in terms of technology, they were combined into a Joint Technical WG. In implementing activities for WG 4, a structure and role were clarified for ANED to be actively involved from the initial stage to ensure

dissemination to other Discos, and information sharing was conducted by inviting other Discos as observers to major meetings. Figures 1-6.2, 1-6.3, and 1-6.4 show the organizational structures of FMP, NAPTIN, and AEDC. The Chairperson of the JCC was the Director of Distribution of FMP. The counterpart at NAPTIN was an instructor belonging to the technical unit under the Director of Training Program. The counterparts at AEDC were personnel from the Technical and Human Resources departments at the headquarters, and cooperation was received from the Apo Regional Office for the implementation of the pilot project.

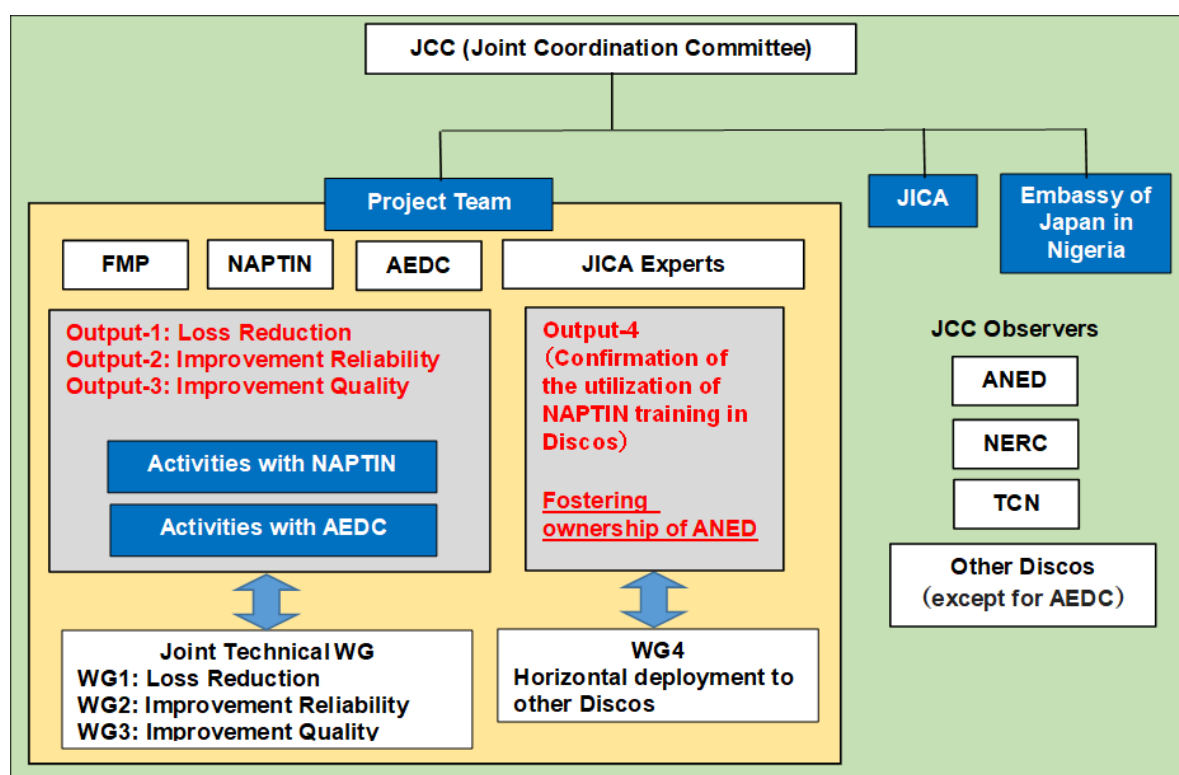
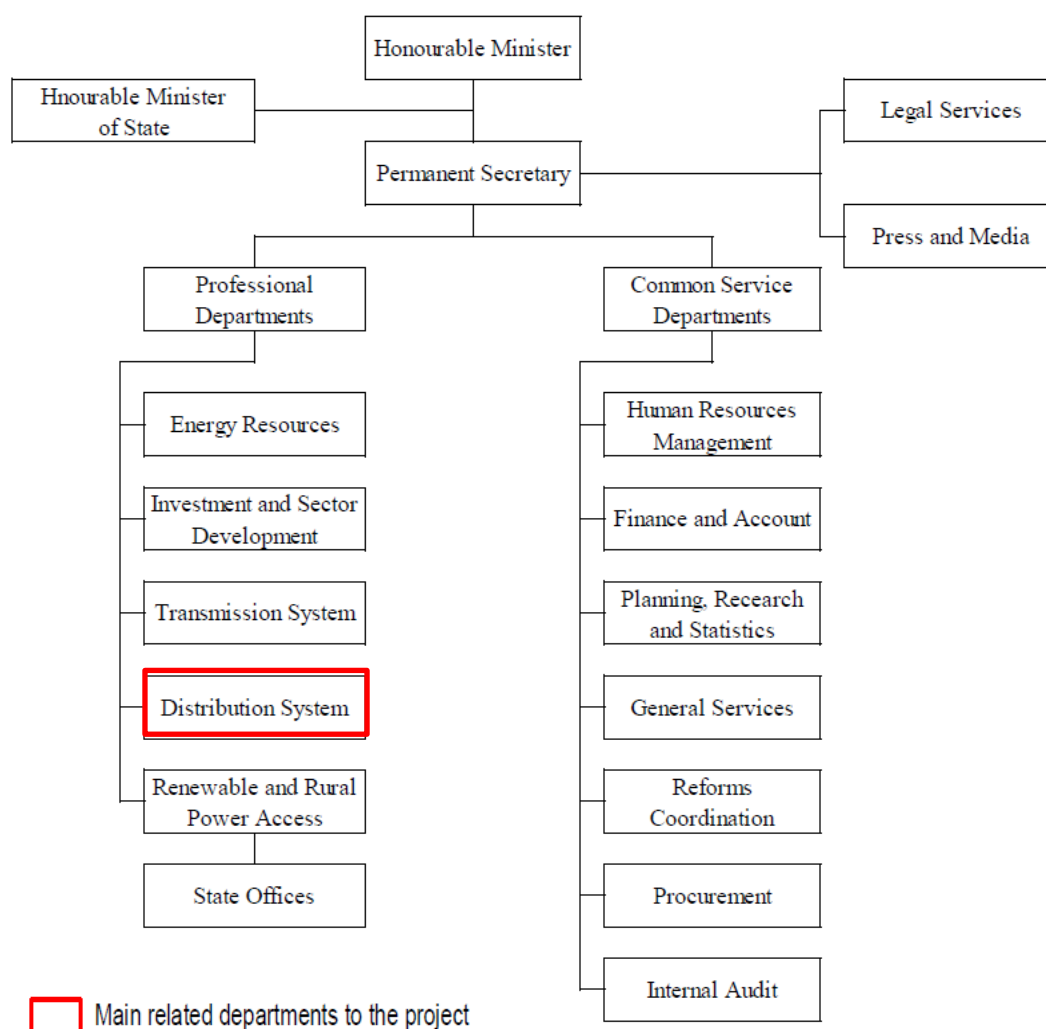


Figure 1-6.1 Implementation Structure of the Project

Table 1-6.1 Outline of Working Group Activities

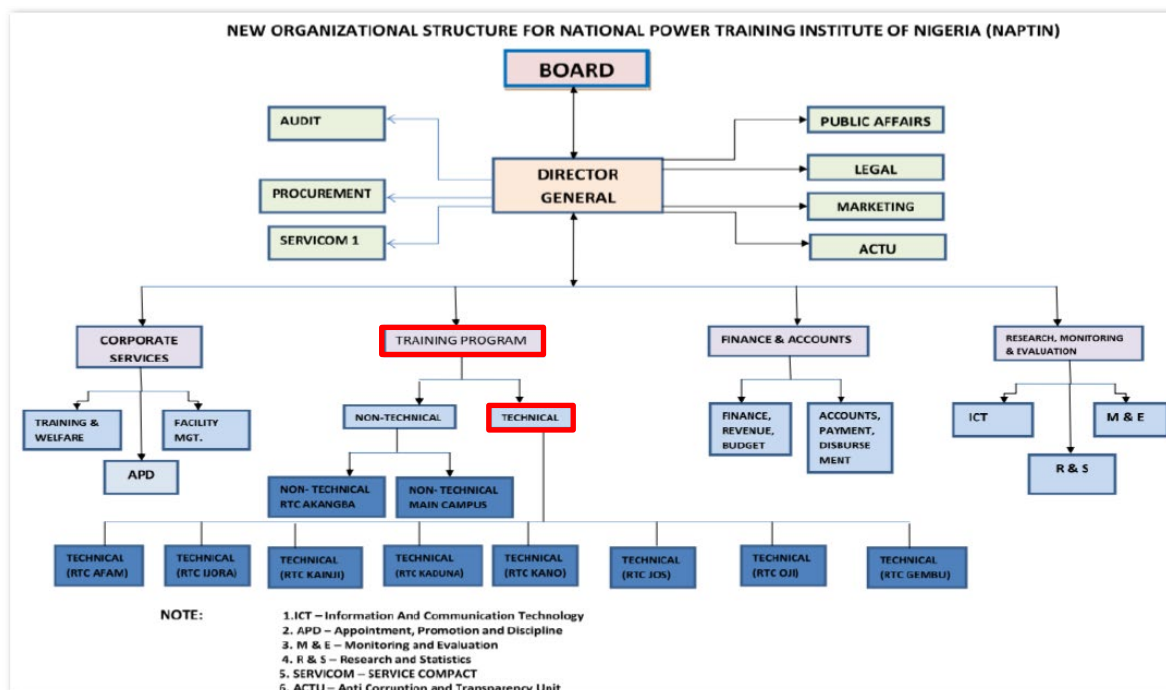
| Working Groups                                          | Major Issues                                                                                                                                                                                                                                        | WG Members                                                                                                                                                                                                            | Advisors                                                                                                                                                                                                | Achievement of Activities                                                                                                                                                                                   |
|---------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Joint Technical WG 1-3                                  | <ul style="list-style-type: none"> <li>Progress, issues, and responses regarding AEDC Pilot Project</li> <li>Progress, issues, and responses regarding NAPTIN distribution training facilities</li> <li>Improvement of Outage Management</li> </ul> | AEDC <ul style="list-style-type: none"> <li>T. K. R.</li> <li>F. O.</li> <li>A. C. M.</li> <li>Y. M.</li> </ul> NAPTIN <ul style="list-style-type: none"> <li>K. Y. A.</li> <li>B. G. G.</li> <li>M. Y. L.</li> </ul> | <ul style="list-style-type: none"> <li>Akihiro Kashiwagi/ Distribution Planning</li> <li>Kazuhiko Koeda/ Distribution Design</li> <li>Seiro Nishiki/ Distribution Maintenance and Management</li> </ul> | <ul style="list-style-type: none"> <li>Conducted a total of 59 meetings between June 2022 and January 2025 (online meetings during work in Japan, face-to-face meetings during work in Nigeria).</li> </ul> |
| Human Resource Development and Training Deployment WG 4 | <ul style="list-style-type: none"> <li>Improvement of Career Framework</li> <li>Study of deployment and</li> </ul>                                                                                                                                  | AEDC (Human Resources & Administration) <ul style="list-style-type: none"> <li>I. K. I.</li> </ul>                                                                                                                    | <ul style="list-style-type: none"> <li>Kyoji Fujii/ Leader Distribution Business Operation</li> </ul>                                                                                                   | <ul style="list-style-type: none"> <li>Conducted a total of 9 meetings between June 2024 and October</li> </ul>                                                                                             |

|  |                                        |                                                                                                                                                               |                                                                                                |                                                                                            |
|--|----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
|  | dissemination measures to other Discos | <ul style="list-style-type: none"> <li>• T. O.</li> <li>• F. H. NAPTIN</li> <li>• A. A.</li> <li>• C. B. I.</li> <li>• L. I. ANED</li> <li>• B. A.</li> </ul> | <ul style="list-style-type: none"> <li>• Kazunori Doi/ Training Program Development</li> </ul> | 2025 (online meetings during work in Japan, face-to-face meetings during work in Nigeria). |
|--|----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|



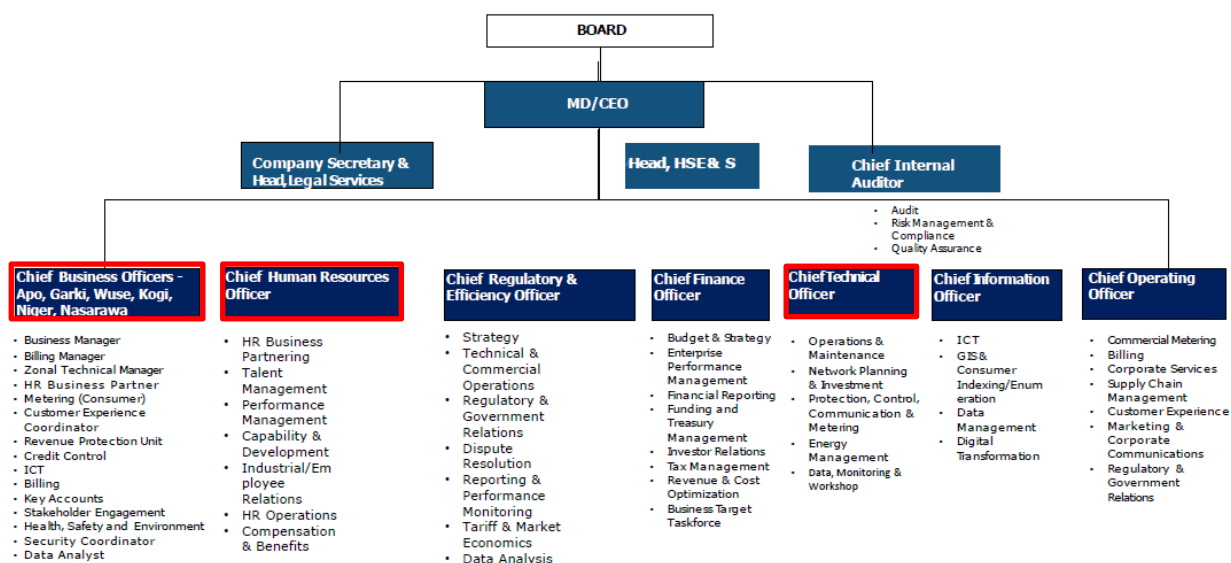
**Figure 1-6.2 Organizational Structure of FMP**





  Main related departments to the project

**Figure 1-6.3 Organizational Structure of NAPTIN**



  Main related departments to the project

**Figure 1-6.4 Organizational Structure of AEDC**

## **Chapter 2 Results of the Project**

## Chapter 2 Results of the Project

### 2-1 Results of Outputs 1-3 (for NAPTIN)

#### 2-1-1 Classroom Training Courses

NAPTIN training courses are diverse, but improvement activities were implemented for the three training courses related to "loss reduction", "reliability improvement", and "quality improvement", which are specified as "expected effects" in this project. Regarding "loss reduction" and "reliability improvement" among these three targets, there are existing training courses at NAPTIN. Therefore, the activities of improving the training course contents were implemented by reviewing the reference manual and training texts used in these courses. On the other hand, regarding "quality improvement", since there was no corresponding training course, a reference manual and a training text were newly prepared in this project. In improving the classroom training courses, Training of Trainers (TOT) was conducted for NAPTIN instructors (No. of instructors: 2 for loss reduction, 3 for reliability improvement, and 2 for quality improvement). These instructors will then be responsible for delivering the training to trainees. Moreover, demonstration lectures (with 5–10 trainees) for classroom training were conducted twice to evaluate the improved training courses; and feedback for the improvement of these training courses were provided.

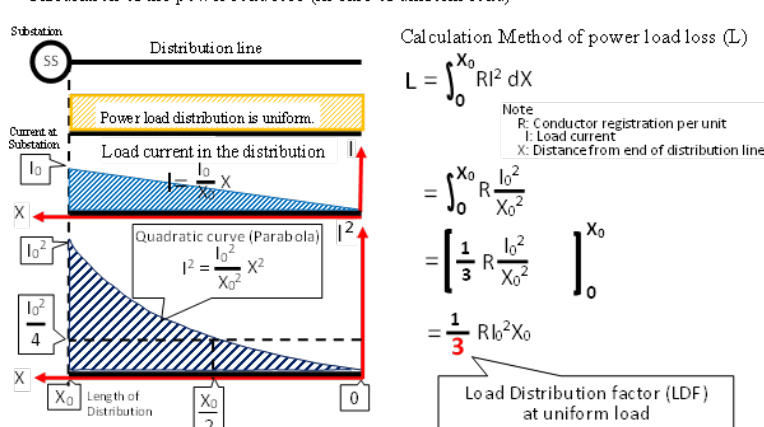
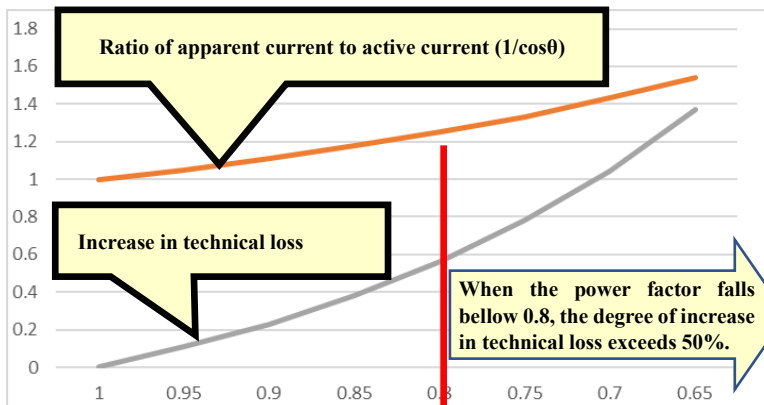
While each NAPTIN training course is conducted for several days, the time for demonstration lectures was limited. Therefore, the contents of the lectures that had not been improved in this project and content such as exercises and discussions about the lecture were omitted. The first classroom training demonstrations were conducted for experienced engineers who were relatively familiar with the lecture contents, as the main purpose of the lectures was to provide feedback on the content, teaching method, and ease of understanding of the training demonstration. On the other hand, the second classroom training demonstrations were conducted for mid-level engineers with approximately 10-years of work experience who are subject to the actual NAPTIN training. The purpose is to grasp and evaluate if they can understand the lecture contents and utilize it in their businesses.

##### 2-1-1-1 Loss Reduction

In the improving the training course for loss reduction, training reference manuals (for instructors) and training text (for trainees) were revised based on them using in existing NAPTIN training, "Distribution Network Loss Management Course". The main review is as shown in the table below.

**Table 2-1-1-1.1 Main Reviews of the Reference Manual for Loss Reduction**

| Item                                     | Major Revisions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4.0 POWER LOSS ESTIMATION AND EVALUATION | <ol style="list-style-type: none"><li>1. Adding calculation examples of instantaneous technical losses by system analysis software (NEPLAN), and the manual calculation process using the same data and models to grasp errors of calculation results of system analysis software and manual calculation and understand what kind of calculation is being carried out by system analysis software.</li><li>2. By using statistical factors such as LLF (Load loss factor), annual technical losses can calculate from instantaneous technical loss at peak load, but system analysis software cannot be used, and manual calculation is needed. Therefore, the calculation process of the instantaneous technical loss which the system analysis</li></ol> |

| Item                                 | Major Revisions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                      | <p>software can utilize and that of the annual technical loss which uses the statistical factor are described separately, so that the calculation process can be easily understood.</p> <p>3. Since there was no description for each factor used in the technical loss calculation, an explanation was added to make it easier to understand how to use it.</p> <p>4. Adding calculation process of LDF (Load Distribution Factor) referring to the cases where electric power loads are uniform.</p> <p>&lt; Calculation of the power load loss (in case of uniform load) &gt;</p>  <p>Calculation Method of power load loss (L)</p> $L = \int_0^{X_0} R I^2 dX$ <p>Note<br/>R: Conductor registration per unit<br/>I: Load current<br/>X: Distance from end of distribution line</p> $= \int_0^{X_0} R \frac{I_0^2}{X_0^2} X^2 dX$ $= \left[ \frac{1}{3} R \frac{I_0^2}{X_0^2} X^3 \right]_0^{X_0}$ $= \frac{1}{3} R I_0^2 X_0$ <p>Load Distribution factor (LDF) at uniform load</p> |
| 5.0 CAUSES POWER LOSS AND MITIGATION | <p>1. Clearly describing that the most important and first thing to carry out loss reduction are to grasp the present state of loss in detail.</p> <p>2. Adding the concrete mitigations since the cause of the technical loss was described, but concrete mitigations were not sufficiently described.</p> <p>3. The cause and the mitigation were arranged in a table form to make it easy to understand, since the relation of them was not cleared only by listing of the related information.</p> <p>4. Adding the initiatives of AEDC pilot-project as the example of the feeder segmentation which is one of the mitigations for technical loss reduction.</p> <p>5. The relationship between power factor and loss was graphed to make it easier to understand how much power factor improvement affects loss reduction.</p>  <p>6. Adding the features of power factor improvement equipment according to the types.</p>                                                      |

For details on the Loss Reduction Reference Manual, refer to Attachment-1 No.1: "Reference Manual for Loss Reduction".

The training text is based on the reference manual, but it is customized to facilitate the understanding of the trainees. In this project, the following items were mainly added for the purpose.

**Table 2-1-1-1.2 Main Reviews of Training Material for Loss Reduction**

Item

Major Revisions

## MODULE II: Evaluation of Technical Losses

- Adding a flow diagram specifying the calculation process of instantaneous technical loss and annual technical loss for those trainees make it easier to understand the process for calculation.

- Describing clearly that instantaneous and annual technical loss can be calculated by algebraic calculation using statistical factors, and adding exercise using excel sheet.

### DISTRIBUTION TECHNICAL LOSS CALCULATION SPREADSHEET

#### Transformer Losses:

1. Transformer Copper Loss (P<sub>cu</sub>): This is calculated based on the formula

$$P_{cu} = I^2 \times R_{pwr} \times 24 \times 8.76$$

where (I) is the current and (R) is the resistance of the transformer's winding.

2. Transformer Iron Loss (P<sub>Fe</sub>): This is usually given by the manufacturer and is constant, regardless of the load.

#### Distribution Line Loss:

1. Line Loss (P<sub>line</sub>): Similar to copper loss, it can be calculated using the formula

$$P_{line} = I^2 \times R_{line} \times 24 \times 8.76$$

where (R<sub>line</sub>) is the resistance of the distribution line.

You would then sum these losses for the total technical loss.

#### Annual technical loss calculation

| Transformer Rating (KVA) | Peak Load (kW) | Annual power supply APS (MWh) | Primary Voltage (KV) | Secondary Voltage (KV) | Percent Impedance Resistive UR1 (%) | Percent Impedance Reactive UR2 (%) | Iron Loss PFe (kW) | Load Factor LF | Load Loss Factor LLF | Load Distribution Factor LDF | Conductor Resist. (Ω/Km) | Line Length (Km) | Power factor | Prim. Current at Peak I <sub>p</sub> (A) | Sec. Current at Peak I <sub>s</sub> (A) | Winding Resistance R (Ω) | Peak Instant. Loss (kW) | Annual Copper Loss P <sub>cu</sub> (MWh) | Annual Iron Loss P <sub>Fe</sub> (MWh) | Annual Line Loss P <sub>line</sub> (MWh) | Total Loss (MWh) |
|--------------------------|----------------|-------------------------------|----------------------|------------------------|-------------------------------------|------------------------------------|--------------------|----------------|----------------------|------------------------------|--------------------------|------------------|--------------|------------------------------------------|-----------------------------------------|--------------------------|-------------------------|------------------------------------------|----------------------------------------|------------------------------------------|------------------|
| 7,000                    | 5,000          | 28,470                        | 220                  | 33                     | 1%                                  | 10%                                | 7                  | 0.65           | 0.468                | 1.5                          | 0.2046                   | 20               | 1.0          | 13.12                                    | 87.48                                   | 69.14                    | 35.71                   | 146.4                                    | 61.3                                   | 256.7                                    | 464.5            |
| 5,000                    | 3,000          | 16,470                        | 220                  | 33                     |                                     |                                    |                    | 0.65           | 0.468                |                              |                          |                  | 1.0          |                                          |                                         |                          | 53.94                   |                                          |                                        |                                          |                  |

You'll need to fill in the blanks with your specific data. The 'Total Loss' column will be the sum of 'Copper Loss (P<sub>cu</sub>)', 'Iron Loss (P<sub>Fe</sub>)', and 'Line Loss (P<sub>line</sub>)' for each transformer.

- As an example of jumper connection, a bolt type connector is introduced.

### Connection and disconnection of Jumpers by Bolt-type connector

<<Status quo (Binding connection)>>

<<Bolt-type connector>>

Weight: 693g/piece,  
Length: 70mm/piece

#### Advantage of Bolt-type connector

- > Repeatedly disconnecting and connecting jumpers is able **without jumper damage**
- > Anyone can do this work (**Skill less**)
- > **Stable the joint quality**
- > No special tools required to work

For details on the Loss Reduction Training Text, refer to Attachment-1 No.2: "Training Demonstration Material for Loss Reduction".

Training demonstration lectures were conducted once each for the 4th and 5th field work, and feedback from the trainees on improvements and grasping the effects of them were conducted. The primary feedback from trainees in the training demonstration was generally positive. The details are as follows.

**Table 2-1-1-1.3 Feedback and evaluation from trainees**

| Date                                                    | Main Feedback                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1st Lecture<br>(June 13, 2024)<br>No. of trainees: 8    | It was generally good in the answer, the calculation method of technical loss and the mitigation necessary for loss reduction were clearly explained, but the following feedbacks for improvement were obtained. <ul style="list-style-type: none"> <li>• I suggest block diagrams could be used to simplify and focus on the sequence of the calculations. (Improved in the second demonstration)</li> <li>• Practical demonstration using NEPLAN. (This time, it was omitted for exercise, but it will be carried out in the actual NAPTIN training.)</li> </ul> |
| 2nd Lecture<br>(February 6, 2025)<br>No. of trainees: 5 | There were comments that it was good as follows, and no especially feedbacks for improvement again. <ul style="list-style-type: none"> <li>• The material is very good and well designed for the purpose of the training.</li> <li>• The training course is ideal for what is needed in the field.</li> <li>• The course is very relevant to the sector ATC&amp;C loss reduction, which is critical for the survival of distribution companies.</li> </ul>                                                                                                         |

For detailed feedback, see Attachment-1 No.11.

## 2-1-1-2 Improvement Reliability

Regarding the improvement of reliability, NAPTIN training course contents were insufficient. Thus, certain descriptions were added to the related reference manuals (for instructors), and training materials (for trainees) were prepared. For detailed reference manuals, refer to Attachment-1 No.3, and for training materials, refer to Attachment-1 No.4.

**Table 2-1-1-2.1 Main Reviews of the Reference Manual for Reliability Improvement**

| Item                                                                | Main Additions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Method of locating fault points<br>(overhead line/underground line) | <ul style="list-style-type: none"> <li>● Method of locating fault point of overhead feeders <ul style="list-style-type: none"> <li>- Method using Hipotronics (determination by measuring fault current)</li> <li>- Method using insulation resistance tester (determination by measuring ground insulation resistance)</li> </ul> </li> <li>● Method of locating fault point of underground feeders <ul style="list-style-type: none"> <li>- Murrey loop method (Wheatstone bridge-circuit) for measuring distance to fault point</li> </ul> </li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Response after a fault                                              | <ul style="list-style-type: none"> <li>● Information to be collected in the event of a fault</li> <li>● Viewpoint during patrol <ul style="list-style-type: none"> <li>- Abnormalities in distribution facilities (conductor breakage, mixed conductors, cracking or discoloration on insulators and equipment bushings, oil leakage from equipment, etc.)</li> <li>- Abnormalities in the surrounding of the line (dead bodies of animals, dispersal insulators, conductive objects, trees or buildings close to line, construction work close to conductor, etc.)</li> </ul> </li> <li>● Major feeder fault causes and aspects <ul style="list-style-type: none"> <li>- Lightning (conductor breakage, damage to insulator or equipment)</li> <li>- Natural disasters (collapse of poles by falling trees or landslides)</li> <li>- Traffic accidents (collapse of poles due to collision of cars or heavy machinery)</li> <li>- Small animals (birds and snakes contacting the charging section)</li> <li>- Others (nests/branches of metal or wood carried by birds or wind contact the charged part)</li> </ul> </li> </ul> |
| Analysis of Fault Records and Prevention                            | <ul style="list-style-type: none"> <li>● Measures to reduce the number of faults <ul style="list-style-type: none"> <li>- Proper data accumulation <ul style="list-style-type: none"> <li>- Fault detection</li> <li>- Examples of items to be accumulated</li> </ul> </li> <li>- System used for fault information storage</li> </ul> </li> <li>- Analysis of the accumulated data <ul style="list-style-type: none"> <li>- Analysis by facilities</li> <li>- Analysis by causes</li> </ul> </li> <li>- Planning and implementation of appropriate measures</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | <ul style="list-style-type: none"> <li>- Example of countermeasures for the combination of fault equipment and its causes</li> <li>- Verification of the results of measures</li> <li>● Measures to reduce the outage duration <ul style="list-style-type: none"> <li>- Early supply to healthy sections</li> <li>- Early restoration of the fault point</li> </ul> </li> <li>● New indicator of reliability (converted duration)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                           |
| Preventive maintenance | <ul style="list-style-type: none"> <li>● Concept of Preventive Maintenance (Periodic Inspection) <ul style="list-style-type: none"> <li>- Purpose of periodic inspection</li> <li>- Purpose of record and performance management</li> <li>- Implementation methods and operation cycles (annual planning, implementation of inspections, progress control, replacement management, results reporting, and analysis)</li> </ul> </li> <li>● Viewpoints for periodic patrol <ul style="list-style-type: none"> <li>- Cracks on the surface of the support</li> <li>- Bird nest near crossarm</li> <li>- Cracks in insulator parts of equipment</li> <li>- Clearance between conductors and other objects (buildings and trees)</li> <li>- Ground height of guy wire (so as not to interfere with vehicle traffic)</li> </ul> </li> </ul> |

Each training demonstration lecture was conducted once for the 4th and 5th field work, and the response of the trainees was generally good.

**Table 2-1-1-2.2 Feedback and evaluation from trainees**

| Date                                                     | Main feedback                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1st Lecture<br>(May 30, 2024)<br>No. of trainees: 7      | <ul style="list-style-type: none"> <li>▪ The presentation materials were clear and concise, and the instructors had high expertise and excellent description skills.</li> <li>▪ It would be better if there were illustrations and practical and detailed examples. (Reflected in the 2nd demonstration lecture)</li> </ul>                                                                                                                                     |
| 2nd Lecture<br>(January 23, 2025)<br>No. of trainees: 10 | <ul style="list-style-type: none"> <li>▪ A clear and concise explanation was given, and measures to keep trainees' interest and concentration were well implemented, such as conducting real-time small tests during the lecture.</li> <li>▪ Some of the presentation materials were too small to be visible. (Enlarged text to make it easier to read.)</li> <li>▪ Unfamiliar terms are difficult to understand. (Replaced with more general terms)</li> </ul> |

For detailed feedback, see Attachment-1 No.11.

### 2-1-1-3 Improvement Quality

Classroom training regarding quality improvement did not exist in existing training courses. Although faults and troubles related to power quality have not yet surfaced in Nigeria at present, there is a possibility that they will surface and become issues in the future. Therefore, agreement was obtained in the Joint Technical WG 1-3 to develop this as a new training course. In this project, a Reference Manual (for instructors) shown in Table 2-1-1-3.1 was newly created, and a training material (for trainees) was prepared. Regarding voltage drop calculations, exercises using Excel sheets were made possible. For detailed reference manuals, refer to Attachment-1 No. 5, and for training materials, refer to Attachment-1 No. 6.

**Table 2-1-1-3.1 Contents of the Quality Improvement Reference Manual**

| Item                                                  | Main Contents                                                                                                                              |
|-------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Introduction to Power Quality Analysis             | <ul style="list-style-type: none"> <li>▪ Definition of "Power Quality" terms</li> <li>▪ Importance of Power Quality</li> </ul>             |
| 2. Objectives of Power Quality Study and Enhancements | <ul style="list-style-type: none"> <li>▪ Reliability and efficiency of power systems</li> <li>▪ Compliance with power standards</li> </ul> |
| 3. Power Quality Definitions                          | <ul style="list-style-type: none"> <li>▪ Power quality in distribution network</li> </ul>                                                  |
| 4. Components of Power Quality                        | <ul style="list-style-type: none"> <li>▪ Components of Power Quality</li> </ul>                                                            |
|                                                       | (1) Transients                                                                                                                             |

|                                                                        |                                                                                                                                                                                                                                                                                                                                 |
|------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                        | (2) Voltage Dips and Interruptions<br>(3) Voltage Sags and Swells<br>(4) Overvoltage and Undervoltage<br>(5) Voltage Unbalance<br>(6) Electrical Noise (or Electromagnetic Interference, EMI)<br>(7) Harmonic Distortion<br>(8) Voltage flickers                                                                                |
| 5. Voltage Drops and Ferranti Effects                                  | <ul style="list-style-type: none"> <li>Standards regarding voltage drop</li> <li>Standard voltage in Nigeria (NERC D-Code)</li> <li>Calculation method of voltage drop</li> <li>Ferranti effects</li> <li>Simple calculation method of voltage drop using Excel</li> <li>Voltage management for distribution network</li> </ul> |
| 6. Effects of Electrical Power Disturbances on Equipment and Processes | <ul style="list-style-type: none"> <li>Effect of Voltage Dips and Interruptions</li> <li>Effect of Overvoltages</li> <li>Effect of Voltage Unbalance</li> </ul>                                                                                                                                                                 |
| 7. Measurement and Evaluation of Power Quality                         | <ul style="list-style-type: none"> <li>Power Quality Measurements and its Objectives</li> <li>Troubleshooting</li> </ul>                                                                                                                                                                                                        |
| 8. Solutions for Improving Power Quality                               | <ul style="list-style-type: none"> <li>Solutions to Voltage Dips and Interruptions</li> <li>Solutions to Overvoltages</li> <li>Solutions to Voltage Fluctuations</li> <li>Solutions to Voltage Unbalance</li> <li>Summary</li> </ul>                                                                                            |

Each training demonstration lecture was conducted once for the fourth and fifth field work, and feedback from trainees was reflected in the Reference Manual and training material. The instructor had high communication skills, the lecture was interactive, and it was felt that the trainees' interest and understanding were high. The main feedback is as follows.

**Table 2-1-1-3.2 Feedback and evaluation from trainees**

| Date                                                    | Main Feedback                                                                                                                                                                                                                                                                          |
|---------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1st Lecture<br>(June 6, 2024)<br>No. of trainees: 9     | <ul style="list-style-type: none"> <li>It is very educative and can help to improve the quality of work and knowledge by colleagues.</li> <li>More emphasis should have on local standards and specification (NEMSA and NERC). (Reflected in the 2nd demonstration lecture)</li> </ul> |
| 2nd Lecture<br>(January 30, 2025)<br>No. of trainees: 8 | <ul style="list-style-type: none"> <li>Components of power anomalies are well detailed and easily understood.</li> <li>General materials were direct and well explained.</li> </ul>                                                                                                    |

For detailed feedback, see Attachment-1 No.11.

## 2-1-2 Distribution Training Facilities

Previously, NAPTIN owned power system simulators, renewable energy (solar and wind) related facilities, and mock-up substation amongst other training equipment. However, the training facilities previously owned by NAPTIN was not suitable for preventing outages or shortening outage durations: issues that Discos need to address.

Therefore, with the main objective of constructing facilities where more practical training and training on accident response can be conducted, the JICA Expert Team proposed the introduction of distribution training facilities modeled after those owned by Japanese power companies, and details were examined in the Joint WG 1-3. By equipping the distribution training facility with various simulated equipment such as 33kV overhead distribution lines, the underground distribution lines, the distribution transformer,



and feeder pillar, it becomes possible to develop and implement training courses tailored to the broad needs of trainees. All distribution training facilities were constructed under this project. Table 2-1-2.1 shows the facilities overview, Figure 2-1-2.1 shows the layout of the distribution training facilities, and Figures 2-1-2.2 to 2-1-2.5 show photos after installation.

**Table 2-1-2.1 Overview of Distribution Training Facilities**

| Item                                         | Quantity                                        | Training Content                                                                       |
|----------------------------------------------|-------------------------------------------------|----------------------------------------------------------------------------------------|
| 33kV Overhead Distribution Line              | 1 system (1 circuit, 130m)                      | Fault location, equipment replacement work, maintenance work                           |
| 33kV Underground Distribution Line           | 1 system (2 circuits, 33m)                      | Fault location, underground cable replacement work                                     |
| Distribution Transformer, Feeder Pillar      | 1 set                                           | Operation training, maintenance work                                                   |
| 33kV Overhead Distribution Line (Short Pole) | 2 systems (Height 1.5m and 3m, length 30m each) | Equipment replacement work, maintenance work (Work possible on ground without ladders) |
| Cable Fault Locator (for Underground Lines)  | 1 set                                           | Operation training                                                                     |
| Phase Detector                               | 1 set                                           | Phase comparison work training on distribution lines                                   |

## **(1) Design**

### **a. 33kV Overhead Distribution Line**

The 33kV overhead distribution line (1 circuit) with a length of approximately 130m complies with NEMSA (Nigerian Electricity Management Services Agency) guidelines. The utility poles are 40-foot concrete poles commonly used for 33kV distribution lines in Nigeria, and the conductors are ACSR 150mm<sup>2</sup>. This facility allows for de-energized training such as fault location, new conductor installation/extension/replacement, pole assembly work, maintenance work, and patrol inspection. Related equipment such as section switches (Load breaking switch, Gang switch), distribution transformer, and feeder pillar were installed. Note that due to budget constraints, arrangements were made to have a used distribution transformer (33kV/415-240V 100kVA) donated by AEDC, but due to a shortage of used stock, an 11kV/415-240V 100kVA transformer was unavoidably installed. Since the distribution line is 33kV, the voltage differs from the transformer, but the distribution transformer will not be energized. As the training assumes wire connection to the transformer, tap changing, and insulation measurement, NAPTIN and JICA experts judged this to be no problem. To set fault points for fault location, 8 low-voltage breaker switches were installed on the poles. Also, 21 conductor covers, which were intended for introduction in the AEDC pilot project, have been installed. While documents regarding the burning/melting incidents at the AEDC pilot project site were submitted to NAPTIN, and an explanation was provided, they remain installed since the equipment are de-energized.

### **b. 33kV Underground Distribution Line**

The 33kV underground distribution line (2 circuits) with a length of approximately 33m complies with NEMSA guidelines. The underground cable is XLPE Cu 185mm<sup>2</sup>. This facility allows for de-energized training such as fault location, cable jointing, cable laying/replacement, maintenance work, and cable termination work. The cable fault locator procured in this project is for underground lines, and it is

possible to create arbitrary fault points and conduct fault location training.

### **c. 33kV Overhead Distribution Line (Short Pole)**

The 33kV overhead distribution line (short pole) with a length of approximately 60m allows for repeated de-energized training on the ground, such as new conductor installation/extension/replacement, pole assembly work, and maintenance work, without climbing 40-foot poles. Instructors can observe, confirm, and guide the trainees' work closely. Two systems were installed with heights from the ground to the conductors of 1.5m and 3m. The poles are 17-foot concrete poles, and the conductors are ACSR 150mm<sup>2</sup>. Additionally, bolt-type connectors introduced in the AEDC pilot project were installed to allow for repeated training on jumper disconnection and reconnection. Simulated training using short poles is also possible for practical training with the phase detector provided in this project.

### **(2) Construction Supervision Support**

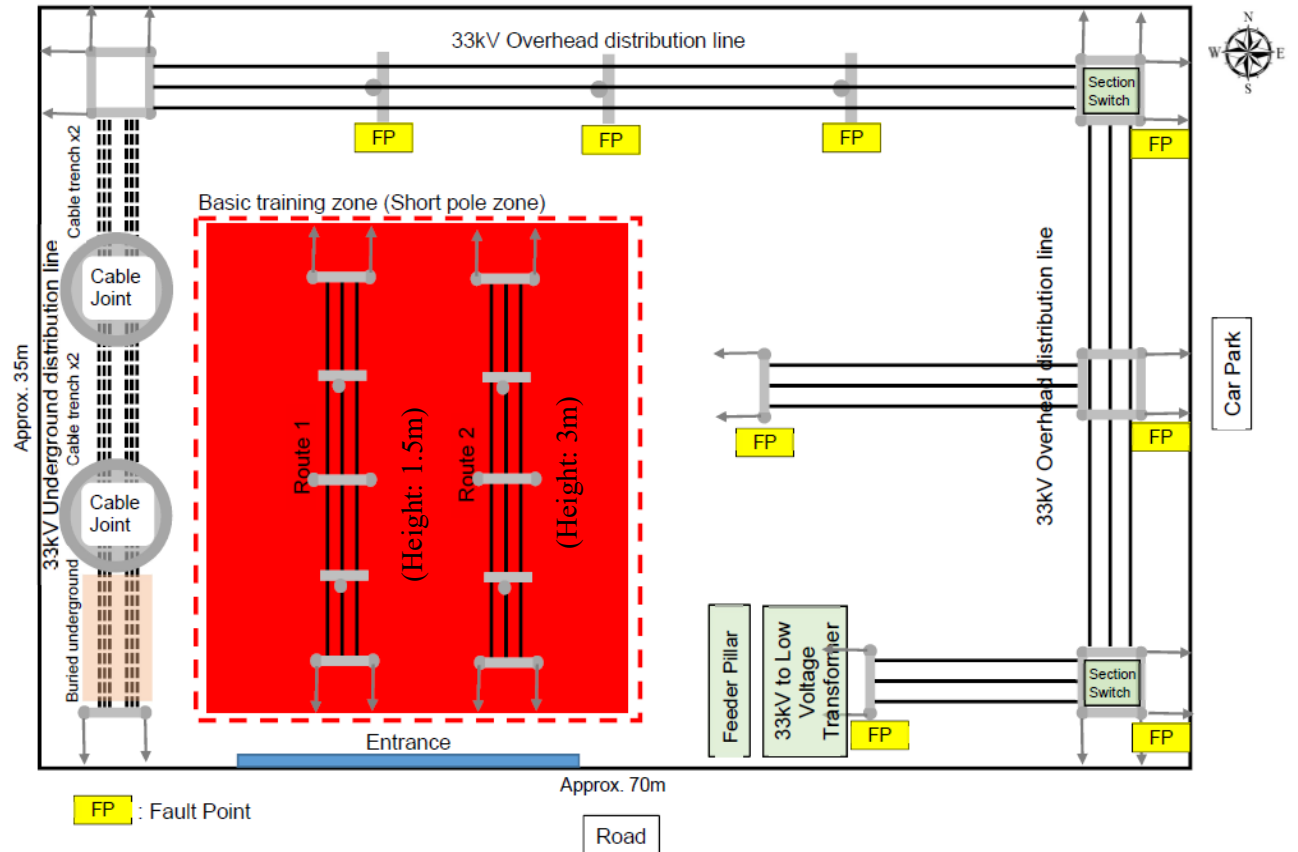
In this project, procurement of necessary materials and equipment was conducted by the Japanese side, and installation work was conducted by the Nigerian side. Hearings were held with contractors experienced in construction at AEDC to support NAPTIN's ordering of installation work. JICA experts also provided draft design documents (Attachment-1 No.7) to be attached to the installation work specifications. During the construction period from November to December 2024, JICA experts patrolled the site and provided guidance and advice to NAPTIN personnel regarding safety measures, compliance with equipment specifications, and installation methods for newly installed section switches and bolt-type connectors in Nigeria.

### **(3) Theft of Equipment**

When JICA experts visited the NAPTIN distribution training facilities on October 21, 2025, it was discovered that copper cables such as the standing part of the underground cable, the grounding wire at the overhead line fault point, and the cable connecting the distribution transformer and feeder pillar had been cut and stolen. NAPTIN was unaware of the incident, and the exact time of the theft is unknown. Although the facility was enclosed by a fence and the entrance was locked, the fence had been broken to gain entry. Table 2-1-2.2 shows the overview of the stolen equipment, and Figures 2-1-2.6 to 2-1-2.8 show photos of the theft locations. While it was possible to carry out practical training demonstration sessions on the overhead line and underground line by restoring grounding wire at the accident site of the overhead line, NAPTIN will need to effectively implement maintenance and management measures for the distribution training facilities and strive for excellent quality training courses. JICA experts requested NAPTIN to strengthen security measures and restore the stolen equipment. Specific measures currently being considered by NAPTIN include the installation of barbed wire, security lights, and security cameras, as well as conducting frequent patrols (including at night), increasing the number of security guards, and encasing cables in concrete.

**Table 2-1-2.2 Overview of Stolen Equipment**

| Equipment                                                        | Wire Type                            | Quantity           |
|------------------------------------------------------------------|--------------------------------------|--------------------|
| 33kV Underground Distribution Line Cable                         | 33kV XLPE Cu 185mm <sup>2</sup>      | 3.5m x 4 locations |
| Grounding wire at overhead line fault point                      | 25mm <sup>2</sup> Cu                 | 1.5m x 6 locations |
| Low voltage cable from Distribution Transformer to Feeder Pillar | 400V XLPE Cu 100mm <sup>2</sup> x 4c | 2m x 1 location    |



**Figure 2-1-2.1 Layout of Distribution Training Facilities**



**Figure 2-1-2.2 Full View of Distribution Training Facilities**



**Figure 2-1-2.3 Overhead Distribution Line and Underground Distribution Line**



**Figure 2-1-2.4 Distribution Transformer and Feeder Pillar**

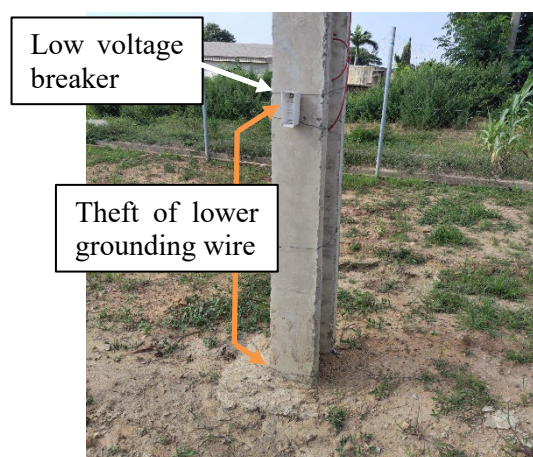


**Figure 2-1-2.5 Overhead Distribution Line (Short Pole)**



**Figure 2-1-2.6 Theft Location at Cable Standing Part**





**Figure 2-1-2.7 Theft Location of Lower Grounding Wire at Overhead Line Fault Point**



**Figure 2-1-2.8 Theft Location of Cable Connecting Distribution Transformer and Feeder Pillar**

### **2-1-3 Practical Training Courses**

NAPTIN Headquarters did not have facilities for on-site work training that Discos perform. While AFD is constructing some simulated facilities such as substations and distribution lines, JICA has constructed facilities for more pragmatic hands-on training that is not contained in AFD project. The JICA Expert Team established "phase comparison work", "overhead line fault location", and "underground cable fault location" as practical training courses which utilize this training facility, and conducted TOT for NAPTIN instructors (No. of instructors: 2 for phase comparison, 3 for overhead line fault location, and 2 for underground cable fault location). These instructors will then be responsible for delivering the training to trainees.

Practical training demonstration sessions (with 5–6 trainees) were conducted twice to evaluate the developed practical training courses and to gather the feedbacks for the improvement of them. The first practical training demonstration sessions were conducted for experienced engineers who were performing the training content at the actual site, with the main purpose being to gather feedback on the content, teaching method, and ease of understanding of the NAPTIN training demonstration. On the other hand, the second practical training demonstration sessions were conducted for young engineers (generally those with about five years of experience), who will be subject to training in actual NAPTIN training courses. The main purpose of this second training is to evaluate whether the trainees can understand the content of NAPTIN training demonstration, and if it can be carried out in their actual work. Although actual NAPTIN training will be conducted for several days, there are time-to-time restrictions in the demonstration sessions. Therefore, in the practical training demonstration sessions, the practical training parts were mainly implemented for all training courses.

#### **2-1-3-1 Phase Comparison**

In Nigeria, since the operation of looping different distribution lines in a charged state (by turning on switches, etc.) has not been carried out, short-circuit trouble due to inconsistency of phases does not occur. However, when an existing three-phase load is connected to different distribution lines (in a

network change, etc.), the reverse rotation trouble on three-phase motors due to inconsistency of phase rotation has occurred. In Japan, a phase comparison is carried out in advance to avoid these troubles, and the existence of the phase mismatch is detected. However, in Nigeria, the phase comparison has not been carried out in the distribution line, the occurrence of trouble is noticed from customers only after the trouble is occurred. In addition, to upgrade the distribution network in the future, phase comparison in advance will become essential. Therefore, in this project, a phase comparator was granted for the looping of distribution lines in AEDC Pilot-Project and phase comparison work on distribution lines was added as content for NAPTIN practical training to widely disseminate the necessity and method of work.

The necessity of phase comparison work on distribution lines was added in an existing reference manual (for instructors) titled "PHASE DETECTOR; FUNCTIONS AND APPLICATIONS:", and TOT to NAPTIN instructors and practical training demonstration sessions were conducted. A Practical Training Manual was used, which included the training methods; and a Phase Comparison Work Manual included implementation methods of phase comparison work. The outline of the review of the Reference Manual, the outline of the description of the Practical Training Manual and the Phase Comparison Work Manual are as shown in the table below.

**Table 2-1-3-1.1 Overview of various manuals required for phase detection in distribution lines**

| Manual                                                                                                                                 | Major items                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Reference manual                                                                                                                       | Adding the necessity of phase comparison work on the distribution line (when it needs to be carried out, and what kind of trouble will occur if it is not carried out).                                                                                                                                                                                                                                                                                                                                                                                                     |
| Practical Training Manual<br>(Description of practical training order for NAPTIN instructors)<br>Refer to Attachment-1 8-1 for details | <p>Illustrating how the short pole zone in distribution training facility simulates the situation in the actual site.</p> <p>The following three steps should be conducted for practical training.</p> <ol style="list-style-type: none"> <li>① Prior preparation (including the necessity of phase comparison on distribution line, and inspection of materials and equipment)</li> <li>② Demonstration of the phase comparison work at short pole zone.</li> <li>③ Confirming the operation of the phase comparator in the charged facilities provided by AFD.</li> </ol> |
| Phase Comparison Work Manual<br>(Distributed to the trainees, too.)<br>Refer to Attachment-1 8-2 for details                           | <p>Necessity of phase comparison work on distribution line</p> <p>Required materials, equipment, and personnel for phase comparison work</p> <p>Preliminary preparations and methods of inspecting materials and equipment</p> <p>Precautions that require special attention</p> <p>Phase comparison work procedures and methods</p> <p>The phase comparison pattern and how to check phase comparison result</p>                                                                                                                                                           |

Each training demonstration session was conducted once for the 6th and 7th field work. Feedback from the trainees after practical training were good (see table below).

**Table 2-1-3-1.2 Feedback and evaluation from trainees in the demonstration session**

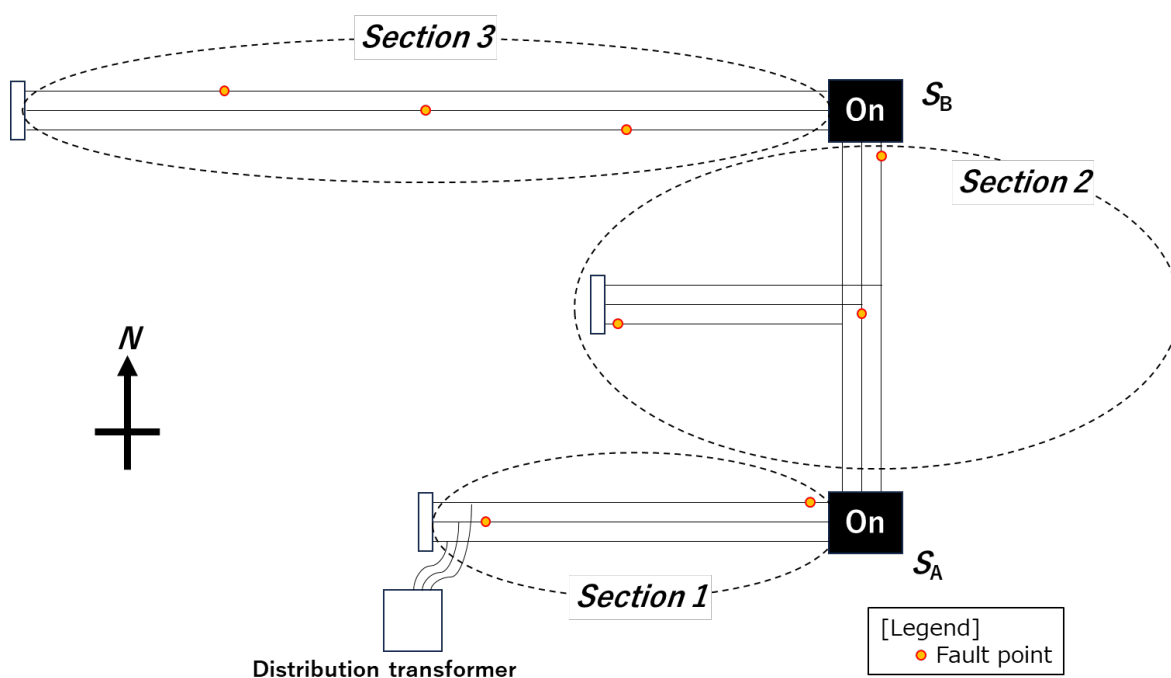
| Date                                                    | Main Feedback                                                                                                                                                                                                                                                            |
|---------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1st Session<br>(July 10, 2025)<br>No. of trainees: 6    | <ul style="list-style-type: none"> <li>• All the points were good and understandable.</li> <li>• There is need to improve more in the technical skill.</li> <li>• The phase comparison should be done on a live line for a better understanding.</li> </ul>              |
| 2nd Session<br>(October 28, 2025)<br>No. of trainees: 5 | <ul style="list-style-type: none"> <li>• I was able to conduct it on my own using the phase comparator machine.</li> <li>• The lecture in class and the practical on site given to me was super and well explained.</li> <li>• We need more of this training.</li> </ul> |

For detailed feedback, see Attachment-1 No.11.

### 2-1-3-2 Overhead Line Fault Location

Practical training for fault location in overhead feeders was not conducted, because NAPTIN had no facilities that could be used for the training. In this project, the distribution training facilities were constructed simulating a 33kV feeder in the training yard of NAPTIN headquarters, and hands-on training was developed to be conducted using the distribution training facilities. Since it was found that NAPTIN did not have the equipment "Hipotronics" to be used for the fault locating work, AEDC cooperated in borrowing the equipment for the project, and TOT and training demonstration sessions were conducted using the equipment from AEDC. Since it is to be purchased by NAPTIN, it will be possible to conduct training on their own after procurement.

Figure 2-1-3-2.1 shows the route of the distribution training facilities.



**Figure 2-1-3-2.1 Diagram of the distribution training facilities (portion used for overhead fault location training)**

As shown in Figure 2-1-2-2.1, the entire network is divided into Section 1, 2, and 3 by the line switch  $S_A$ ,  $S_B$ . The location of the fault point can be narrowed down by the location of the locating device, the on/off state of  $S_A$  and  $S_B$ , and whether the locating device detects the fault current. The "Fault point" in the figure is a simulated fault point, in which a grounding wire connected to the overhead conductor is hung along the pole and connected to the ground through a breaker (Figure 2-1-3-2.2). When the breaker is set to "ON", the overhead conductor and ground are electrically connected to each other, and a ground fault can be reproduced (when the breaker is set to "OFF", there is no ground fault). This is the reproduction method of ground fault points in fault location training conducted by frontline engineers of Kansai Transmission and Distribution, Inc.

This training can illustrate how to handle work in locating equipment, read and interpret indications, and how to operate line switches, etc. necessary for the fault location of overhead feeder.



**Figure 2-1-3-2.2 Breaker of Fault point**

TOT was conducted by experienced technicians from AEDC's PC&M team during the 5th, 6th, and 7th field works. Each training demonstration session was conducted once for the 6th and 7th field work, and feedback from the trainees was obtained. For detailed training manuals, refer to Attachment-1 No.9.

**Table 2-1-3-2.1 Feedback and evaluation from trainees in the demonstration session**

| Date                                                    | Main feedback                                                                                                                                                                                                                                                       |
|---------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1st Session<br>(July 10, 2025)<br>No. of trainees: 6    | <ul style="list-style-type: none"> <li>The explanation from the instructor is very clear, and it will be easy for the young engineer to understand. It is a useful training and worth recommending to colleagues.</li> </ul>                                        |
| 2nd Session<br>(October 28, 2025)<br>No. of trainees: 5 | <ul style="list-style-type: none"> <li>The location scenario carried out was in practice, and the theoretical content of the locating work and the handling method of the equipment were also well understood. This should be recommended to colleagues.</li> </ul> |

For detailed feedback, see Attachment-1 No.11.

### 2-1-3-3 Underground Cable Fault Location

Classroom training regarding underground power facilities was previously conducted within the conventional "CABLE JOINTING" training course, covering the overview of power cables, installation methods, and cable faults. However, there was no practical training. For the practical training course on underground cable fault location, hands-on training was developed using the Megger portable cable fault locator (STX40-2000), which was procured in this project and provided to NAPTIN, utilizing the 33kV underground distribution lines of the distribution training facilities installed at the NAPTIN headquarters. An overview of the portable cable fault locator is shown in Figure 2-1-3-3.1. Underground cable fault location requires an understanding of the overview of underground power facilities and the mechanism of cable faults to be carried out. Furthermore, since the handling of the portable cable fault locator is complex, it was decided to conduct classroom training before the practical training. Therefore, a Reference Manual (for instructors) describing the overview of underground power facilities, mechanisms of cable faults, etc., and the hands-on training was created as shown in Table 2-1-3-3.1.



(See Attachment-1 No.10)

|                                 |                                                                                                                             |                                                                                      |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| <b>Protection class</b>         | IP 43, weather-resistant and rainproof                                                                                      |   |
| <b>Weight</b>                   | 119 kg (262 lbs) standard version<br>124 kg (273 lbs) extended version                                                      |                                                                                      |
| <b>Insulation test</b>          | Voltage ranges of 5/10/15/20 kV<br>Measuring range of up to 650 MΩ                                                          |  |
| <b>HV DC source</b>             | 0 ... 40 kV DC test (DC hipot)<br>50 mA nominal continuous current at 40 kV                                                 |                                                                                      |
| <b>Breakdown detection</b>      | 0 ... 40 kV                                                                                                                 |                                                                                      |
| <b>Burning</b>                  | High frequency burner<br>Voltage ranges of 40/20/10/5 kV<br>Max burn currents of 100/200/400/850 mA                         |                                                                                      |
| <b>Standard surge levels</b>    | 0 ... 8 / 0 ... 16 / 0 ... 32 kV<br>2,000 / 2,000 / 2,000 J                                                                 |                                                                                      |
| <b>Additional surge levels</b>  | Optionally 4 kV with 1,100 J                                                                                                |                                                                                      |
| <b>Surge rate</b>               | Adjustable 3 ... 10 sec, and single shot;<br>3 seconds at full output of 32 kV                                              |                                                                                      |
| <b>Sheath testing</b>           | Voltage ranges of 3/5/10/20 kV DC                                                                                           |                                                                                      |
| <b>Sheath fault pinpointing</b> | Pulsed DC from HV DC source for<br>voltage gradient method (step voltage method)<br>Pulse sequences of 0.5:1, 1:3, 1:4, 1:6 |                                                                                      |
| <b>Built-in prelocation</b>     | 32 kV inductive ARM Best Picture Multishot<br>32 kV ICE<br>40 kV DECAY<br>Mode for locating intermittent faults (IFL)       |                                                                                      |
| <b>Operating temperature</b>    | -20°C ... +55°C (-4°F ... +131°F)                                                                                           |                                                                                      |
| <b>Storage temperature</b>      | -40°C ... +70°C (-40°F ... +158°F)                                                                                          |                                                                                      |
| <b>Mains input supply</b>       | 2.5 kW wide range power supply<br>110 ... 230 V AC, 50/60 Hz<br>Limited to 1.6 kW at 120 V AC (as per ANSI NEMA 5)          |                                                                                      |
| <b>Dimensions (L x W x H)</b>   | 710 x 740 x 1,080 mm<br>(27.9 x 29.1 x 42.5 in.)                                                                            |                                                                                      |

[Source] Megger ®

**Figure 2-1-3-3.1 Overview of Portable Cable Fault Locator**

**Table 2-1-3-3.1 Contents of the Reference Manual for Underground Cable Fault Location**

| Item                                 | Main Contents                                                                                                                                                                               |
|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Underground vs. Overhead          | <ul style="list-style-type: none"> <li>• Overhead lines</li> <li>• Underground lines</li> <li>• Underground vs. Overhead</li> </ul>                                                         |
| 2. Brief history of power cables     | <ul style="list-style-type: none"> <li>• Brief history of power cables</li> </ul>                                                                                                           |
| 3. Power lines in cables             | <ul style="list-style-type: none"> <li>• Functional characteristics of the cables</li> <li>• Type of laying</li> </ul>                                                                      |
| 4. Common underground infrastructure | <ul style="list-style-type: none"> <li>• Radial main feeder</li> <li>• Open-loop feeder</li> </ul>                                                                                          |
| 5. Cable fault/failure mechanisms    | <ul style="list-style-type: none"> <li>• Overview of faults</li> <li>• Description of cable faults</li> <li>• Cause of faults</li> <li>• Protection methods on underground lines</li> </ul> |

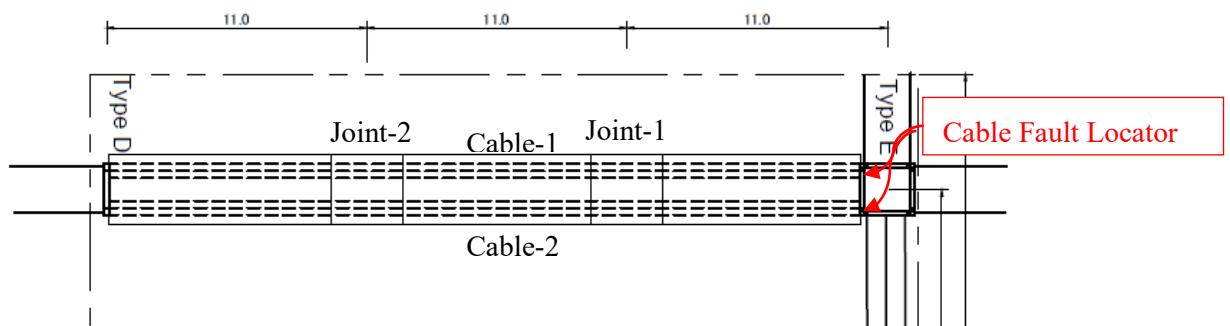
|                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6. Cable testing and diagnostics of MV cables | <ul style="list-style-type: none"> <li>• Very low frequency AC high voltage testing</li> <li>• Tan delta diagnostics</li> <li>• Partial discharge diagnostics</li> </ul>                                                                                                                                                                                                                                                                                                                                                                            |
| 7. Introduction to cable fault location       | <ul style="list-style-type: none"> <li>• Thumping a cable</li> <li>• Time domain reflectometry (TDR)</li> <li>• Arc reflection technique (ARC)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                           |
| 8. Hands-on/Practical training                | <ul style="list-style-type: none"> <li>• Functions of Cable Fault Locator STX 40 (Megger) <ul style="list-style-type: none"> <li>(1) Insulation test</li> <li>(2) DC voltage test / breakdown detection</li> <li>(3) Pulse reflection method (TDR)</li> <li>(4) Surge pinpointing</li> <li>(5) Arc reflection measurement (ARM)</li> <li>(6) Voltage decoupling (DECAY)</li> <li>(7) Current decoupling (ICE)</li> </ul> </li> <li>• Preparation of equipment, materials, gears &amp; tools</li> <li>• Procedure of cable fault location</li> </ul> |

## (1) Procedure for Underground Cable Fault Location

### a. Open end, Faultless

Conduct tests and measurement below on Cable-1 or Cable-2 at A, B or C Phase. Confirm that the cable in the section is healthy.

- Insulation test
- DC voltage test / breakdown detection
- Pulse reflection measurement (TDR)

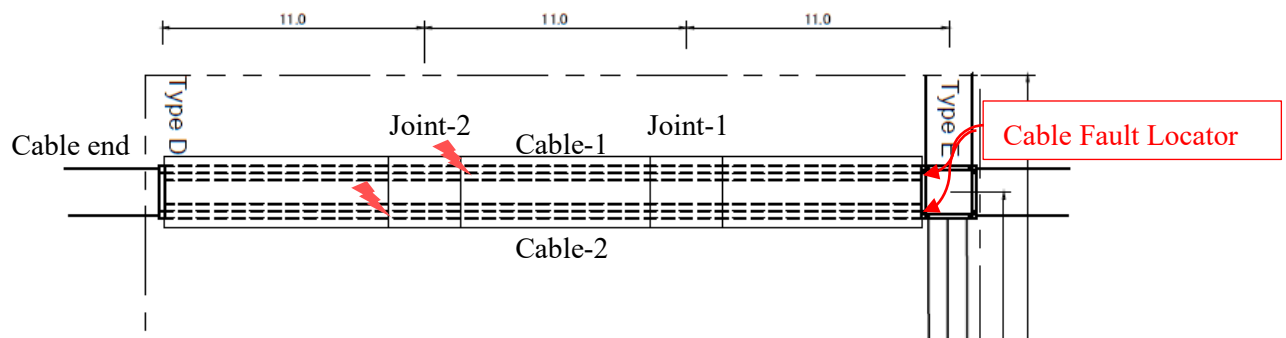


**Figure 2-1-3-3.2 Underground Cable Fault Location (Open end, Faultless)**

### b. Low resistance fault (<10 Ω)

Make a low resistance fault on Cable-1 or Cable-2. Conduct tests and measurements below on the faulty cable. Confirm that there is a fault point in the cable of the section and identify the fault point.

- Insulation test
- DC voltage test / breakdown detection
- Pulse reflection measurement (TDR)
- Surge pinpointing



**Figure 2-1-3-3.3 Underground Cable Fault Location (Low Resistance Ground Fault)**

## (2) Main Feedback from Trainees in Training Demonstration Sessions

TOT was conducted by experienced technicians from AEDC's PC&M team during the 5th, 6th, and 7th field works. The training demonstration session consisted of approximately 1 hour of classroom training and 2 hours of practical training. For the training demonstration session, a training manual (for trainees) was created based on the Reference Manual (for instructors). Each training demonstration session was held once for the 6th and 7th field work, and feedback from the trainees was obtained. The instructor had high communication skills, the training was interactive, and it was sensed that the trainees' interest was high. Since the handling of the portable cable fault locator is complex, it is necessary to allocate sufficient time for the actual practical training. The main feedback is provided in Table 2-1-3-3.1. Figures 2-1-3-3.4 to 2-1-3-3.7 show photos of the training demonstration sessions.

**Table 2-1-3-3.1 Feedback and evaluation from trainees in the demonstration session**

| Date                                                    | Main Feedback                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1st Session<br>(July 8, 2025)<br>No. of trainees: 6     | <ul style="list-style-type: none"> <li>▪ This is a very important exercise for all engineers involved in underground lines.</li> <li>▪ It would be good to develop training courses in line with actual incidents and equipment.</li> </ul>                                                                                                                      |
| 2nd Session<br>(October 23, 2025)<br>No. of trainees: 5 | <ul style="list-style-type: none"> <li>▪ The course will be good to our colleague too, because they will understand underground cable how it is been prepared, how to detect fault and trace the fault underground.</li> <li>▪ The practical aspect should be given more time so that each trainee can be opportune to use the machine independently.</li> </ul> |

For detailed feedback, see Attachment-1 No.11.



**Figure 2-1-3-3.4 1st Training Demonstration session (Classroom)**



**Figure 2-1-3-3.5 1st Training Demonstration session (Practical)**



**Figure 2-1-3-3.6 2nd Training Demonstration session (Classroom)**



**Figure 2-1-3-3.7 2nd Training Demonstration session (Practical)**

## **2-2 Results of Outputs 1-3 (for AEDC)**

The final goal of this project is to upgrade the level of technical knowledge transfer from NAPTIN to Discos by improving and enhancing the level of NAPTIN training, thus upgrading the technical and operational level of Discos. However, the assessment of the NAPTIN training course from Disco at the time of the baseline survey was, that the contents of the training were not suitable for the actual field circumstances and lacked practicality. For this reason, concrete activities for improvement and enhancement were implemented in this project based on the actual site environments and work operations in AEDC, which is one of the Discos. These activities were implemented in AEDC with the aim of making the training more practical by incorporating the details and benefits into NAPTIN training. In this project, these activities for improvement and enhancement were implemented for the three items of "loss reduction", "reliability improvement", and "quality improvement".

### **2-2-1 Pilot Project**

#### **(1) Selection of pilot project feeder**

In order to select a pilot-project feeder which can improve and enhance three items of "loss



reduction", "reliability improvement", and "quality improvement", some feeders were extracted from AEDC feeders on the condition of the following matters.

Through the field surveys, the JICA Expert Team checked whether realistic and concrete countermeasures could be taken for the feeders extracted above. As a result, H31 feeder in Apo T/S (Transmission Substation) shown in the following map (Figure 2-2-1.1) was finally selected as the target feeder for the pilot-project (the pink-colored line is the feeder route). Apo T/S H31 feeder has the following issues to be solved.

Therefore, the following improvement measures as the pilot project was implemented, proactively utilizing materials and equipment from Japan.

**Figure 2-2-1.1 Pilot-project feeder (Apo T/S H31 feeder)**

## (2) Outline and aim of the pilot project

### a. Outline of the construction for the pilot project

In the construction of the pilot project, the existing feeder (Apo T/S H31 feeder) was looped by constructing a new feeder indicated by the red line in Figure 2-2-1.2. The feeder was then divided into the north and south by the breaker of GUDU1 injection substation and the load breaking switch (LBS) was installed at the end of the feeder. Bolt-type connectors were also installed at major jumper points. For details on the implementation of the pilot project, refer to Attachment-1 No.12-1. The newly introduced equipment considered in the pilot project is as shown in Attachment-1 No.12-2.

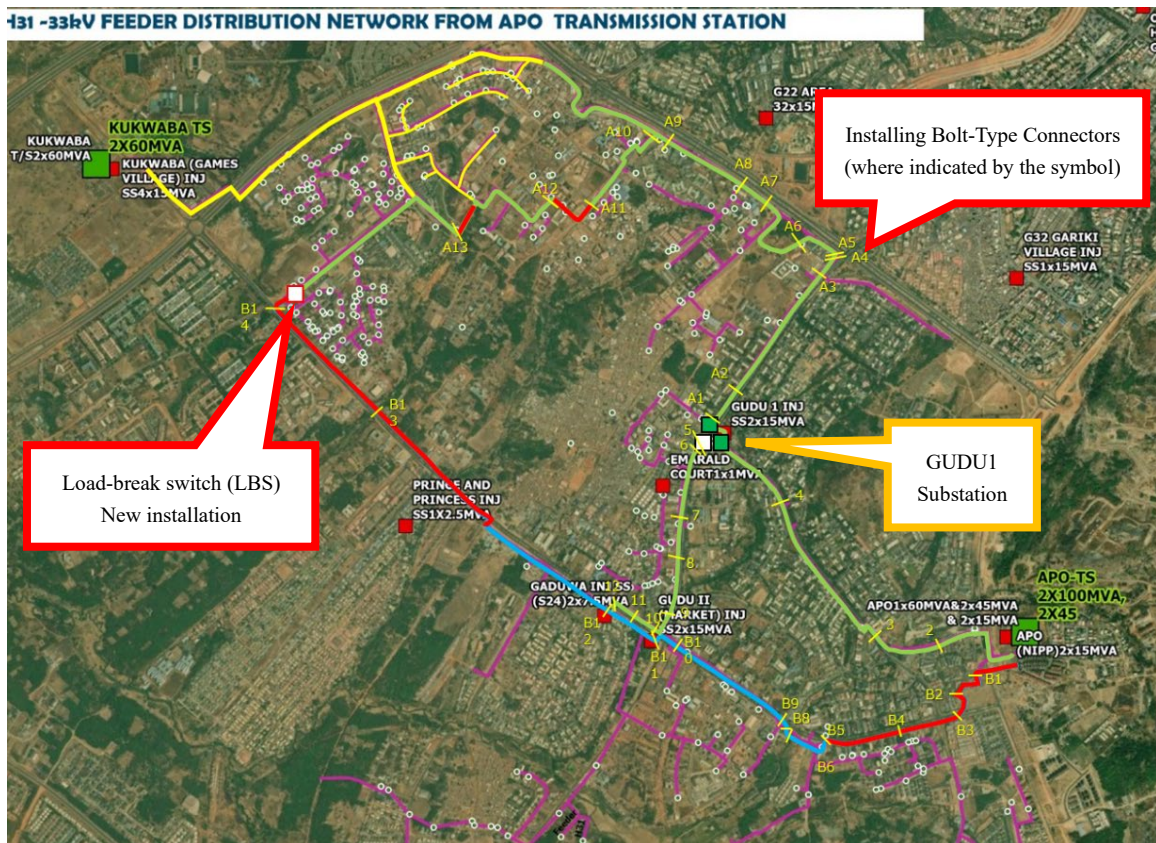


Figure 2-2-1.2 Outline of the pilot project

### b. Looping and dividing the trunk feeders [Loss reduction, quality improvement]

Once, the feeder is looped by constructing a new feeder route, and divided into two parts by the breaker in the injection substation; and the pole is mounted LBS at the end of the distribution line, current flow waste is reduced. Concentration of current at the point near the substation is also eased, so the loss is expected to be reduced and the voltage is expected to be improved. In addition, by changing the power supply source of the area around the end of feeder to the Kukwaba T/S which is closer than Apo T/S, the voltage will be improved as well.

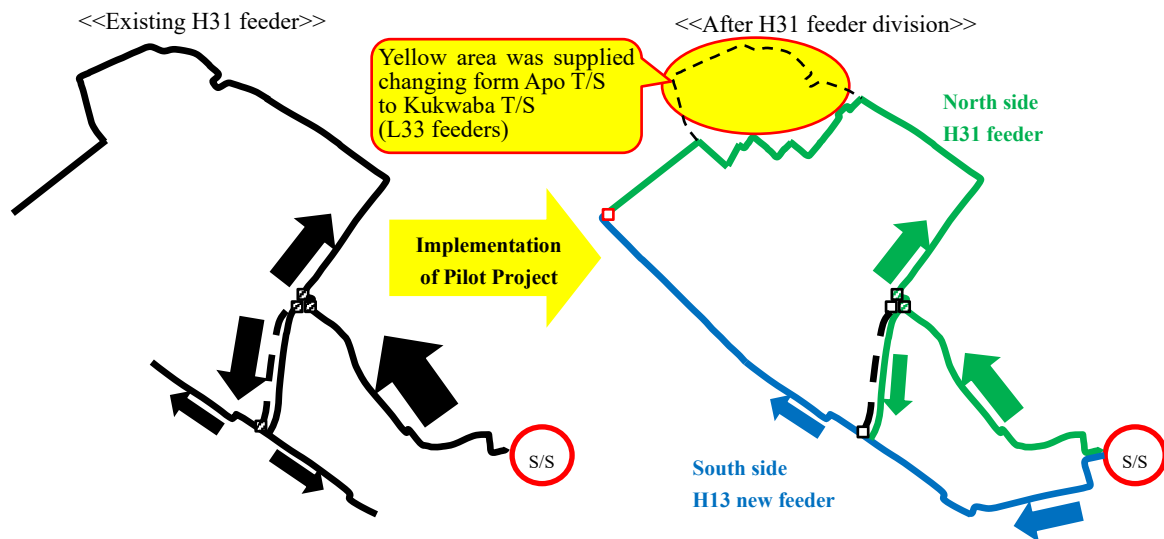


Figure 2-2-1.3 Image diagram of loss reduction and voltage drop improvement

### c. Promotion of partial energizing to intact sections by introducing bolt-type connectors [Improvement of reliability]

In order to identify and disconnect the fault section, multiple jumper connection and disconnection works must be repeatedly carried out. Therefore, bolt-type connectors are introduced at jumper connection points in order to enable these works to be carried out easily, quickly, and without damage to the jumper. This facilitates the separation of fault points into the minimum section, and the synergistic effect with the feeder looping promotes the fast partial power energizing to the intact section, which can be expected to reduce outage duration. Since the bolt-type connector was the material to be installed for the first time in Nigeria, the prior applications were submitted to NEMSA for facilities to be intalled on actual feeders in a pilot-project, and provisional permits were received.

#### Connection and disconnection of Jumpers by Bolt-type connector

<<Status quo (Binding connection)>>

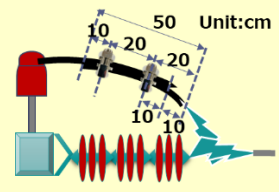


➔

<<Bolt-type connector>>



Weight: 693g/piece,  
Length: 70mm/piece



Bolt-type connectors are installed at two points to connect one phase Jumper

**Advantage of Bolt-type connector**

- > Repeatedly disconnecting and connecting jumpers is able **without jumper damage**
- > Anyone can do this work (Skill less)
- > Stable the joint quality
- > No special tools required to work




228 Pieces (38 points) were installed

Figure 2-2-1.4 Bolt-type connector overview and benefits

#### **d. Reduction of tree contact power failure by conductor covers [Improved reliability]**

In AEDC, there had been many faults (ground fault faults) caused by trees touching conductors for a long time. For the countermeasure, the installation of conductor covers was carried out as a pilot project with the goal of reducing the number of ground faults by trees.

Since conductor covers had not been used in Nigeria, it was required to obtain permission for use by NEMSA. Concretely, it was verified according to the test items and methodologies specified in ASTM standard, and it was confirmed that the conductor cover to be introduced satisfies the required specifications. By this, the provisional permission in 33kV feeder was obtained from NEMSA.

In June 2024, the first conductor cover was installed in the 33kV feeder, but the installation work which was unfamiliar took time at first. Therefore, the conductor covers were installed on only two phases due to the expiration of the power outage time, and the work was finished with the bare wire on one phase with no conductor cover installed. Installation work was not carried out the next day due to rain, but burnout occurred on that day. In addition, before the removing work, the conductor cover melted and was broken out from its back.

The following two points were found by the verification test at the manufacturer at a later date. ① The withstand voltage performance at the pin-electrode is around 31kV (the conductor cover is designed to sufficiently withstand 20kV that is the voltage to ground, but it cannot withstand the phase-to-phase voltage 33kV). ② If the conditions at the time of the melting loss (load current and wire resistance) are simulated with the conductor cover installed, the internal temperature did reach as high as 130°C and exceeded the melting temperature of the conductor cover (100mm<sup>2</sup> was used in the location where 150mm<sup>2</sup> had to be used, making the internal temperature of the cover reach the melting temperature which is between 120-130°C).

The policy was changed considering the two points above. ① Install not on the 33kV feeder but on the 11kV feeder to avoid short circuit. ② Establish the installation criteria based on the load current and the thickness of the conductor at the installation location, and install covers to the proper location where covers will not melt.

To test the durability of the conductor covers, several experimental sites without vegetation contact were selected; these tests confirmed that the covers would not melt. Following this validation, the covers were installed on the 11kV feeder at specific sites meeting the safety criteria to mitigate faults caused by vegetation.

However, over two times in June and July 2025, burnout events occurred again in the conductor covers installed on 11kV feeder. Judging from the state of the trees after the event, it was considered that the trees burned before the conductor cover burned, and that the ignition of the trees by the leakage current was the cause. There were many inappropriately-installed covers, where the fitting part was not completely closed, or the fitting part was facing upward due to twisting of the



conductor cover. Therefore, it is not possible to deny the possibility that improper installation was one of the causes of tree ignition, but there is a possibility that the conductor cover's ability to control the leakage current was not sufficient.

Though the appropriate installation methods had been taught to AEDC at every opportunity in the JICA Expert Team's field work in Abuja, it appears to be difficult to keep the installation quality high for an extended period in Nigeria, since many installation defects were discovered. Nevertheless, the possibility that the original insulation performance of the conductor cover was insufficient in the environment of Nigeria could not be ignored.

As described above, the burnout events occurred three times during the project, and it became impossible to conclude that similar events would not occur in the future. Therefore, it was decided to exclude the installation of the conductor cover from the pilot project and not verify the effect of reducing the number of faults.

See Annex-2 for details.

### **(3) Procurement of materials and equipment and construction supervision support**

In the procurement of materials and equipment, there was a possibility that the arrival of the materials and materials to be granted could be delayed due to the impact of the external factors such as tax exemption procedures among other factors. Therefore, a plan was made that only supports (concrete poles) are procured by AEDC, which are not from overseas, so AEDC can begin construction work prior to the delivery of the granted materials and equipment.

Regarding construction supervision, although the construction works in this project are positioned as being implemented by AEDC, implementation promotion for AEDC were periodically conducted in the steps of specification-making, tendering, contract, start-up instruction (advanced payment), and construction. Regarding materials and equipment to be installed for the first time in AEDC in this project, the method of installation and its cautionary notes were explained in advance at the work briefing session and the working conditions were checked at the site as appropriate. Furthermore, witness inspections were conducted—including during the mandatory NEMSA inspection—to ensure the newly constructed feeder was energized and construction remained on schedule.

### **(4) Grasping the effects of the pilot project**

Because the looping of feeders H13 (newly installed in this project) and H31 was not completed during the project period, the pilot project's impact could not be evaluated. However, the methodologies for assessing these results were transferred to AEDC, and preparations were made for future evaluation. For details on the tasks AEDC must perform to assess the pilot project's impact, please refer to Attachment-1 No.12-3.

#### **a. Quantification of Loss Reduction Effect by System Analysis**

Grasping the effect of technical loss reduction in this project was planned by calculating technical loss of the feeder before and after the pilot project by the system analysis software using the detailed network data of the feeder in which the pilot project was carried out. However, detailed network data and system analysis software were not prepared by AEDC during this project. Therefore, since there was no choice but to abandon the grasping effects in this project, the following works were conducted for AEDC's reference in the future.

##### **① Organizing Feeder Network Data**

Regarding formats for organizing feeder network data required for technical loss calculation by system analysis software, the one prepared by AEDC Headquarters was improved by the JICA Expert Team, and it was shared with the person in charge at AEDC FCT South Regional Dispatch to request data organization.

##### **② Calculation of technical loss**

Though there is no license of the system analysis software at present in AEDC, if the license is obtained in the future, the calculation of technical loss using the software can be carried out by utilizing the organized detail distribution network data.

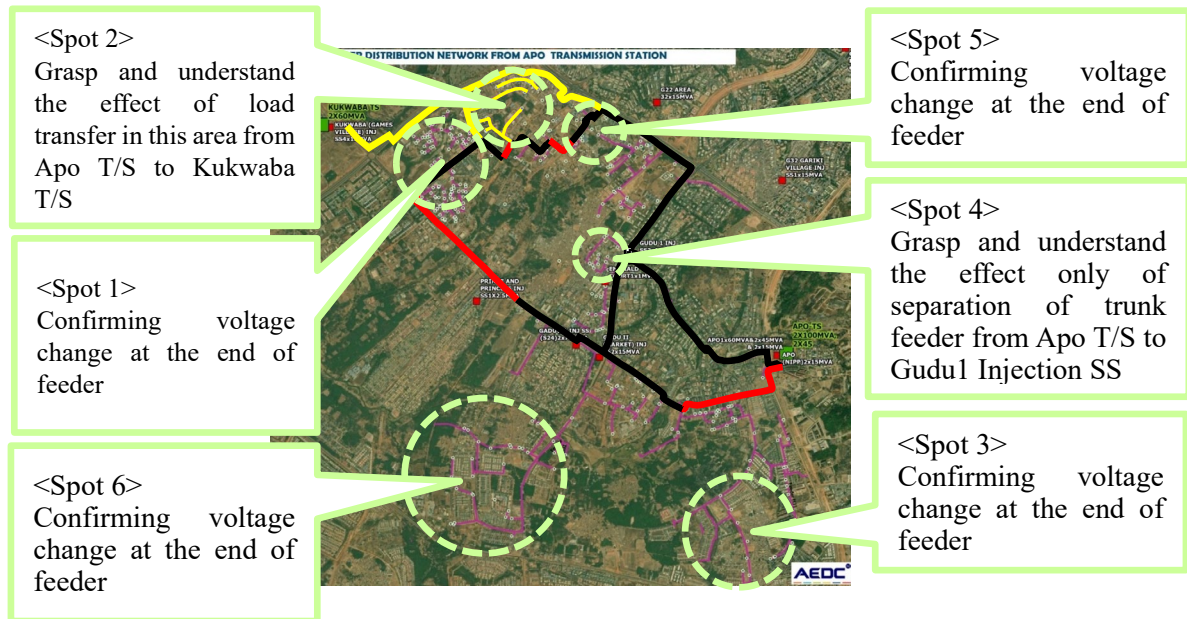
Since detailed distribution network data was not available during this project, the effect of the technical loss reduction was estimated using a very simple model (the branch line was regarded as one load, and the rated capacity of the transformer was regarded as the power load and only for line loss excepting transformer loss). As a result, the technical loss of the feeder was reduced from 202.7kW to 87.0kW (57.1% reduction) at the peak-time load (15.9MW) of the existing H31 feeder. For details on the calculation methods and results, refer to Attachment-1 No.12-4.

#### **b. Grasping the improvement of the degree of voltage drop in the feeder by measurement at the actual site**

To assess the voltage drop across the high-voltage feeder before and after the pilot project, voltages were measured on the secondary side of the connected transformers and converted to primary-side values. Measurements were taken at the following 6 areas (25 points in total):

**Table 2-2-1.1 Features of the areas where voltage measurements were conducted to grasp the effect of improvement of voltage**

| <b>Spot</b> | <b>Features of the area</b>                                                                                                                                                |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Spot 1      | Area farthest from the substation in the trunk line section                                                                                                                |
| Spot 2      | Area where the power source is changed to neighboring Kukwaba T/S L33 feeders after the pilot project, since there have been complaints from customers due to voltage drop |
| Spot 3      | Branched feeder area near the substation                                                                                                                                   |
| Spot 4      | Area where the substation trunk branches first, near Gudu1 injection substation (where 11kV loads are connected).                                                          |
| Spot 5      | Area immediately before the area of Spot 2 to be separated after the pilot project                                                                                         |
| Spot 6      | Area in the longest branch                                                                                                                                                 |



**Figure 2-2-1.5 Location of the voltage measurement area to grasp the effect of improving the voltage drop**

The actual looping work proceeded as follows.

1. The pilot project planned to eventually transfer the load in the Spot 2 area, where voltage complaints were occurring, to the Kukwaba substation (as Kukwaba is obviously closer than the Apo substation).
2. As voltage complaints worsened, AEDC transferred the load in the Spot 2 area to the Kukwaba substation before the start of the pilot project. At the time, in addition to Spot 2, the load in the Spot 1 area, required for the trunk looping, was also transferred to the Kukwaba substation (as construction of the pilot project had not yet begun).
3. As a result, the required path for the trunk looping remained within the supply area of Kukwaba substation, meaning the looping work could not be completed and the load had to be transferred back.
4. Unless the load was transferred back, the load at Apo Substation would remain reduced, and it would be impossible to compare voltage under the same conditions as before the construction not only in the Spot 1 area but also in other areas (Spots 4, 5, etc.), so voltage measurements after the pilot project were abandoned.

For details on the trunk line looping work (work to separate Kukwaba areas) that were not completed within this project period, refer to Attachment-1 No.12-5. The installation results of bolt-type connectors are shown in Attachment-1 No.12-6.

For this reason, the results of voltage measurements were shared with AEDC so that AEDC could grasp the effect of the voltage improvement as a result of the pilot project by themselves after

completion of the trunk feeder looping work. For details on the detailed voltage measurement data, refer to Attachment-1 No.12-7.

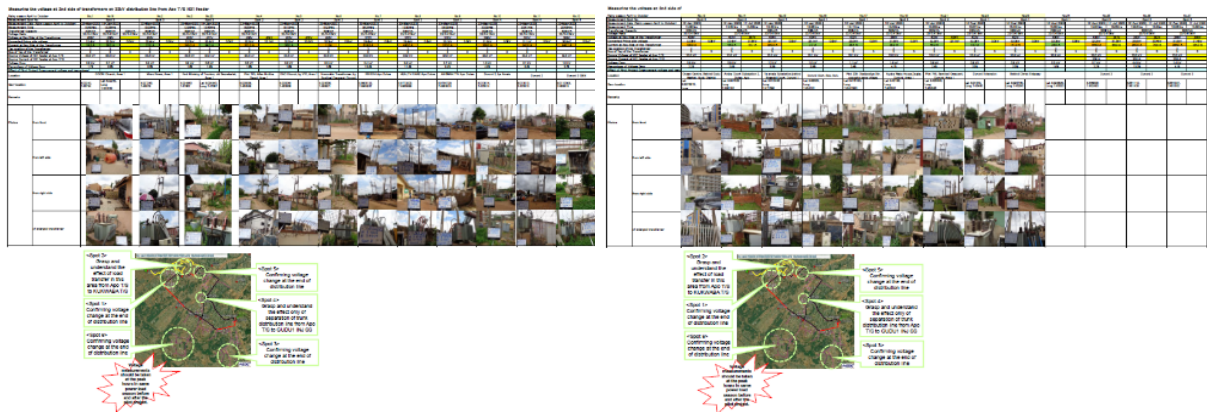


Figure 2-2-1.6 Voltage measurement result record sheet

### c. Grasp of partial energizing effect to intact section by calculation of converted outage duration time

Looping feeders proposed in the pilot project will enable backward partial energizing to the intact section(s) in the event of a power outage. Grasping the reduction effect of outage duration was made possible in this project by calculating the converted outage duration time; which is the stepwise outage duration time by partial energizing. Technical transfer was conducted for this concept, and the calculation method for the converted outage duration time was completed with the converted outage duration calculation sheet in order to grasp the reduction of outage duration time by AEDC after the looping work of the pilot project feeder.

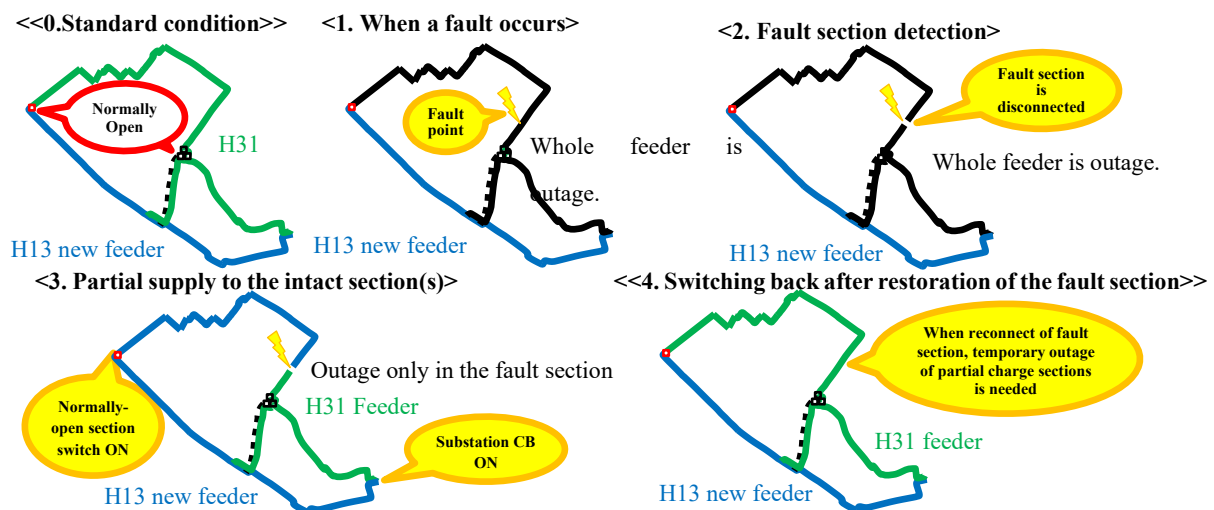


Figure 2-2-1.7 Partial energizing to the intact section(s) when a power outage occurs

### Introduction of the new indicator: "Converted outage duration time"

- If some intact sections were energized before the complete restoration, this action does reduce the number of your customers that suffer from the outage. This new indicator "Converted outage duration time" reflects such an action.
- Converted outage duration time is defined as follows:

$$\text{Converted outage duration time} = t_1 + a_1(t_2 - t_1) + a_2(t_3 - t_2) + a_3(t_4 - t_3) + \dots$$

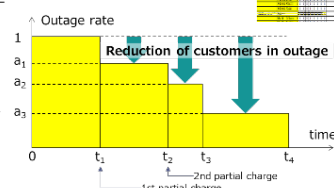
- $a_1, a_2, a_3, \dots$  : mean Outage rate

$$\text{Outage rate} := \frac{\text{Number of customers in outage}}{\text{Number of all customers}}$$

However, as grasping number of customers in outage is difficult in Nigeria, following alternative outage rate will be used.

$$\text{Alternative Outage Rate} := \frac{\text{Subtotal capacity of transformer(s) in outage}}{\text{Total capacity of all transformers in the feeder}}$$

- $t_1, t_2, t_3, \dots$  : mean the time of energizing partially
- Converted outage duration time is equal to the area of the yellow region in the right graph.



**Figure 2-2-1.8 Explanation of Converted Outage Duration Time and Calculation Sheet**

As described above, AEDC's preparation was made to calculate the converted outage duration time. However, since the looping work of pilot project feeders was not completed within this project period, there was no choice but to abandon data acquisition. In the future when the looping work is completed and outage with partial energizing occurs, it is possible to assess the reduction of outage duration time by AEDC using the converted outage duration calculation sheet illustrated above. For details on the converted outage duration calculation sheet provided, refer to Attachment-1 No.12-8.

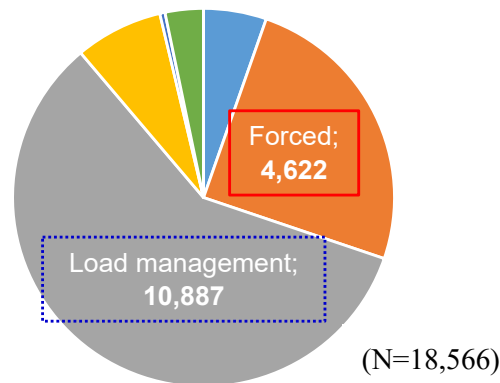
In conclusion, the looping work by AEDC was not completed within the project period, so assessing the effects of the pilot project was not possible. However, implementation of the grasping work by AEDC will be expected after their looping work is completed.

## 2-2-2 Improvement of Outage Management

### (1) Baseline survey to grasp the current situation and identify problems

In AEDC, Outage Management System (OMS) had been in operation since July 2021, enabling them to share outage information from the field to HQ all at once. In addition to the so-called Forced Outages, all kinds of outages, including outages for load-limiting (Load Management) and work-related outages (Planned Outage), are supposed to be recorded. (The system used for outage management was upgraded to Outage Management App (OMA) from June 2023, and further to the new system from 2025).

In the baseline survey, looking at the total number of 18,566 cases registered in OMS at that time by class of outage, as shown in Figure 2-2-2.1, approximately 59% were Load Management and approximately 25% were Forced Outage.



**Figure 2-2-2.1 Number of power outages by 11/33/132/330kV**

Outage due to Load Management is often caused by a shortage of power supply (power generation) and is not directly concluded as AEDC's responsibility. Therefore, from the viewpoint of reducing the total number of outages, it was considered reasonable to focus on reducing the number of Forced Outages that account for about one-quarter of the total.

Through the baseline survey, the following problems in the recording method of outage (distribution fault) were extracted.

"Nature of Fault" (aspect of the fault, "Fault Details" after OMA) and Root Cause Analysis (root cause of the fault, "Root Cause" after OMA) are registered for every single outage event. For Nature of Fault, operators can selectively register the appropriate one from the list, but Root Cause Analysis was free-form (and therefore not suitable for record analysis). The image of this information input is shown in Figure 2-2-2.2.

**Figure 2-2-2.2 Image of ourage information input**

When JICA Expert Team checked the registration circumstance of outage information, the following problems were found.

- Regarding Nature of Fault, it turned out that 4228 of 4274 cases (98.9%) were registered as "Other".
- When the JICA Expert Team checked the Root Cause Analysis of the event in which Nature of Fault is "Other", the descriptions of "Cable Fault" and "Wire Cut" etc. existed in several hundred units respectively. "Cable Fault" and "Wire Cut" are only phenomena (content to be

described in Nature of Fault originally). Descriptions should reveal why "Cable Fault" and "Wire Cut" occurred in Root Cause Analysis.

Root Cause Analysis was free-form and therefore not suitable for record analysis.

- In addition to Outage Management System, there was another system called "Fault Reporting Dashboard", and since there is no systematic link between the two, data entry was also very inefficient.

In summary, 98.9% of Nature of Fault is "Other", which makes it very difficult to analyze faults quantitatively and efficiently. This is not desirable from the viewpoint of efficient investment of corporate resources. Therefore, there is room to improve outage management, including a review of the input-rule and Nature of Fault items themselves.

## **(2) Consideration of ways of improvement**

Based on the results of the baseline survey, the focus was on the more efficient utilization of the system used for outage management, and improvement measures were considered. Concretely, the following two points were emphasized, and the system was modified. The summary of the OMS improvement is as shown in Attachment-1 No.13-1.

- ① Introduce the Fault Reporting Dashboard items in the Outage Management System and eliminate Fault Reporting Dashboard.
- ② For Nature of Fault and Root Cause that are critical in the fault-analysis, the JICA Expert Team and AEDC HQ dispatch worked together on rearrangement of the items, so that "Other" cannot be easily used. Root Cause was changed from free form to drop-down form in order to improve the effectiveness of fault analysis.

At the same time, the JICA Expert Team explained the outline of the system-modification and the importance of surely inputting Nature of Fault and Root Cause to the persons in charge of Regional Dispatches, and requested from them steady accumulation of the fault record.

## **(3) Accumulation of fault records using modified systems**

**[First] June 2023 to December 2023** (For analysis data, refer to Attachment-1 No.13-2)

The JICA Expert Team analyzed the records of faults that occurred between June and December 2023 and were registered in the system. As shown in Table 2-2-2.1, the register rates of Fault Details and Root Cause differed from one Regional office to another, and that of whole AEDC was approximately 50-60%, which was not considered appropriate as an analytical target to obtain valid data through quantitative analysis. In FCT South region and Kogi region, the number of forced outages registered during the period was zero. Compared to other regions, it was unlikely that a fault did not occur at all over six months. This was a manifestation of not even registering a forced outage that occurred, and this indicated that system usage in AEDC was not thorough.



**Table 2-2-2.1 Number of forced outages and Fault Details,  
Root Causes registered between June 2023 and December 2023**

| Region          | Number of forced outages | Fault Details registered |       | Root Causes registered |       |
|-----------------|--------------------------|--------------------------|-------|------------------------|-------|
|                 | [a]                      | [b]                      | [b/a] | [c]                    | [c/a] |
| FCT Central     | 115                      | 73                       | 63.5% | 83                     | 72.2% |
| FCT East        | 62                       | 37                       | 59.7% | 43                     | 69.4% |
| FCT North       | 27                       | 17                       | 63.0% | 16                     | 59.3% |
| FCT South       | 0                        | 0                        | ---   | 0                      | ---   |
| FCT South East  | 84                       | 24                       | 28.6% | 30                     | 35.7% |
| FCT South South | 41                       | 34                       | 82.9% | 34                     | 82.9% |
| FCT West        | 11                       | 5                        | 45.5% | 9                      | 81.8% |
| Nasarawa        | 18                       | 13                       | 72.2% | 15                     | 83.3% |
| Niger           | 131                      | 57                       | 43.5% | 67                     | 51.1% |
| Kogi            | 0                        | 0                        | ---   | 0                      | ---   |
| Total           | 489                      | 260                      | 53.2% | 297                    | 60.7% |

There was a shortage of data available for analysis as whole at AEDC, but in some Regions, the number of registered Fault Detail and Root Causes were comparatively large, and the analysis of tendency of the cause of the fault was carried out for such Regions. Major combinations of Root cause and Fault detail and possible measures for them were then provided to AEDC (HQ Dispatch) as shown in Tables 2-2-2.2.

**Table 2-2-2.2 Major Root cause and Fault detail Combinations and Possible Measures (1st)**

| Root Causes                    | Fault Details                   | Possible Solutions                                                                                                                           |
|--------------------------------|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| Aging                          | Wire cut                        | <ul style="list-style-type: none"> <li>● Creating and implementing the replacement plan</li> <li>● Try to use conductor covers</li> </ul>    |
|                                | Broken wooden cross arm         | <ul style="list-style-type: none"> <li>● Creating and implementing the replacement plan</li> <li>● Replacement at every discovery</li> </ul> |
|                                | Jumper cut                      | <ul style="list-style-type: none"> <li>● Require contractor for better installation</li> <li>● Try to use bolt-type connectors</li> </ul>    |
| Other objects touched the line | Line was hit or touched by tree | <ul style="list-style-type: none"> <li>● Proper vegetation control</li> <li>● Try to use conductor covers</li> </ul>                         |
| Stormy rain                    | Wire cut                        | <ul style="list-style-type: none"> <li>● Creating and implementing the replacement plan</li> </ul>                                           |

Additionally, the following points were conveyed to AEDC. However, it was not submitted in a official format, so it is unclear whether it was officially acknowledged by the AEDC.

- Data analysis is indispensable in considering countermeasures against any faults (forced outages), and data analysis must be conducted from a quantitative point of view in order to ensure the appropriateness of the countermeasures. This leads to the efficient use of AEDC's limited resources.
- For this reason, accurate outage recording is crucial, but the current registration rates of Fault Details and Root Causes are about 50-60%, so the reliability of the analysis acquired this time was not sufficiently high. The data shortage makes it difficult to grasp the tendency of faults.
- Since the tendency of faults differs from one Region to another, it is necessary to analyze each Region in order to take truly appropriate countermeasures.

There was no feedback from AEDC on the above-mentioned analysis and suggestions.

**[Second] June 2023-June 2025** (For analysis data, refer to Attachment-1 No.13-3)

#### **a. Limitation of forced outages to be analyzed**

In AEDC, minimum guaranteed supply hours per 24-hour period differ by feeder, which in turn results in different tariffs charged to consumers. Consistent with expectations, areas with longer guaranteed supply hours are associated with higher tariffs, and such areas tend to be inhabited by higher-income households, improving the prospects for tariff collection. For this reason, AEDC also prioritizes investing in feeders with longer guaranteed supply hours and efficient tariff collection.

The first analysis was conducted for all feeder faults (as well as the consideration and proposal of countermeasures), but taking the above-mentioned AEDC's policy into account, the all-sample analysis is not particularly informative. A more pragmatic strategy is to restrict the analysis to feeders with longer minimum guaranteed supply hours.

Therefore, the JICA Expert Team decided to accumulate and analyze the forced outage data by focusing on feeders with the longest minimum guaranteed supply hours (Band A feeders: 20 hours or more of supply guarantee during 24 hours) and consider countermeasures based on the tendency.

#### **b. Analysis of forced outages in Band A feeders**

The record of all kinds of outages from June 2023 (commencement of OMA operation) to June 2025 were acquired from AEDC, and the records of forced outages in Band A feeders were prepared by matching with the lists of Band A feeders published on NERC website. Tables 2-2-2.3 shows register rates of Fault Details and Root Cause for each Region for forced outages only in Band A feeders. The register rates of Fault Details and Root Cause across all of AEDC is about 40-50%, which is lower than the previous analysis.

**Table 2-2-2.3 Number of forced outages and Fault Details and Root Causes registered between June 2023 and June 2025 (Band A feeder only)**

| Region          | Number of forced outages | Fault Details registered |       | Root Causes registered |        |
|-----------------|--------------------------|--------------------------|-------|------------------------|--------|
|                 | [a]                      | [b]                      | [b/a] | [c]                    | [c/a]  |
| FCT Central     | 299                      | 121                      | 40.5% | 162                    | 54.2%  |
| FCT East        | 0                        | ---                      | ---   | ---                    | ---    |
| FCT North       | 42                       | 28                       | 66.7% | 30                     | 71.4%  |
| FCT South       | 0                        | 0                        | ---   | 0                      | ---    |
| FCT South East  | 58                       | 34                       | 58.6% | 39                     | 67.2%  |
| FCT South South | 106                      | 16                       | 15.1% | 32                     | 30.2%  |
| FCT West        | 15                       | 1                        | 6.7%  | 11                     | 73.3%  |
| Nasarawa        | 10                       | 7                        | 70.0% | 10                     | 100.0% |
| Niger           | 44                       | 21                       | 47.7% | 24                     | 54.5%  |
| Kogi            | 51                       | 12                       | 23.5% | 12                     | 23.5%  |
| Total           | 625                      | 240                      | 38.4% | 320                    | 51.2%  |

As in the case of the first data-accumulation, some Regions had a relatively large number of Fault Detail and Root Causes registered, and for such Regions the tendency of the cause of the fault was

analyzed. Possible countermeasures were presented and some examples are shown in Table 2-2-2.4.

**Table 2-2-2.4 Major Root cause and Fault detail Combinations and Possible Measures (Second)**

| Root Causes                    | Fault Details                   | Possible Solutions                                            |
|--------------------------------|---------------------------------|---------------------------------------------------------------|
| Imperfect maintenance          | Jumper cut                      | Use of proper connectors                                      |
| Other objects touched the line |                                 |                                                               |
|                                | Line was hit or touched by tree | Much more frequent trimming                                   |
| Imperfect facility             |                                 |                                                               |
| Stormy rain                    | Jumper cut                      | Use of proper connectors                                      |
|                                | Termination failure             | Perfect installation<br>Periodic partol for better prevention |
|                                | Straight through failure        |                                                               |
| Water ingress                  |                                 |                                                               |

Based on the above, the following points were conveyed to AEDC HQ Dispatch. However, as with the first case, this was not a official submission.

- AEDC has a system that is suitable for efficient and appropriate analysis by using objective data as well as the accumulation of fault data. However, at present, the system has not been fully utilized. The analysis results are not fully on-target because of the small number of data worthy of analysis and lower reliability.
- It is essential to accumulate accurate outage records; consistent data collection is a priority for the project's success. As a countermeasure, HQ Dispatch can monitor registration status daily and coordinate with Regions to ensure all causes are captured. This will be supported by strong HQ oversight and enhanced cooperation between HQ and Regions.
- Though the measures to be taken differ depending on Region, what can be said about all Regions is that while there is intent to reduce forced outages, concrete action should follow for meaningful change.
- It is understandable that, from the viewpoint of landscape protection, it is difficult to cut trees on a massive scale in Abuja. However, if AEDC wishes to reduce the ground fault caused by tree contact, more frequent vegetation control is necessary even on a small-scale.
- The JICA Expert Team recommends AEDC takes the necessary step on a trial basis, even if it is only for Band A distribution feeders to start.

As in the first analysis, there was no feedback from AEDC on the aforementioned observations and suggestions. In addition, it was difficult to communicate with AEDC, partially because the person in charge suddenly resigned. Therefore, on October 21, 2025, during JICA Expert Team's 7th field work in Abuja, the JICA Expert Team gave a presentation for AEDC's CTO and management regarding the improvement of the reliability and suggestions for that including the aforementioned points (importance of appropriate fault-record accumulation). (Refer to

Attachment-1 No.13-4) CTO instructed the management attending there to properly accumulate records of outages using the system.

## **2-3 Results of Output 4**

While Outcomes 1 through 3 of this project concerned the development and implementation of training courses related to loss reduction, reliability improvement, and quality improvement; the project's goals cannot be achieved unless Disco utilizes the training courses after taking them. Therefore, this project positioned activities to promote the utilization of the NAPTIN training as Outcome 4. Activities related to Outcome 4 will play a crucial role in sustaining the project's outcomes and enabling horizontal deployment to other Discos. To achieve Outcome 4, WG4 was established separately from the technical working groups to examine training deployment methods and conducted activities. For WG materials, refer to Attachment-1 No.14-1 to 14-4.

### **2-3-1 Collecting information, analysis, and presentation of improvement plans for Career framework**

In implementing activities within WG4, we established a framework and clearly defined roles for ANED's active involvement from the initial stages to facilitate horizontal deployment to other Disco companies. Three NAPTIN instructors, two AEDC HR department members, and one ANED representative were selected as working group members, and activities commenced following the 4th field work. Positioning AEDC, the counterpart for this project, as the representative of the 11 Discos nationwide, information gathering was conducted from AEDC regarding the career framework and the utilization status of NAPTIN training. This was achieved through meetings during the on-site visit and web conferences.

During the initial activities of WG4, AEDC was interviewed regarding the utilization status and challenges of NAPTIN training. AEDC's training plan for engineers includes 38 courses, of which 31 utilize internal resources and 7 utilize external resources, including NAPTIN. The internal training courses cover diverse areas related to Disco's activities, specifically including Standard Operating Procedures (SOPs), Work Permit Systems, Maintenance, Relays and Protection, Accident Prevention, Loss Reduction, Safety Management, Metering, and NERC Regulations. Key topics covered by external resources include smart distribution panels, power protection systems, loss calculations using NEPLAN, switchgear and transformer maintenance, cable joints, and instrument management. Three of these courses are delivered in an e-learning format.

AEDC maintains its own training facilities at the Gwagwalada (power line training ground) and the Garki training room. According to AEDC's human resources department, NAPTIN has contributed to enhancing AEDC's overall capabilities through diverse training modules. These include training on new technologies, maintenance methodologies, and energy management systems, which aid in operational optimization and loss reduction. However, some feedback indicated that NAPTIN training often focuses on basic, textbook-style content with limited practical training.

Through interviews with AEDC's HR department, it was revealed that the primary challenge in sending staff for external training is insufficient training budget. AEDC has formulated the aforementioned training plan, which includes external training, but budget constraints prevent the plan from being fully

implemented. Therefore, reducing training costs was identified as the top priority for promoting participation in NAPTIN training by Disco. WG4 discussed various measures to help reduce these training costs.

Regarding the positioning of NAPTIN training within the career framework, under AEDC's personnel system, completing specific NAPTIN training courses is not a requirement for salary increases or promotions. The conditions for career advancement for engineers at AEDC involve gaining experience across various departments and acquiring the necessary technical skills and competencies. Training is positioned as one means to acquire these required technical skills and competencies. The same applies to completing NAPTIN training.

## 2-3-2 Information Sharing with Other Discos

WG4 was established and activities were conducted with the objective of having the NAPTIN training program developed under this technical cooperation project widely attended by distribution companies (Discos) to improve distribution operations. During the 5th field work, an online workshop was held on January 31, 2025, to introduce the classroom training courses developed under the technical cooperation project to other Discos. Information was shared on the classroom training courses improved under this project (loss reduction, reliability improvement, quality improvement) and the content of the practical training courses currently under development (phase comparison, overhead line fault detection, underground cable fault detection). An outline of NAPTIN online workshop is shown in Table 2-3-2.1. For presentation materials, see Attachment-1 No.14-5.

**Table 2-3-2.1 Summary of NAPTIN Online Workshop**

|              |                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Date & Time  | 31st January, 2025 10:00 – 12:00 (Nigerian Standard Time)                                                                                                                                                                                                                                                                                                                                                  |
| Venue        | Meeting Room Obecha-B, Abuja Continental Hotel<br>Address: Zone 4, 1 Iadi Kwali St, Wuse, Abuja 900001, Federal Capital Territory, Nigeria                                                                                                                                                                                                                                                                 |
| Objective    | To share information with Discos regarding the content and learning outputs of the classroom training courses, and to promote participation                                                                                                                                                                                                                                                                |
| Agenda       | <ol style="list-style-type: none"> <li>1. Outline of Work Plan</li> <li>2. Outline of NAPTIN's new training courses <ol style="list-style-type: none"> <li>(1) Technical Loss Reduction</li> <li>(2) Reliability Improvement</li> <li>(3) Quality Improvement</li> </ol> </li> <li>3. Outline of Distribution Training Equipment and Practical Training Courses</li> <li>4. Question and answer</li> </ol> |
| Participants | <ul style="list-style-type: none"> <li>• C/P</li> <li>• AEDC</li> <li>• NAPTIN</li> <li>• FMP</li> <li>• ANED</li> <li>• Other Discos (Online)</li> <li>• JICA Nigeria Office</li> <li>• JICA Expert Team</li> </ul>                                                                                                                                                                                       |

## 2-3-3 Reflection on NAPTIN training

Results from the AEDC survey regarding participation in NAPTIN training revealed that the primary obstacle to promoting NAPTIN training participation is insufficient training budgets, indicating a need

to reduce the training costs borne by Disco. According to NAPTIN instructors, approximately 60% of training costs are allocated to actual expenses such as lodging and meals. Reducing these costs incurred during in-person training sessions would enable overall training cost reduction. Regarding this point, WG members proposed countermeasures including converting training to e-learning, shortening training duration, and utilizing subsidies. Table 2-3-2.2 shows the measures and proposals discussed in WG4 to promote participation in NAPTIN training. Among these, it was decided to prioritize implementing the conversion of classroom-based training to e-learning, as this is feasible as a project activity and is already partially implemented by NAPTIN. Furthermore, discussions were held on how to promote the newly established training courses within NAPTIN's training programs and how to increase motivation for participation in the training.

**Table 2-3-2.2 Measures and Proposals Discussed in WG4 to Promote Participation  
in NAPTIN Training**

| No | Implementation Items                                                                                                 | Implementation period                     | Implementation Site                | Implementing entity                                                 | Goal                                     | Implementation Details                                             |
|----|----------------------------------------------------------------------------------------------------------------------|-------------------------------------------|------------------------------------|---------------------------------------------------------------------|------------------------------------------|--------------------------------------------------------------------|
| 1  | ① Online Workshop on the New Training Course                                                                         | Friday, January 31, 2025, 10:00 AM–       | Inside the Abuja Continental Hotel | ①The JICA expert team and NAPTIN will collaborate with FMP and ANED | Promoting Participation in this Training | New Training Course Promotion                                      |
|    | ②Notice of New Training Courses available on the NAPTIN Website                                                      | as needed                                 | NAPTIN (Website)                   | ②NAPTIN                                                             | Ditto                                    | Ditto                                                              |
|    | ③ To enhance understanding of the new training content, utilize training session videos on social media and YouTube. | as needed                                 | NAPTIN (on social media)           | ③NAPTIN                                                             | Ditto                                    | Ditto                                                              |
| 2  | Invite Disco trainees to a free trial training session (full program)                                                | To be determined                          | NAPTIN Training Facility           | NAPTIN                                                              | Promoting participation in this Training | Implementation of Trial Training (Full Program)                    |
| 3  | ①Introduction of e-learning                                                                                          | as needed                                 | NAPTIN Training Facility           | NAPTIN                                                              | Reduction in training expenses           | Measures to lower the barriers to participation in NAPTIN Training |
|    | ② Creation of custom training programs that fully align with training needs                                          | Ditto                                     | Ditto                              | Ditto                                                               | Ditto                                    | Ditto                                                              |
| 4  | ①Implement a training plan that incorporates new training courses                                                    | The 2025 training plan has been finalized | AEDC Facility Conference Room      | ①AEDC, JICA Expert Team, and NAPTIN                                 | Promoting Adoption to Other Discos       | Promoting the introduction of new training courses                 |



|   |                                                               |                                               |       |                             |                                                                     |                                                             |
|---|---------------------------------------------------------------|-----------------------------------------------|-------|-----------------------------|---------------------------------------------------------------------|-------------------------------------------------------------|
|   | into the AEDC training program.                               | and is awaiting board approval.               |       |                             |                                                                     | into Disco's own training plan                              |
|   | ② Disseminate the experience gained from AEDC to other Discos | To be determined                              | -     | ② NAPTIN and ANED           | Ditto                                                               | Ditto                                                       |
| 5 | ① Develop a career framework                                  | Development complete, awaiting board approval | AEDC  | ① AEDC                      | Clarify the conditions for employee promotions and salary increases | Evaluate the AEDC career framework and propose improvements |
|   | ② Review the developed career framework                       | To be determined                              | Ditto | ② JICA Expert Team          | Ditto                                                               | Ditto                                                       |
|   | ③ Propose an improvement plan for the career framework        | To be determined                              | Ditto | ③ JICA Expert Team and AEDC | Ditto                                                               | Ditto                                                       |
|   | ④ Incorporate the proposal into the AEDC career framework     | To be determined                              | Ditto | ④ AEDC                      | Ditto                                                               | Ditto                                                       |

To promote NAPTIN's new training programs, we proposed measures such as introducing the new training through online workshops and creating a dedicated section on the NAPTIN website to showcase the new offerings. With support from AFD, NAPTIN's Training Management and Information System portal has been established, enabling users to view training content and register for courses online.

NAPTIN training currently incorporates e-learning. To convert the training materials developed for this project into e-learning, we will proceed with converting classroom training into e-learning following the procedures and content outlined in Table 2-3-2.3.

**Table 2-3-2.3 Procedure of converting classroom trainings into e-learning courses**

| Steps for Improving E-Learning Materials                    | Workflow for Creating e-Learning Materials                                                                                                                                                                                                                                                           |
|-------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Step-1<br>Select contents suitable for e-learning           | 1. Classroom trainings (All or selected parts?)<br>1-1 Technical loss reduction<br>1-2 Reliability improvement<br>1-3 Quality improvement<br>2. Practical trainings (Explanation on theory only)<br>2-1 Phase comparison<br>2-2 Overhead line fault location<br>2-3 Underground cable fault location |
| Step-2<br>Develop training materials for e-learning courses | 1. Modify developed training materials for the three classroom trainings above (1-1, 1-2 and 1-3) to fit e-learning<br>2. Develop e-learning contents of the practical trainings for three courses above (2-1, 2-2 and 2-3)                                                                          |
| Step-3<br>Review and feedback from JICA Experts             | JICA Experts will review the developed e-learning contents and give feedback to NAPTIN.                                                                                                                                                                                                              |
| Step-4<br>Finalize the e-learning contents                  | NAPTIN will finalize the e-learning contents incorporating feedback from JICA Experts.                                                                                                                                                                                                               |

The three pieces of content developed during the project were selected as suitable for e-learning. To convert classroom training courses into e-learning, NAPTIN itself must create the e-learning content. When JICA experts reviewed an existing e-learning course (Power System Loss Reduction) created by NAPTIN instructors, they observed numerous instances where the instructor appeared alone on screen delivering explanations. The videos were lengthy lectures conveying course content. While slides were projected in some sections, it was often unclear which part of the slide was being discussed, with information conveyed almost entirely through audio. The current e-learning course is difficult for students to follow and is also lengthy, making it hard to maintain concentration. Therefore, the JICA expert introduced examples of e-learning used for internal training and provided guidance on points for improvement. Specifically, they recommended shortening the duration of each content segment and making better use of slides, diagrams, and photographs. Improvement recommendations for the existing e-learning course are shown in Attachment-1 No.14-6.

As we entered fiscal year 2025 and were advancing our e-learning implementation plans, the AEDC HR department pointed out the inefficiencies of e-learning. NAPTIN recognized the following challenges with e-learning:

**1. Decreased attention during virtual sessions**

**2. Monitoring and attendance issues**

**3. Low engagement and interaction**

**4. Unstable internet connectivity**

**5. Insufficient access to appropriate devices**

**6. Limited digital literacy**

**7. Power supply interruptions**

※4,5, 6,7 are issues beyond NAPTIN's control.

For the main challenges, 1, 2, and 3, solutions are outlined below.

**Issue 1. Decreased attention during virtual sessions**

Unlike in-person training sessions, which typically last 6-7 hours while minimizing external distractions, maintaining learner focus for the same duration in e-learning is considerably challenging. Online, factors like screen time, home distractions, and limited physical interaction quickly lead to fatigue, resulting in reduced concentration, passive participation, and lower overall engagement levels. Learners often multitask or completely disconnect during extended e-learning sessions, negatively impacting learning quality and retention.

**【Strategies to Maintain Focus】**

| <b>Solution</b>                            | <b>Contents</b>                                                                              |
|--------------------------------------------|----------------------------------------------------------------------------------------------|
| Incorporate group discussions              | Enhancing participation through exchange of opinions among participants                      |
| Insert quizzes and polls as appropriate    | Conduct quizzes and polls at short intervals to give participants time to think.             |
| Take frequent breaks                       | Take regular breaks during long training sessions to reset participants' concentration.      |
| Lectures actively engage with participants | Ask questions and provide feedback to participants to increase their sense of participation. |
| Use the survey function                    | Confirm understanding of content with short tests to maintain concentration.                 |

**Issue 2. Monitoring and Attendance Challenges**

During e-learning sessions, it is difficult to verify whether participants are actively engaged, especially when cameras or interactive tools are unavailable. This raises concerns about learning effectiveness and participant accountability. The following countermeasures to technical issues which prevent the participation in e-learning are proposed.

**【Countermeasures for Technical Issues related to the participation in e-learning】**

| <b>Solution</b>                       | <b>Contents</b>                                                                                                                |
|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| Conduct a rehearsal in advance        | Before training, check connections and test tools to prevent problems before they occur.                                       |
| Distribute clear operating guidelines | Distribute materials explaining how to use the tools to participants in advance to reduce operational errors.                  |
| Utilizing recordings                  | Record the training session so that participants who were unable to attend due to connection problems, etc. can view it later. |
| Assign support staff                  | Have staff available to respond quickly in the event of technical problems.                                                    |
| Prepare backup means of communication | Prepare alternative means of communication, such as email and chat, to ensure smooth response in case of trouble.              |

**Issue 3. Low engagement and interaction**

E-learning often lacks real-time interaction, leading to passive learning. Participants have expressed a preference for face-to-face learning, where they can freely ask questions and receive immediate feedback. This is particularly important considering that most of our training requires hands-on work.

**【Communication Improvement Measures】**

| <b>Solution</b>                    | <b>Contents</b>                                                                                                                                    |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| Accept questions in real time      | Set aside time for questions and answers via chat or voice chat so that participants can immediately ask questions about points that concern them. |
| Utilize post-course questionnaires | Collect feedback and opinions from participants through questionnaires and reflect them in future training sessions.                               |
| Conduct a test                     | Conduct tests to measure understanding of the contents and provide participants with opportunities for self-assessment.                            |
| Set aside time for discussion      | Set aside time for participants to exchange opinions with each other and deepen their learning.                                                    |

|                           |                                                                                                        |
|---------------------------|--------------------------------------------------------------------------------------------------------|
| Utilize breakout sessions | Hold small group discussions and provide opportunities for participants to actively exchange opinions. |
|---------------------------|--------------------------------------------------------------------------------------------------------|

We are proposing to NAPTIN the following to address challenges in advancing e-learning.

**【Proposal Details】**

- Introduce on-site training sessions. Instead of having participants come to the facility, NAPTIN will dispatch instructors. This approach is expected to reduce costs through instructor travel.
- Implement microlearning. While typical e-learning content lasts 30 minutes to an hour, microlearning sessions range from 1 to 5 minutes. The advantage of microlearning is that busy learners can utilize their spare moments to advance their studies.
- Benefits of Video-Based Learning Materials  
The advantages of video-based learning materials—such as recordings of instructor lectures (currently in use) and animated videos featuring characters—lie in their ability to deepen learner understanding through a visual approach.
- Blended Learning  
Blended learning combines "different types of learning methods," such as face-to-face instruction with e-learning, or e-learning with hands-on training. Its benefit is enabling more efficient and deeper learning compared to relying solely on one method like face-to-face instruction alone.
- Using "Role-Playing-Based Troubleshooting Training" as an example: Learners repeatedly consider how to address each prepared trouble scenario, compare their responses to correct solutions, and learn pathways for smoothly resolving issues.

Based on the above, the final JCC meeting held on October 30, 2025, reported on the outcomes of WG4's activities.

NAPTIN's Training Calendar 2025 had scheduled courses on reliability improvement and quality improvement for late March 2025, and on distribution loss reduction for late April 2025. However, these trainings were not conducted due to a lack of applications from the Discos. Upon conveying this situation to the FMP (Director of Distribution), the FMP commented that they would issue a letter to Disco urging participation in the training and would also send FMP staff to participate in the training. AEDC's Human Resources Department included four NAPTIN training courses (three of which were developed by this project) in the 2025 Training Plan. AEDC incorporated the three NAPTIN classroom training courses developed through the JICA project into its 2025 training plan. Furthermore, with the approval of the FMP's Deputy Secretary General, 21 employees are scheduled to participate in NAPTIN training courses. Additionally, the development of e-learning contents for three new classroom training courses (Technical Loss Reduction, Reliability Improvement, and Quality Improvement) will be completed, with their release scheduled by the end of February 2026.

## 2-4 Others

### 2-4-1 Results of considerations on gender, peace-building, poverty reduction, etc.

Both NAPTIN and AEDC employ a significant number of female staff. Gender equality within the Project was achieved through the routine efforts of the Counterparts, such as Human Resources Department in AEDC ensuring gender balance when selecting participants for training course.

Female engineers actively participated in and implemented activities for WG1-3 and WG4 without discrimination. In particular, women played a significant role in WG4, accounting for 2 out of 3 members from NAPTIN, 2 out of 3 from AEDC, and 1 out of 1 from ANED.

Regarding NAPTIN TOT, 3 out of 8 instructors were women. In the Demonstration Training course, female participation was as follows: 2 out of 13 participants for "Loss Reduction," 1 out of 17 for "Reliability Improvement," and 3 out of 16 for "Quality Improvement." For the Practical Demonstration Training course covering "Phase comparison work on distribution lines", "Overhead line fault location" and "Underground cable fault location", the number of participants remained consistent across all courses, with 1 female engineer out of 11 participants taking part in the implementation.

It is believed that the improvement of Discos' operational capabilities achieved through this Project is expected to contribute to the development of the regional economy and the improvement of the quality of life for residents through the stabilization of power supply.

### 2-4-2 Results of public relations activities

To disseminate the Project's activities to NAPTIN, AEDC, and other Discos beyond the direct Counterparts, the seminar was held on 31st May, 2023. In addition to attendees from FMP, NAPTIN, and AEDC, approximately 20 participants from other Discos joined online, leading to an active exchange of opinions. An outline of the seminar is shown in the table below. For presentation materials, see Attachment-1 No.14-7.

**Table 2-4-2.1 Summary of the seminar**

|              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Date & Time  | 31st May, 2023 13:30 – 16:00 (Nigerian Standard Time)                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Venue        | The Meeting Room 1&2, Fraser Suites Hotel<br>Address: Plot 294, Leventis Close Central Business District Abuja Nigeria                                                                                                                                                                                                                                                                                                                                                                          |
| Objective    | To disseminate the Project's activities to NAPTIN, AEDC, and other Discos, targeting personnel other than the C/P                                                                                                                                                                                                                                                                                                                                                                               |
| Agenda       | <ol style="list-style-type: none"><li>1. Results of baseline survey</li><li>2. Outline of Work Plan</li><li>3. Contents of activities<ol style="list-style-type: none"><li>(1) Introduction of the Project's Activities</li><li>(2) Request to each organization to achieve project results</li><li>(3) Request for cooperation from each organization after project completion</li></ol></li><li>4. Observation on project activities by counterparts</li><li>5. Question and answer</li></ol> |
| Participants | <ul style="list-style-type: none"><li>• C/P</li><li>• AEDC</li><li>• NAPTIN</li><li>• FMP</li></ul>                                                                                                                                                                                                                                                                                                                                                                                             |

|  |                                                                                                                                                      |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <ul style="list-style-type: none"> <li>• ANED</li> <li>• Other Discos (Online)</li> <li>• JICA Nigeria Office</li> <li>• JICA Expert Team</li> </ul> |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------|

### 2-4-3 Result of Training in Japan

Training in Japan was conducted from Tuesday, 25th July to Thursday, 3rd August, 2023, with the aim of improving knowledge and skills regarding operational frameworks and procedures in the power distribution sector. Thirteen participants from the Counterparts attended the training. An outline is shown in the table below.

For details, refer to Attachment-2, "Implementation Report on the Project for Capacity Development of Power Distribution in Nigeria (1st Technical Training)."

**Table 2-4-3.1 Summary of Training in Japan**

|                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Training Title       | The Project for Capacity Development of Power Distribution in Nigeria (1st Technical Training)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Training Schedule    | Training Period: Tuesday, 25th July 25 – Thursday, 3rd August, 2023<br>Sunday, 23rd July – Saturday, 5th August, 2023 (including travel days)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Training Locations   | <ul style="list-style-type: none"> <li>• Kansai Transmission and Distribution, Inc. <ul style="list-style-type: none"> <li>➢ Distribution Training Center [Ibaraki]</li> <li>➢ Technical Research Center</li> <li>➢ Hanshin Distribution Office</li> <li>➢ Osaka Minami Engineering Center</li> <li>➢ Distribution Training Center [Suminoe]</li> </ul> </li> <li>• Kinden Corporation <ul style="list-style-type: none"> <li>➢ Amagasaki City and Sanda City (On-site / Work sites)</li> <li>➢ Kinden Gakuen</li> </ul> </li> <li>• Daito Denzai Co., Ltd. Hikone Office</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Training Objectives  | <p>To improve knowledge and skills regarding operational frameworks and procedures in the power distribution sector.</p> <ol style="list-style-type: none"> <li>1. Understand what specific operations are being performed and how they are carried out in order to reduce losses, improve reliability, improve quality; and reflect them in the future improvement of the electric power business in Nigeria.</li> <li>2. Understand the human resources development system in place to accurately carry out business in the Japanese electric power company to see how skills are improved; and reflect them in Disco's human resources development program through the NAPTIN training courses in Nigeria.</li> <li>3. By understanding the distribution training facilities and training contents in the Japanese electric power company, the installation of NAPTIN's distribution training facilities will be implemented appropriately.</li> <li>4. By understanding the efforts of the Japanese electric power company to reduce power outages. (Reduction of power outages by section switches, mechanism and operation method of automatic operation of distribution lines, etc.) The effect of the AEDC pilot project and the effect of the Outage Management System improvement will be understood more concretely, and the AEDC pilot project and the Outage Management System improvement will be implemented appropriately.</li> </ol> |
| Feedback by Trainees | <ul style="list-style-type: none"> <li>• Most trainees responded that they clearly understood the training goals before participation, achieved these goals, and could apply the knowledge and experience gained in the training to their own work.</li> <li>• There were many opinions that the time allocated for each curriculum and the overall training duration were short.</li> <li>• There were many opinions stating that the materials and explanations for each curriculum were generally well understood and highly useful. Additionally, there were many positive comments regarding the support provided by the Japanese side, including the interpreters.</li> <li>• All respondents to the questionnaire stated that they were highly satisfied with the training.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

## **Chapter 3 Actual Inputs and Activities**

## Chapter 3 Actual Inputs and Activities

### 3-1 Input by the Japanese side (Planned and Actual)

#### 3-1-1 Dispatch of JICA Experts

The Japanese side dispatched nine experts, shown in the table below, for 99.16 months.

**Table 3-1-1.1 Planned and actual dispatches of JICA experts**

| Name              | Task in charge                                  | Period              | Plan (months) | Actual (months) |       |       |
|-------------------|-------------------------------------------------|---------------------|---------------|-----------------|-------|-------|
|                   |                                                 |                     | Total         | Nigeria         | Japan | Total |
| Kyoji FUJII       | Leader / Distribution Business Operation        | Apr 2022 - Feb 2026 | 13.35         | 10.70           | 5.30  | 16.00 |
| Akihiro KASHIWAGI | Distribution Planning                           | Apr 2022 - Feb 2026 | 13.12         | 8.47            | 5.95  | 14.42 |
| Kazuhiko KOEDA    | Distribution Design                             | Apr 2022 - Feb 2026 | 13.30         | 9.93            | 5.84  | 15.77 |
| Seiro NISHIKI     | Distribution Maintenance and Management         | Apr 2022 - Feb 2026 | 13.15         | 8.50            | 6.22  | 14.72 |
| Hiroki AOYAGI     | Pilot Project 1 (Procurement Survey)            | Apr 2022 - Feb 2026 | 7.50          | 6.83            | 4.02  | 10.85 |
| Hiroyuki TOYOKAWA | Pilot Project 2 (Construction Supervision)      | Apr 2022 - Apr 2023 | 7.00          | 0.00            | 1.75  | 1.75  |
| Michinori YASUI   | Pilot Project 2 (Construction Supervision)      | May 2023 - Feb 2025 | 0             | 1.43            | 1.40  | 2.83  |
| Kazunori DOI      | Training Courses Planning                       | Apr 2022 - Feb 2026 | 11.77         | 5.00            | 7.87  | 12.87 |
| Ruriko SUEZAWA    | Project Coordination and Monitoring /Evaluation | Apr 2022 - Feb 2026 | 12.50         | 5.50            | 4.45  | 9.95  |
| Total (month)     |                                                 |                     | 91.69         | 56.36           | 42.80 | 99.16 |

#### 3-1-2 Training in Japan

The Japanese side dispatched five experts, shown in the table below, for 1.31 months.

**Table 3-1-2.1 Planned and actual dispatches of JICA experts for Training in Japan**

| Name              | Task in charge                           | Period              | Plan (months) | Actual (months) |
|-------------------|------------------------------------------|---------------------|---------------|-----------------|
| Kyoji FUJII       | Leader / Distribution Business Operation | Jul 2023 – Aug 2023 | 0.15          | 0.15            |
| Akihiro KASHIWAGI | Distribution Planning                    | Jul 2023 – Aug 2023 | 0.38          | 0.38            |
| Kazuhiko KOEDA    | Distribution Design                      | Jul 2023 – Aug 2023 | 0.20          | 0.20            |
| Seiro NISHIKI     | Distribution Maintenance and Management  | Jul 2023 – Aug 2023 | 0.35          | 0.35            |
| Kazunori DOI      | Training Courses Planning                | Jul 2023 – Aug 2023 | 0.23          | 0.23            |
| Total             |                                          |                     | 1.31          | 1.31            |



### 3-1-3 Equipment procurement

The necessary equipment and materials for carrying out this project's activities were provided to each counterpart (AEDC, NAPTIN). Procurement was handled by the Japanese side, and installation work was carried out by the Nigeria side.

#### 3-1-3-1 NAPTIN Distribution training facilities

Table 3-1-3-1.1 and Table 3-1-3-1.2 shows the details of the equipment provided by Japanese side to NAPTIN. In addition to the materials necessary for installing the distribution training facilities, equipment used for training (cable fault locator and phase detector) was provided.

**Table 3-1-3-1.1 List of Equipment Provided (NAPTIN: Handover in 2023)**

| No.  | Item                               | Quantity | Unit | Specification                                                |
|------|------------------------------------|----------|------|--------------------------------------------------------------|
| N-1  | Power pole 40ft                    | 27       | no   | Concrete, 12.2m(40ft)/25kN                                   |
| N-2  | Power pole 17ft                    | 18       | no   | Concrete, 5.18m(17ft)/25kN                                   |
| N-3  | 33kV Conductor                     | 1,100    | m    | ACSR 150mm <sup>2</sup>                                      |
| N-4  | 33kV Underground cable             | 360      | m    | XLPE Cu 33kV 185mm <sup>2</sup>                              |
| N-5  | 33kV Raychem Termination kit       | 12       | kit  | Size 150-240mm <sup>2</sup>                                  |
| N-6  | 185mm <sup>2</sup> Cable Lug       | 12       | no   | Galvanized sealed head                                       |
| N-10 | 4" PVC Pipe                        | 12       | no   | Polyvinyl chloride, Length 300cm, Diameter 10cm              |
| N-12 | 33kV Pin insulator                 | 66       | no   | 33kV, Silicone                                               |
| N-13 | 33kV Silicone disk insulator       | 54       | no   | 33kV, Silicone                                               |
| N-14 | 6-Bolt clamp                       | 54       | no   | 150mm <sup>2</sup>                                           |
| N-15 | Adaptor Socket Tongue              | 54       | no   | 150mm <sup>2</sup>                                           |
| N-16 | Fiber crossarm                     | 9        | no   | 9ft                                                          |
| N-17 | 33kV Angle iron                    | 32       | no   | 9ft, Galvanized                                              |
| N-18 | 33kV Channel iron                  | 34       | no   | 9ft, Galvanized                                              |
| N-20 | 33kV Tie-strap                     | 22       | no   | Galvanized                                                   |
| N-21 | Stay wire                          | 280      | m    | 70mm <sup>2</sup>                                            |
| N-22 | Stay Rod                           | 28       | no   | 8ft, Galvanized                                              |
| N-23 | Stay Block                         | 28       | no   | 2ft x 2ft x 15inches, concrete                               |
| N-24 | Stay insulator (33kV)              | 28       | no   | Porcelain                                                    |
| N-25 | 33kV Lightning Arrester            | 1        | set  | Lighting impulse withstand 170kVp                            |
| N-26 | Section switch (33kV): PAS         | 1        | unit | Pole mount, Water proof, 33kV, PAS                           |
| N-27 | Section switch (33kV): Gang switch | 1        | unit | Pole mount, Water proof, 33kV, Gang switch                   |
| N-28 | Earth rod                          | 15       | unit | 22mm, Length 9ft                                             |
| N-29 | Earth wire                         | 100      | m    | 25mm <sup>2</sup> copper                                     |
| N-30 | 5/8 Washers                        | 400      | no   | Galvanized                                                   |
| N-31 | Bolt and Nut 5/8 x 11 inches       | 100      | no   | Galvanized                                                   |
| N-32 | Bolt and Nut 5/8 x 9 inches        | 100      | no   | Galvanized                                                   |
| N-34 | Bolt and Nut 5/8 x 6 inches        | 100      | no   | Galvanized                                                   |
| N-35 | Bolt and Nut 5/8 x 2 inches        | 100      | no   | Galvanized                                                   |
| N-36 | LV Cable                           | 15       | m    | XLPE 400V Aluminum 100mm <sup>2</sup> x4c                    |
| N-37 | Circuit Breaker                    | 10       | no   | For fault point, LV, 2Pole, 20A                              |
| N-38 | Circuit Breaker Box                | 10       | no   | For fault point                                              |
| N-39 | IV wire                            | 100      | m    | For fault point, LV, 4mm                                     |
| N-40 | Conductor cover                    | 30       | no   | 35kV, Polyethylene                                           |
| N-41 | Bolt type connector                | 30       | no   | Copper Alloy                                                 |
| N-42 | Cable Fault Locator                | 1        | unit | DC insulation tester, 0-40kV, 0-50mA                         |
| N-43 | Generator                          | 1        | unit | 2.5kVA/2.0kW, Single phase                                   |
| N-44 | Phase detector                     | 1        | unit | 11/33kV, 50Hz                                                |
| N-45 | Short circuit and Grounding device | 2        | unit | Copper                                                       |
| N-46 | 33kV Fused Cutout switch           | 3        | unit | 33kV, 50Hz for 33kV/415-240V distribution transformer 100kVA |

(Date of CERTIFICATE OF HANDOVER: March 28, 2024)

**Table 3-1-3-1.2 List of Equipment Provided (NAPTIN: Handover in 2025)**

| No. | Item                       | Quantity | Unit | Specification               |
|-----|----------------------------|----------|------|-----------------------------|
| 1   | Safety belt                | 4        | no   | M size                      |
| 2   | high-voltage rubber gloves | 2        | set  | Maximum Usage Voltage: 36kV |

(Date of CERTIFICATE OF HANDOVER: June 20, 2025)

### 3-1-3-2 AEDC Pilot Project

Table 3-1-3-2.1 shows the details of the equipment provided by the Japanese side to AEDC. Materials for installing power distribution lines of the pilot project, as well as conductor covers, bolt-type connectors, and phase detector, were provided to improve reliability.

**Table 3-1-3-2.1 List of Equipment Provided (AEDC: Handover in 2023)**

| No.  | Item                                 | Quantity | Unit | Specification                                   |
|------|--------------------------------------|----------|------|-------------------------------------------------|
| N-3  | 33kV Conductor                       | 16,200   | m    | ACSR 150mm <sup>2</sup>                         |
| N-4  | 33kV Underground cable               | 300      | m    | XLPE Cu 33kV 185mm <sup>2</sup>                 |
| N-5  | 33kV Raychem Termination kit         | 6        | kit  | Size 150-240mm <sup>2</sup>                     |
| N-6  | 185mm <sup>2</sup> Cable Lug         | 6        | no   | Galvanized sealed head                          |
| N-7  | 70mm <sup>2</sup> Cable Lug          | 100      | no   | Galvanized sealed head                          |
| N-8  | Cable Slab                           | 218      | no   | 18inches, Concrete                              |
| N-9  | Sharp Sand                           | 10       | ton  | For underground cable                           |
| N-10 | 4" PVC Pipe                          | 78       | no   | Polyvinyl chloride, Length 300cm, Diameter 10cm |
| N-11 | Cable Marker                         | 4        | set  | 300m, Red, yellow, blue paint for one set       |
| N-12 | 33kV Pin insulator                   | 26       | no   | 33kV, Silicone                                  |
| N-13 | 33kV Silicone disk insulator         | 42       | no   | 33kV, Silicone                                  |
| N-14 | 6-Bolt clamp                         | 42       | no   | 150mm <sup>2</sup>                              |
| N-15 | Adaptor Socket Tongue                | 42       | no   | 150mm <sup>2</sup>                              |
| N-17 | 33kV Angle iron                      | 36       | no   | 9ft, Galvanized                                 |
| N-18 | 33kV Channel iron                    | 46       | no   | 9ft, Galvanized                                 |
| N-19 | 33kV Composite Insulator (Base Type) | 344      | no   | 33kV, Composite silicone                        |
| N-21 | Stay wire                            | 420      | m    | 70mm <sup>2</sup>                               |
| N-22 | Stay Rod                             | 28       | no   | 8ft, Galvanized                                 |
| N-23 | Stay Block                           | 28       | no   | 2ft x 2ft x 15inches, concrete                  |
| N-24 | Stay insulator (33kV)                | 28       | no   | Porcelain                                       |
| N-25 | 33kV Lightning Arrester              | 6        | set  | Lighting impulse withstand 170kVp               |
| N-26 | Section switch (33kV): PAS           | 1        | unit | Pole mount, Water proof, 33kV, PAS              |
| N-28 | Earth rod                            | 60       | unit | 22mm, Length 9ft                                |
| N-29 | Earth wire                           | 640      | m    | 25mm <sup>2</sup> copper                        |
| N-30 | 5/8 Washers                          | 1,800    | no   | Galvanized                                      |
| N-31 | Bolt and Nut 5/8 x 11 inches         | 2,342    | no   | Galvanized                                      |
| N-32 | Bolt and Nut 5/8 x 9 inches          | 208      | no   | Galvanized                                      |
| N-33 | Bolt and Nut 5/8 x 6 inches          | 72       | no   | Galvanized                                      |
| N-34 | Bolt and Nut 5/8 x 6 inches          | 68       | no   | Galvanized                                      |
| N-40 | Conductor cover                      | 470      | no   | 35kV, Polyethylene                              |
| N-41 | Bolt type connector                  | 270      | no   | Copper Alloy                                    |
| N-44 | Phase detector                       | 1        | unit | 11/33kV, 50Hz                                   |

(Date of CERTIFICATE OF HANDOVER: December 9, 2024)

### 3-2 Input by the Nigeria side (Planned and Actual)

The input by the Nigeria side was implemented as originally planned, except for budgetary measures and installation work, as shown in the Table 3-2.1.

**Table 3-2.1 Input by the Nigeria side**

| <b>Input by the Nigeria side</b>          | <b>Planned</b>                                                                                                                                 | <b>Actual</b>                                                                                                                                                                                                                       |
|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Budgetary Measures                        | Budget allocated for project implementation                                                                                                    | Regarding the installation costs for the distribution training facility, the budgeting process by NAPTIN was delayed by approximately one year compared to the original plan.                                                       |
| Provision of offices and other facilities | Provision of office space, equipment, electricity, water, etc.                                                                                 | Office space, equipment, electricity, water, etc. were provided.                                                                                                                                                                    |
| Required permits and tax exemptions       | Acquisition of permits and licenses necessary for project implementation and tax exemption measures for procurement of materials and equipment | Although procedural delays occurred, the necessary permits (FCDA, NEMSA) and tax exemption measures were completed.                                                                                                                 |
| Installation work                         | Installation work for equipment and materials provided by Japan                                                                                | Implemented by NAPTIN (Distribution training facilities) and AEDC (Pilot Project), but significant delays occurred due to budget delays, inadequate construction systems, accidents, etc., impacting the project evaluation period. |

### 3-3 Project Achievements

#### 3-3-1 Project Outcomes and Indicators

The outline of the plan and actual performance of each activity is shown in Figure 3-3-1.1. The achievement status of individual output indicators is shown in Table 3-3-1.1. The implementation period of this project was originally from April 2022 to March 2025, but it was extended to cover April 2022 to February 2026. (for details in Chapter 4) Additionally, the major deliverables of this project are shown in Attachment-1. (List of deliverables is shown in Annex-1) The PO (Plan of Operation) showing the activity plan and actual performance is as shown in Annex-3.

| Activities                                                                             |                | Year | 2022 |    |     |    | 2023 |    |     |    | 2024 |    |     |    | 2025 |    |     |    |
|----------------------------------------------------------------------------------------|----------------|------|------|----|-----|----|------|----|-----|----|------|----|-----|----|------|----|-----|----|
|                                                                                        | Sub-Activities |      | I    | II | III | IV | I    | II | III | IV | I    | II | III | IV | I    | II | III | IV |
| Output 1-3 : 1-5 with NAPTIN, 6-7 with AEDC                                            |                |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| 1 Planning training courses, teaching materials preparation, TOT                       | Plan           |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual         |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| 2 Conducting training course                                                           | Plan           |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual         |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| 3 Evaluating training courses and giving feedback                                      | Plan           |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual         |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| 4 Incorporating pilot results into training(Considering training improvement)          | Plan           |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual         |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| 5 Design and construction of training equipment for demonstration                      | Plan           |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual         |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| 6 Field survey, Extracting issues in business operations                               | Plan           |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual         |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| 7 Consideration and implementation of pilot proposal                                   | Plan           |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual         |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| 8 Incorporate pilot results into business operations (revising technical standards)    | Plan           |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual         |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| Output 4:                                                                              |                |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| 4.1 Collecting information, analysis, and presentation of improvement plans for Career | Plan           |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual         |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| 4.2 Creating dissemination plans for other Discos                                      | Plan           |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual         |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| Training in Japan                                                                      |                |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| Training in Japan                                                                      | Plan           |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual         |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| Public Relations                                                                       |                |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| Public Relation Activities                                                             | Plan           |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual         |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| Monitoring                                                                             |                |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| Joint Coordinating Committee                                                           | Plan           |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual         |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| Submission of Monitoring Sheet                                                         | Plan           |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual         |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| Field Work in Nigeria                                                                  |                |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
| Field Work in Nigeria                                                                  | Plan           |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |
|                                                                                        | Actual         |      |      |    |     |    |      |    |     |    |      |    |     |    |      |    |     |    |

Figure 3-3-1.1 Planned and Actual Activities

Table 3-3-1.1 Achievement Status of Individual Output Indicators

| Output in PDM                                                                                                                                                                                                                                               | Activity Plan                                                                                                  | Activity Actual and Achievement Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Major Deliverables                                                                                                                                                                                                                                                                                                                                            |                        |                          |                |               |                  |                         |              |                  |                     |              |                  |                  |               |                  |                              |               |                  |                                  |              |                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|--------------------------|----------------|---------------|------------------|-------------------------|--------------|------------------|---------------------|--------------|------------------|------------------|---------------|------------------|------------------------------|---------------|------------------|----------------------------------|--------------|------------------|
|                                                                                                                                                                                                                                                             | [0-1]<br>Baseline survey (field survey, update information)                                                    | <ul style="list-style-type: none"><li>A baseline survey was conducted during the first field work period from mid-May to the end of June 2022, and the survey results were reported to JICA and the JCC by the 1st JCC (September 13, 2022).</li></ul> <p><b>[Achievement Level] 100%</b></p> <div><div></div><div></div><div></div><div></div><div></div></div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <ul style="list-style-type: none"><li>Baseline survey report</li></ul>                                                                                                                                                                                                                                                                                        |                        |                          |                |               |                  |                         |              |                  |                     |              |                  |                  |               |                  |                              |               |                  |                                  |              |                  |
| [Output 1]<br>Development and implementation of training for loss reduction measures<br>[Output 2]<br>Development and implementation of training to improve reliability<br>[Output 3]<br>Development and implementation of training for quality improvement | Below, X corresponds to Outputs 1-3<br>[X-1]<br>Planning training courses, teaching materials preparation, TOT | <ul style="list-style-type: none"><li>Planned classroom training courses regarding "Loss Reduction," "Improvement Reliability," and "Improvement Quality," and improved/created Reference Manuals (for instructors) from November 2022 to December 2023.</li><li>Created classroom training materials (for trainees) from January 2024 to February 2025.</li><li>Developed "Phase comparison", "Overhead Line Fault Location", and "Underground Cable Fault Location" as practical training courses using the distribution training facilities and created practical training manuals from July 2024 to June 2025.</li><li>TOT was held approximately once every two weeks from November 2022 to June 2025. (Online meetings during work in Japan, face-to-face meetings during work in Nigeria.)</li></ul> <p><b>[Achievement Level] 100%</b></p> <div><div></div><div></div><div></div><div></div><div></div></div>                                                                                                                                                    | <ul style="list-style-type: none"><li>Classroom Training Course (Loss Reduction, Reliability Improvement, Quality Improvement) Reference Manuals &amp; Training Materials (Attachment-1 No.1-6)</li><li>Practical Training Course (Phase Comparison, Overhead Line Fault Location, Underground Cable Fault Location) Manuals (Attachment-1 No.8-10)</li></ul> |                        |                          |                |               |                  |                         |              |                  |                     |              |                  |                  |               |                  |                              |               |                  |                                  |              |                  |
|                                                                                                                                                                                                                                                             | [X-2]<br>Conducting training courses                                                                           | <ul style="list-style-type: none"><li>Regarding classroom training courses and practical training courses, training demonstration lectures and training demonstration sessions were conducted twice each for AEDC veteran engineers and mid-level engineers as model trainees, as shown in the table below.</li></ul> <table><tr><th></th><th>AEDC veteran engineers</th><th>AEDC mid-level engineers</th></tr><tr><td>Loss Reduction</td><td>June 13, 2024</td><td>February 6, 2025</td></tr><tr><td>Improvement Reliability</td><td>May 30, 2024</td><td>January 23, 2025</td></tr><tr><td>Improvement Quality</td><td>June 6, 2024</td><td>January 30, 2025</td></tr><tr><td>Phase comparison</td><td>July 10, 2025</td><td>October 28, 2025</td></tr><tr><td>Overhead line fault location</td><td>July 10, 2025</td><td>October 28, 2025</td></tr><tr><td>Underground cable fault location</td><td>July 8, 2025</td><td>October 23, 2025</td></tr></table> <p><b>[Achievement Level] 100%</b></p> <div><div></div><div></div><div></div><div></div><div></div></div> |                                                                                                                                                                                                                                                                                                                                                               | AEDC veteran engineers | AEDC mid-level engineers | Loss Reduction | June 13, 2024 | February 6, 2025 | Improvement Reliability | May 30, 2024 | January 23, 2025 | Improvement Quality | June 6, 2024 | January 30, 2025 | Phase comparison | July 10, 2025 | October 28, 2025 | Overhead line fault location | July 10, 2025 | October 28, 2025 | Underground cable fault location | July 8, 2025 | October 23, 2025 |
|                                                                                                                                                                                                                                                             | AEDC veteran engineers                                                                                         | AEDC mid-level engineers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                               |                        |                          |                |               |                  |                         |              |                  |                     |              |                  |                  |               |                  |                              |               |                  |                                  |              |                  |
| Loss Reduction                                                                                                                                                                                                                                              | June 13, 2024                                                                                                  | February 6, 2025                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                               |                        |                          |                |               |                  |                         |              |                  |                     |              |                  |                  |               |                  |                              |               |                  |                                  |              |                  |
| Improvement Reliability                                                                                                                                                                                                                                     | May 30, 2024                                                                                                   | January 23, 2025                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                               |                        |                          |                |               |                  |                         |              |                  |                     |              |                  |                  |               |                  |                              |               |                  |                                  |              |                  |
| Improvement Quality                                                                                                                                                                                                                                         | June 6, 2024                                                                                                   | January 30, 2025                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                               |                        |                          |                |               |                  |                         |              |                  |                     |              |                  |                  |               |                  |                              |               |                  |                                  |              |                  |
| Phase comparison                                                                                                                                                                                                                                            | July 10, 2025                                                                                                  | October 28, 2025                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                               |                        |                          |                |               |                  |                         |              |                  |                     |              |                  |                  |               |                  |                              |               |                  |                                  |              |                  |
| Overhead line fault location                                                                                                                                                                                                                                | July 10, 2025                                                                                                  | October 28, 2025                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                               |                        |                          |                |               |                  |                         |              |                  |                     |              |                  |                  |               |                  |                              |               |                  |                                  |              |                  |
| Underground cable fault location                                                                                                                                                                                                                            | July 8, 2025                                                                                                   | October 23, 2025                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                               |                        |                          |                |               |                  |                         |              |                  |                     |              |                  |                  |               |                  |                              |               |                  |                                  |              |                  |

| Output in PDM | Activity Plan                                                                                                                       | Activity Actual and Achievement Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Major Deliverables                                                                                                                                                                                |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|               | [X-3] Evaluating training courses and giving feedback                                                                               | <ul style="list-style-type: none"> <li>Summarized evaluation results using pre-prepared trainee questionnaires and provided feedback to instructors.</li> <li>Instructors improved Reference Manuals, Training Materials, and teaching methods based on the evaluation results.</li> </ul> <p><b>[Achievement Level] 100%</b></p>                                                                                                                                                                                                              | <ul style="list-style-type: none"> <li>Comments table for classroom training demonstration lecture and practical training demonstration session (Attachment-1 No.11)</li> </ul>                   |
|               | [X-4] Incorporating pilot results into training (Considering training improvement plans)                                            | <ul style="list-style-type: none"> <li>Due to delays in the installation work for the AEDC pilot project, it was not possible to secure a period to evaluate the results after construction. Consequently, only the loss reduction effects were grasped and incorporated into the "Loss Reduction" Reference Manual.</li> </ul> <p><b>[Achievement Level] 70%</b></p>                                                                                                                                                                          | <ul style="list-style-type: none"> <li>"Loss Reduction" Reference Manual and Training Material (Attachment-1 No.1-2)</li> </ul>                                                                   |
|               | [X-5] Design and construction of training equipment for demonstration                                                               | <ul style="list-style-type: none"> <li>Designed the distribution training facilities from July 2022 to January 2023, and conducted installation work from October 2024 to December 2024.</li> </ul> <p><b>[Achievement Level] 100%</b></p>                                                                                                                                                                                                                                                                                                     | <ul style="list-style-type: none"> <li>Distribution training facilities design documents (Attachment-1 No.7)</li> </ul>                                                                           |
|               | [X-6] Field survey, Extracting issues in business operations                                                                        | <ul style="list-style-type: none"> <li>Conducted a baseline survey during the first field work period from mid-May to the end of June 2022, identified issues in business operations (such as improvement of Outage Management), and reported the survey results to JICA and the JCC by the 1st JCC (September 13, 2022).</li> </ul> <p><b>[Achievement Level] 100%</b></p>                                                                                                                                                                    | <ul style="list-style-type: none"> <li>Baseline survey report</li> </ul>                                                                                                                          |
|               | [X-7] Consideration and implementation of pilot proposal                                                                            | <ul style="list-style-type: none"> <li>Considered and designed the AEDC pilot project from July 2022 to January 2023, and conducted installation work from June 2023 to December 2025.</li> <li>Conducted data analysis regarding the improvement of Outage Management and made recommendations to AEDC.</li> </ul> <p><b>[Achievement Level] 100%</b></p>                                                                                                                                                                                     | <ul style="list-style-type: none"> <li>AEDC pilot project related materials (Attachment-1 No.12-1 to 12-8)</li> <li>Outage Management related materials (Attachment-1 No.13-1 to 13-4)</li> </ul> |
|               | [X-8] Incorporate pilot results into business operations (revising technical standards, SOPs (Standard Operating Procedures), etc.) | <ul style="list-style-type: none"> <li>Due to delays in the installation work for the AEDC pilot project, it was not possible to secure a period to evaluate the results after construction, so only the loss reduction effects were grasped. Although the plan was to grasp the effects of voltage drop improvement and forced outage time improvement, this was not possible.</li> <li>Planning documents and effect assessment materials for the pilot project have been provided to AEDC.</li> </ul> <p><b>[Achievement Level] 70%</b></p> | <ul style="list-style-type: none"> <li>"Loss Reduction" Reference Manual (Attachment-1 No.1)</li> </ul>                                                                                           |

| Output in PDM                                                              | Activity Plan                                                                                                                                    | Activity Actual and Achievement Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Major Deliverables                                                                                                                                                                    |
|----------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [Output 4]<br>Confirmation of the utilization of NAPTIN training in Discos | [4-1]<br>Collecting information, analysis, and presentation of improvement plans for Career framework in AEDC and application of NAPTIN training | <ul style="list-style-type: none"> <li>Proposed incorporating the NAPTIN training courses developed in this project into AEDC's training plan. AEDC has included 4 NAPTIN training courses (3 of which were developed in this project) in its 2025 Training Plan.</li> </ul> <b>[Achievement Level] 100%</b> <div> 0                      50%                      100% <div> <div></div> <div></div> <div></div> <div></div> </div> </div>                                                                                                                    |                                                                                                                                                                                       |
|                                                                            | [4-2]<br>Creating dissemination plans for other Discos                                                                                           | <ul style="list-style-type: none"> <li>Held an online workshop on January 31, 2025, to introduce the classroom training courses developed in this project to other Discos.</li> <li>Formulated a plan to convert the classroom training courses developed in this project into e-learning (currently being created using AFD project budget). Video recording began in October 2025.</li> </ul> <b>[Achievement Level] 100%</b> <div> 0                      50%                      100% <div> <div></div> <div></div> <div></div> <div></div> </div> </div> | <ul style="list-style-type: none"> <li>Presentation Materials for Online workshop (Attachment-1 No.14-5)</li> <li>WG4 related materials (Attachment-1 No.14-1 to 14-4)</li> </ul>     |
| Training in Japan                                                          |                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                       |
|                                                                            | Conduct training in Japan for about 2 weeks for a total of 10 people from NAPTIN and AEDC.                                                       | <ul style="list-style-type: none"> <li>Conducted training in Japan from July 25 (Tue) to August 3 (Thu), 2023 (excluding travel days), for a total of 13 participants from NAPTIN, AEDC, NERC, and FMP.</li> <li>Submitted the implementation report to JICA.</li> </ul>                                                                                                                                                                                                                                                                                       | <ul style="list-style-type: none"> <li>The Project for Capacity Development of Power Distribution in Nigeria (1st Technical Training) Implementation Report (Attachment-2)</li> </ul> |
| Public Relations                                                           |                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                       |
|                                                                            | Hold a seminar regarding the implementation details of this project.                                                                             | <ul style="list-style-type: none"> <li>Held on May 31, 2023 (Wed) with in-person participation from FMP, AEDC, NAPTIN, and ANED, and online participation from 10 Discos other than AEDC.</li> </ul>                                                                                                                                                                                                                                                                                                                                                           | <ul style="list-style-type: none"> <li>Presentation Materials for the Seminar (Public Relations) (Attachment-1 No.14-7)</li> </ul>                                                    |

### 3-3-2 Project Purpose and Indicators

The achievement status of the project purpose is shown in Table 3-3-2.1.

**Table 3-3-2.1 Project Purpose and Achievement Status**

| Project Purpose                                                               | Objectively Verifiable Indicators                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Achievement Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| To improve the capabilities of engineers in the power distribution department | <ol style="list-style-type: none"> <li>1. 70% or more participants in the training demonstration will be evaluated that they acquired correct knowledge about reducing technical loss.</li> <li>2. 70% or more participants in the training demonstration will be evaluated that they acquired correct knowledge about improving reliability.</li> <li>3. 70% or more participants in the training demonstration will be evaluated that they acquired correct knowledge about quality improvement.</li> <li>4. A training system (curriculum, teaching materials, training equipment, instructors, budget measures, etc.) will be established.</li> </ol> | <p>[Indicator 1-3]<br/>Status: Achieved</p> <ul style="list-style-type: none"> <li>▪ New classroom training courses for technical loss reduction, reliability improvement, and quality improvement were achieved.</li> <li>▪ Even though new classroom training developed through the project have already been released by NAPTIN, there were no participants in the training. However, judging from the feedback of model trainees who participated in training demonstration, the training provided relevant and necessary information and the materials and teaching method were good enough for them to understand well.</li> </ul> <p>[Indicator 4]<br/>Status: Achieved</p> <ul style="list-style-type: none"> <li>▪ New classroom training courses have been developed. NAPTIN has released 2025 official training calendar including the newly developed training courses. (100% completed)</li> <li>▪ Teaching materials for new classroom training courses have been completed. (100% completed)</li> <li>▪ New practical training courses have been developed. (100% completed)</li> <li>▪ Teaching materials for new practical training courses have been completed. (100% completed)</li> <li>▪ Installation of distribution training facilities has been completed. (100% completed)</li> <li>▪ Instructors' capacity has been developed. (100% completed)</li> <li>▪ Formulated a plan to convert the classroom training courses developed in this project into e-learning using AFD funding. (100% completed)</li> </ul> |



### 3-4 General comments on activities

Through the activities for Outputs 1 to 4, the project goal "To improve the capabilities of engineers in the power distribution department" was achieved. However, the overall evaluation of the activities is as follows:

#### (1) Outputs 1–3

- The development of classroom training courses (Loss Reduction, Reliability Improvement, Quality Improvement) was delayed by approximately 8 months due to reasons such as the inability to secure sufficient working time for NAPTIN instructors. However, the content was completed as planned, finalized through two training demonstration lectures, and the release of the training courses was completed. Nevertheless, no applications were submitted to participate in the training course, so the participants could not evaluate the training content, but their understanding of the training demonstration lecture reached the target value. The quality of the teaching materials was also well evaluated.
- The securing of the budget for the installation of distribution training facilities at NAPTIN was delayed by approximately one year compared to the plan, which caused a delay of approximately one year in the installation work of the distribution training facilities. Consequently, the development of practical training courses was also delayed by approximately one year. Although two training demonstration sessions were conducted, the release of the training courses could not be completed. Additionally, regarding the "Phase Comparison" developed as a practical training course, it was planned in consultation with NAPTIN to conduct part of the training (operation check of phase detectors) using energized substation equipment from the AFD project. However, due to delays in the substation construction work by the AFD project, training demonstration session on energized equipment was not possible, they were conducted only on the de-energized distribution training facilities. The level of understanding of the participants in the training demonstration lecture reached the target value, and the quality of the teaching materials was also well evaluated. Some of the improvement effects for training could not be incorporated, yet planning, installation, and operation methods of the AEDC pilot project could be incorporated and disseminated to other Discos.
- Due to a delay of approximately two years in the installation work and start of operation of the AEDC pilot project compared to the plan, it was not possible to secure a period to evaluate the results after construction. Regarding loss reduction effects only, it was possible to estimate the effects using simplified grid data and incorporate them into the NAPTIN's training courses, but the effects of voltage drop improvement and forced outage time improvement could not be incorporated into the training.
- Although the introduction of conductor covers for overhead distribution lines was proposed as

a measure for reliability improvement, the installation of conductor covers was abandoned because burning and melting of the covers occurred. The results of the conductor cover installation trial in Nigeria were shared with relevant parties.

- Regarding the "Improvement of Outage Management," which was identified as an operational issue through the baseline survey, the importance of data entry, such as causes of forced outages, was regularly conveyed to AEDC. However, sufficient data to formulate effective equipment measures was not provided. Thus concrete improvement methods could not be recommended to AEDC. The value in data accumulation was understood by AEDC.

## (2) Output 4

- The conversion of classroom training courses to e-learning was selected as a means to promote participation of Discos in NAPTIN training. Consequently, specific implementation methods and points for improvement were formulated within these project activities.

## (3) Others

- Training in Japan was conducted as planned, and the training effects on participants were also good.
- Public relations activities were also conducted as planned; participants asked active questions, indicating high interest.

## 3-5 PDM revision history

The revision history of the PDM is given in the table below. The respective versions of the PDM are shown in Annex-3.

**Table 3-5.1 Revision history of the PDM**

| Version              | Revision Date    | Revised details                                            |
|----------------------|------------------|------------------------------------------------------------|
| Original (version 0) | 31 August 2022   | -                                                          |
| Version 1            | 22 June 2023     | N/A                                                        |
| Version 2            | 6 December 2023  | Update of Achievement                                      |
| Version 3            | 25 June 2024     | Update of Achievement and dispatch period of Japanese side |
| Version 4            | 13 February 2025 | Update of Achievement                                      |
| Version 5            | 30 October 2025  | Update of Indicator                                        |

**Table 3-5.2 Revisions to the PDM**

| Subject               | Item | Before change | After change | Reason for change                                                                                                    |
|-----------------------|------|---------------|--------------|----------------------------------------------------------------------------------------------------------------------|
| Revision to version 1 | -    | -             | -            | Version 1 was created following the update of the Monitoring Sheet and the Tentative Plan of Operation; however, the |

| Subject               | Item                       | Before change                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | After change                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Reason for change                                                                                                        |
|-----------------------|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
|                       |                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | content remains unchanged.                                                                                               |
| Revision to version 2 | Achievement                | Refer to Annex-3; changes are marked in red                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Refer to Annex-3; changes are marked in red                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Addition of the description of meetings with C/P                                                                         |
| Revision to version 3 | Achievement                | Refer to Annex-3; changes are marked in red                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Refer to Annex-3; changes are marked in red                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Addition of the description of meetings with C/P                                                                         |
|                       | Inputs (The Japanese Side) | Refer to Annex-3; changes are marked in red                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Refer to Annex-3; changes are marked in red                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Due to the contract amendment                                                                                            |
| Revision to version 4 | Achievement                | Refer to Annex-3; changes are marked in red                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Refer to Annex-3; changes are marked in red                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | -Release of NAPTIN Training courses<br>-Addition of the description of meetings with C/P                                 |
| Revision to version 5 | Indicator                  | 1. 70% or more participants in the training courses will be evaluated that they acquired correct knowledge about reducing technical loss.<br>2. 70% or more participants in the training courses will be evaluated that they acquired correct knowledge about improving reliability.<br>3. 70% or more participants in the training courses will be evaluated that they acquired correct knowledge about quality improvement.<br>4. A training system (curriculum, teaching materials, training equipment, instructors, budget measures, etc.) will be established. | 1. 70% or more participants in the training <b>demonstration</b> will be evaluated that they acquired correct knowledge about reducing technical loss.<br>2. 70% or more participants in the training <b>demonstration</b> will be evaluated that they acquired correct knowledge about improving reliability.<br>3. 70% or more participants in the training <b>demonstration</b> will be evaluated that they acquired correct knowledge about quality improvement.<br>4. A training system (curriculum, teaching materials, training equipment, instructors, budget measures, etc.) will be established. | As the NAPTIN Training courses were not conducted, the evaluation was based on feedback from the Training Demonstration. |
|                       | Achievement                | Refer to Annex-3; changes are marked in red                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Refer to Annex-3; changes are marked in red                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | - Final Evaluation<br>-Addition of the description of meetings with C/P                                                  |

## **Chapter 4 Challenges and Lessons Learnt in Project implementation**

## Chapter 4 Challenges and Lessons Learnt in Project implementation

### 4-1 Key factors affecting implementation and outcomes

The factors that affected the implementation and results of this project, the measures taken, and the results are shown in Table 4-1.1.

**Table 4-1.1 Factors Affecting Project Implementation, Measures, and Results**

| Factors                                                                                                                        | Measures                                                                                                                                                                                                                                           | Results                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (1)NAPTIN                                                                                                                      |                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 1-1. Delay in classroom training improvement work due to NAPTIN instructors' other training or business trips to other centers | Raised the issue at the JCC and requested NAPTIN DG to involve NAPTIN management and adjust the instructors' workload.                                                                                                                             | The revision work for the instructor manuals (Reference Manuals) and training materials for the three classroom training courses did not proceed as planned. This delayed the implementation of the classroom training demonstration lectures and the incorporation of the courses into NAPTIN's training menu.                                                                                                                                                                                      |
| 1-2. Delay in classroom training improvement work due to NAPTIN instructors' promotion or resignation                          | Delays occurred due to workload imbalances caused by the promotion or resignation of NAPTIN instructors assigned to the three developed classroom training courses. Requested NAPTIN DG to review instructor assignments.                          | <b>&lt;Classroom Training Manual Revision&gt;</b><br><b>Plan:</b> Completion in April 2023<br><b>Actual:</b> Completion in December 2023                                                                                                                                                                                                                                                                                                                                                             |
| 1-3. Delay in securing budget for distribution training facilities                                                             | Installation of distribution training facilities was planned for 2023, but NAPTIN could not secure the budget for 2023. Raised the issue at the JCC and requested NAPTIN DG to secure the budget for 2024 and handle site leveling and compaction. | The installation of distribution training facilities was delayed by approximately 1 year and 2 months compared to the original plan. This delayed the Training of Trainers (TOT) for practical training using the distribution training facilities, making it difficult to follow up on its incorporation into NAPTIN's training menu.<br><br><b>&lt;Instration of Distribution Training Facilities&gt;</b><br><b>Plan:</b> Completion in October 2023<br><b>Actual:</b> Completion in December 2024 |
| 1-4. Delay in practical training course development due to delay in installation of distribution training facilities           | Prioritized improvement work for classroom training courses and decided to postpone the development of practical training courses until the installation of distribution training facilities was completed.                                        | The creation of manuals for practical training courses was delayed by approximately 1 year and 5 months compared to the original plan, hindering the incorporation of practical training into NAPTIN's curriculum.<br><br><b>&lt;Creation of Manuals for Practical Training Courses&gt;</b><br><b>Plan:</b> Completion in September 2023<br><b>Actual:</b> Completion in February 2025                                                                                                               |
| 1-5. Delay in e-learning content creation                                                                                      | Agreed with NAPTIN on the development of e-learning content as a measure for expanding training courses, but delays occurred due to lack of budget. The e-learning content will be created using AFD project budget.                               | Creation of e-learning content could not be completed within the project period, making it impossible to follow up on the content.<br><br><b>&lt;Creation of E-learning Content&gt;</b><br><b>Plan:</b> Completion in March 2025<br><b>Actual:</b> Completion in February 2026 (Scheduled)                                                                                                                                                                                                           |

| Factors                                                                        | Measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Results                                                                                                                                                                                                                                                                                                    |
|--------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1-6. Implementation of phase comparison work on live lines                     | Since the distribution training facilities provided in this project consists of de-energized (dead) facilities, the plan was to conduct operation training using live facilities provided by the AFD project. However, due to delays in the AFD project construction, TOT using live lines could not be conducted within this project. Since operation checks for phase detectors can only be performed on live lines, the training demonstration session only covered simulation training. The operation check of the phase detectors themselves was handled by conducting TOT during actual field work in the AEDC pilot project. | Confirmation of phase detector operation within NAPTIN training could not be implemented.                                                                                                                                                                                                                  |
| 1-7. Impact of theft of distribution training facilities on practical training | It was discovered that copper wires, such as underground cables and grounding wires, from the distribution training facilities had been stolen. Restoration work for grounding wires at the overhead line fault point was required before the 2nd practical training demonstration session. Although underground cables were stolen, the practical training demonstration session was able to be conducted. Requested NAPTIN DG to strengthen security measures and restore the stolen equipment.                                                                                                                                   | The 2nd practical training demonstration session was conducted on schedule.                                                                                                                                                                                                                                |
| (2) AEDC                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                            |
| 2-1. Delay in FCDA approval                                                    | Applied to the FCDA for the new distribution line design plan for the pilot project in June 2022. Local staff strove to monitor the situation and follow up, but approval took about one year.                                                                                                                                                                                                                                                                                                                                                                                                                                      | The start of construction for the pilot project was delayed by approximately 2 months compared to the original plan.<br><br><b>&lt;Commencement of Construction for Pilot Project&gt;</b><br><b>Plan:</b> Start in April 2023<br><b>Actual:</b> Started in June 2023                                       |
| 2-2. Delay in installation work ordered by AEDC                                | AEDC ordered the installation work for the pilot project from a construction company, but significant delays occurred due to delays in advance payments, the rainy season, and tower construction delays. Strove to monitor the situation and follow up through bi-weekly online meetings and local staff.                                                                                                                                                                                                                                                                                                                          | Installation work by the pilot project contractor was delayed by approximately 5 months compared to the original plan (contractor's plan).<br><br><b>&lt;Installation work by Pilot Project Contractor&gt;</b><br><b>Plan:</b> June 2023 – August 2023<br><b>Actual:</b> June 2023 – January 2024          |
| 2-3. Lack of AEDC's construction preparation capacity                          | AEDC performed direct construction for the installation of bolt-type connectors and section switches within the pilot project installation work. JICA experts instructed AEDC on construction methods, and work was performed, but significant delays occurred due to a lack of direct construction capacity (linemen not arranged, no vehicles, no fuel, no materials, etc.). Strove to monitor the                                                                                                                                                                                                                                | Installation of bolt-type connectors and section switches by AEDC for the pilot project was delayed by approximately 11 months compared to the original plan.<br><br><b>&lt;Installation work by AEDC for Pilot Project&gt;</b><br><b>Plan:</b> May 2024 – June 2024<br><b>Actual:</b> May 2024 – May 2025 |

| Factors                                                                                    | Measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Results                                                                                                                                                                                                                                                                            |
|--------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                            | situation and follow up through bi-weekly online meetings and local staff.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                    |
| 2-4. Lack of information sharing with relevant parties                                     | Person in charge did not attend work briefings, etc. Even when explained to managers, materials were not shared with person in charge, and information was not conveyed. Consequently, situations frequently arose where person in charge had heard nothing when it came time to perform the work later. In the latter half of the project, explanations were given directly to both managers and person in charge as much as possible.                                                                                                                                                              | Explanations to both managers and person in charge often resulted in duplicated effort and affected project progress due to schedule adjustments.                                                                                                                                  |
| 2-5. Lack of material management capacity                                                  | Construction plans were formulated and agreed upon in advance to complete construction during the field work in Nigeria, and work began. However, due to construction delays, work was not completed during the field work in Nigeria. Materials were handed over so that construction could continue after the JICA experts returned to Japan.                                                                                                                                                                                                                                                      | AEDC lost materials for bolt-type connectors, and it was not possible to install the bolt-type connectors at all planned locations.<br><br><b>&lt;Installation of Bolt-type Connectors&gt;</b><br><b>Plan:</b> 270 units (45 locations)<br><b>Actual:</b> 228 units (38 locations) |
| 2-6. Collapse of tower due to FCDA road works                                              | The tower in front of Apo Substation for the pilot project was installed in January 2024 but collapsed in January 2025 due to FCDA road works. Local staff strove to monitor the situation and follow up on restoration work.                                                                                                                                                                                                                                                                                                                                                                        | Since this occurred just before the start of operation of the new feeder for the pilot project, the start of operation was delayed by approximately 4 months.                                                                                                                      |
| 2-7. Delay in technical loss calculation for distribution lines via grid analysis software | The plan was to calculate technical losses of distribution lines before and after the pilot project using grid analysis software to evaluate the pilot project. However, AEDC has not been able to procure the software license after it expired. The issue was raised at the JCC and requested via letter to AEDC CTO.                                                                                                                                                                                                                                                                              | The evaluation of technical losses for the pilot project was delayed.                                                                                                                                                                                                              |
| 2-8. Burning/Melting of conductor covers                                                   | In June 2024, conductor covers were installed at the pilot project site, but burning and melting were confirmed. Installation was stopped, and some burnt/melted covers were brought back to Japan for cause investigation. Investigation revealed that dielectric breakdown may occur on 33kV distribution lines, and if the current is high, the wire temperature may exceed the melting point of the conductor cover. Based on this, although originally planned for 33kV lines, it was decided to install them on 11kV lines in selected locations where melting due to current would not occur. | After installation on 11kV lines, burning occurred at 2 locations near trees. It was concluded that the possibility of burning at locations near trees cannot be ruled out, so the installation of conductor covers in this project was cancelled.                                 |
| 2-9. Incomplete entry of outage causes into Outage Management App                          | AEDC developed and rolled out the Outage Management App in July 2023 to analyze outage causes for effective equipment renovation. However, the entry of outage causes was not thoroughly practiced.                                                                                                                                                                                                                                                                                                                                                                                                  | Data analysis across the company could not be performed.                                                                                                                                                                                                                           |

| Factors                                | Measures                                                                                                                                                                                                                                                                                | Results                                                                                                                                                                                                                                  |
|----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                        | Strove to monitor the situation and follow up through bi-weekly online meetings.                                                                                                                                                                                                        |                                                                                                                                                                                                                                          |
| (3) Others                             |                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                          |
| 3-1. Delay in tax exemption procedures | A request letter for tax exemption procedures was issued to FMP from the JICA Nigeria Office in May 2023 regarding the procurement of imported materials/equipment for the pilot project. Subsequently, efforts were made to follow up through the specific procedures described below. | It took about 6 months until completion in November 2023. Although tax exemption procedures for imported materials/equipment were delayed, the installation work for the pilot project was also delayed, so overall there was no impact. |

#### <Specific Procedures regarding Tax Exemption>

- For each shipment of equipment, the JICA Expert Team requests the JICA Nigeria Office to issue a tax exemption request letter addressed to FMP. The following items (1) to (4) are attached to the tax exemption request letter:
  - Proforma Invoice of the target equipment
  - Product Certificate issued by SON (Standards Organization of Nigeria)
  - Insurance Policy
  - Bilateral agreement documents serving as the basis for tax exemption (M/D and R/D)
- Based on the above request, FMP creates Form M for tax exemption on the MOF (Ministry of Finance) Form M creation site. (*→ The above procedure by FMP had stalled. A JICA expert checked for issues while looking at the PC of the person in charge at FMP's Finance department. As a result, the FMP staff was asked to inquire about a defect via the "Contact Us" on the MOF Form M creation site, and the issue was resolved.*)
- Once the tax-exempt Form M is approved by MOF, an IDEC (Import Duty Exemption Certificate) is issued.
- Even after the IDEC was issued, detailed interactions with MOF's IDEC (Import Duty Exemption Certificate Office) occurred for actual customs clearance [e.g., sending the PAAR (Pre-Arrival Assessment Report) to IDEC].

#### 4-2 Evaluation on the results of the Project Risk Management

As shown in 4-1, risks existed such as counterparts prioritizing their regular duties, lack of progress in budget measures for NAPTIN's burden, and lack of progress in budget measures and arrangement of materials/equipment and personnel for AEDC's burden. However, by extending the cooperation period and implementing the various risk response measures shown in the table above, the impact on the project was kept to a minimum, and the planned activities were almost completely carried out. As shown in Table 4-2.1, the capacity of more than 10 AEDC engineers was improved regarding loss reduction, reliability improvement, and quality improvement, hence achieving the project goals.



**Table 4-2.1 Project Goal Achievement Status**

| Achievement Indicator                                                                                                                                                                          | Achievement Status                                                                                                            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| 1. The number of Disco engineers involved in design and construction is 10 or more, using the knowledge acquired in the NAPTIN training demonstration to reduce technical loss.                | Status: Achieved.<br>• 13 AEDC engineers are utilizing knowledge acquired in training demonstration to reduce technical loss. |
| 2. The number of Disco engineers involved in design and construction is 10 or more, using the knowledge acquired in the NAPTIN training demonstration to improve reliability (SAIFI, SAIDI).   | Status: Achieved.<br>• 17 AEDC engineers are utilizing knowledge acquired in training demonstration to improve reliability.   |
| 3. The number of Disco engineers involved in design and construction is 10 or more, using the knowledge acquired in the NAPTIN training demonstration for quality improvement (voltage, etc.). | Status: Achieved.<br>• 16 AEDC engineers are utilizing knowledge acquired in training demonstration for quality improvement.  |

(Note) The range of the effects of 1-3 is limited to the pilot project area in AEDC.

### 4-3 Challenges, Solution and Lessons learnt in project implementation

The challenges, solution, and lessons learnt through the project are shown in Table 4-3.1.

**Table 4-3.1 Challenges, Solution, and Lessons Learnt in Project Implementation**

| Item                                | Challenges/Solution                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Lessons Learnt                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Project Implementation Structure    | [Related to Table 4-1.1: 1-1, 1-2, 2-2, 2-3, 2-4]<br><b>Challenge:</b> Implementation of counterpart (NAPTIN, AEDC) tasks and burden items was delayed due to their prioritization of regular duties and lack of management capacity, etc.<br><br><b>Solution:</b> Held bi-weekly online meetings (Joint Technical WG, TOT meetings) during work in Japan to strive to grasp the status of and follow up on the implementation of counterpart tasks and burden items. | <b>Lesson:</b> While it is common in other donor projects for the donor side to procure materials and equipment and carry out installation work, this project assigned installation work as a counterpart burden. Also, some works were assigned as counterpart tasks for capacity development. <u>The implementing agencies' understanding and cooperation regarding the project implementation structure were insufficient.</u><br><br>For significant counterpart delays in the burden, tenacious progress management via bi-weekly meetings and a multi-layered approach involving related agencies and the JICA office are essential for achieving goals. |
|                                     | [Related to Table 4-1.1: 1-3]<br><b>Challenge:</b> Repeatedly requested budget measures for installation work from NAPTIN, but a delay of about 1 year occurred.<br><br><b>Solution:</b> In addition to raising issues at the JCC and requesting NAPTIN DG, support was requested from FMP and NERC. The JICA Nigeria Office also provided follow-up.                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Work Process                        | <b>Challenge:</b> At every JCC, confirmation of minutes was requested in advance and signed on the day, but non-fulfillment by NAPTIN and AEDC was frequent, delaying the project schedule.<br><br><b>Solution:</b> Local staff strove to monitor the situation and follow up, but confirmed items at JCC were not conveyed to relevant internal parties, and situations where they were not implemented upon continued.                                              | <b>Lesson:</b> Compliance with JCC confirmed items was not thoroughly recognized within the organizations, and there was a lack of sense of responsibility among JCC minutes signatories and related parties.<br><br>It is necessary for the JICA Expert Team to explain JCC confirmed items in internal organizational meetings, set roles and deadlines for achievement, and follow up.                                                                                                                                                                                                                                                                      |
| Burning/Melting of conductor covers | [Related to Table 4-1.1: 2-8]<br><b>Challenge:</b> Conductor covers, a material new to Nigeria, were introduced, but burning and melting occurred, so installation in this project was cancelled.                                                                                                                                                                                                                                                                     | <b>Lesson:</b> It was found that installing conductor covers on bare wires as a countermeasure against accidents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

|                          |                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                             |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                          | <b>Solution:</b> Investigations into the causes of burning and melting on 33kV and 11kV distribution lines were conducted, and countermeasures and trial results were explained to relevant parties on each occasion.                                                                                                              | caused by trees carries a high risk of burning and melting.                                                                                                                                                                 |
| Tax exemption procedures | <p>[Related to Table 4-1.1: 3-1]</p> <p><b>Challenge:</b> Tax exemption procedures took about 6 months.</p> <p><b>Solution:</b> A request letter for tax exemption procedures was issued to FMP from the JICA Nigeria Office, and efforts were made to follow up using the specific tax exemption procedures described in 4-1.</p> | <p><b>Lesson:</b> When problems or delays occur, it is necessary for JICA experts and local staff to directly visit staff handling tax exemption procedures at FMP or IDEC to identify the cause and solve the problem.</p> |

(Supplement) Regarding counterpart burden items in the project, the Record of Discussions (R/D) signed and agreed upon between Nigeria and Japan in February 2022 did not explicitly state that the installation work for equipment procured by the project was a counterpart burden, nor did it state the scale of the amount to be borne by the counterpart. After the start of the project, consultants explained the burden of installation costs to NAPTIN and AEDC and obtained agreement, but there was insufficient time for budget application and securing. Regarding counterpart burden items, JICA should have explained the content of the burden and the necessity of securing a budget to the implementing agency before the start of the project, explicitly stated it in the R/D, and obtained agreement. In particular, government agencies like NAPTIN, for whom the national budget is the only source of funds, can only operate within the scope of the pre-allocated budget and cannot respond to unplanned large-scale expenditures. It was necessary to plan the implementation timing and fulfillment deadline of the project after also grasping the schedule of the Nigerian side's budget measures.

## **Chapter 5 For the Achievement of Overall Goal after the Project Completion**

## **Chapter 5 For the Achievement of Overall Goal after the Project Completion**

### **5-1 Prospects to achieve Overall Goal**

The overall goal is as follows.

Overall Goal: To improve Disco's business operations capabilities

#### **(1) Towards Achievement of Overall Goal**

Through the activities of this project, it was expected that the capacity of Disco engineers would be improved. By having these engineers with enhanced skills utilize the knowledge gained from training in their practical work, it was anticipated that more reliable and high-quality electricity would be distributed to customers, thereby improving the business operational capacity (on the technical side) of the Discos.

The activities for Outputs 1-3 included improving and developing NAPTIN's classroom and practical training courses, installing distribution training facilities, implementing the AEDC pilot project, and improving Outage Management. Originally, to expand the adoption of the results from the AEDC pilot project into the business operations of other Discos, it was necessary to incorporate the results of the AEDC activities into NAPTIN's training courses. However, as described in Chapter 4, various factors caused delays during project implementation, and it was not possible to proceed according to the original schedule. Consequently, there was insufficient time to fully evaluate the results of the AEDC pilot project, and its incorporation into NAPTIN's training courses was inadequate. Moreover, the planning, installation, and operation methods of the AEDC pilot project could be incorporated into the training and disseminated to other Discos. Furthermore, in the activities for Output 4, an expansion plan for Discos was formulated, but this also was insufficient due to delays in the creation of e-learning content. Additionally, NAPTIN's public relations activities for its training courses have been inadequate. Although sufficient results for achieving the overall goal were not obtained during the project implementation period due to operational delays from various factors, it is hoped that FMP, NAPTIN, and AEDC will continue to collaborate in the future to achieve the overall goal.

#### **(2) Addressing Hindrances to the Achievement of Overall Goal**

A hindrance factor to achieving the overall goal is the inability to secure funds for improving technical losses, reliability, and quality. Capital investment is necessary to improve technical losses, reliability, and quality. Even if the necessity for facilities restoration and configuration is understood through the improvements in NAPTIN's training courses which is an outcome of this project, and planning for it becomes possible, it cannot be executed without securing the necessary funds. In particular, if the financial situation improves, for example by reducing commercial and collection losses, it might be possible to secure funds for improving technical losses. However, measures are needed to generate these funds. Furthermore, although an initiative to effectively carry out facilities restoration within a limited budget by improving Outage Management was trialed at AEDC, its effectiveness is limited in the current situation where only corrective maintenance is practiced. It is hoped that in the future, a shift to preventive maintenance, such as

conducting regular equipment inspections, will be made, allowing for planned and effective implementation of facilities restoration to improve technical losses, reliability, and quality.

## **5-2 Recommendations for NAPTIN**

### **(1) Proactive Promotion of Training Courses**

Currently, NAPTIN makes its training programs and courses available for viewing on its website (a training portal site) and also disseminates information via social media. However, other proactive promotional activities are not being conducted, and newly developed and improved training courses are not sufficiently publicized to the Discos. It is desirable that NAPTIN carry out more proactive promotional activities (such as sending direct mail) to enhance the capacity of Discos and attract more trainees. Furthermore, although the training portal site is an important source of information for applicants, the information such as course descriptions is often insufficient. Therefore, improvement of the training portal site is desired.

### **(2) Voluntary Improvement and Development of Training Courses**

Currently, NAPTIN receives support from entities such as AFD and JICA for the improvement and development of its training courses and does not undertake these activities voluntarily. It is necessary for NAPTIN to voluntarily provide training courses that more reflect the opinions and needs of the Discos. The business environment, challenges, and capacity development need of the Discos are not static but are constantly changing. Therefore, NAPTIN is required to take the initiative to voluntarily improve and develop its training courses by actively gathering and analyzing feedback from participants and opinions and requests from Discos at every opportunity. It is also crucial to incorporate case studies and practical exercises into the training courses to make them more practical and effective.

### **(3) Skill Improvement for NAPTIN Instructors**

Related to point (2) above, it is necessary to develop NAPTIN instructors who are capable of voluntarily improving and developing training courses. The experience gained in this project, where NAPTIN instructors created their own manuals and teaching materials for new course development, was valuable, and it is hoped that they will apply this experience in future efforts in course improvement and development.

Furthermore, in this project, technology was transferred from experienced AEDC engineers to NAPTIN instructors for the development of practical training courses. While it is difficult for NAPTIN instructors to enhance their skills for practical training courses due to a lack of opportunities to acquire such practical skills, it is necessary to arrange for technology transfer from experienced Disco engineers to NAPTIN instructors as needed.

### **(4) Expansion and Maintenance of Distribution Training Facilities**

In this project, distribution training facilities were installed at the NAPTIN headquarters to develop more practical, hands-on training courses. A foundation for discussions within NAPTIN regarding utilization at regional training centers has been formed. Expansion to regional training centers by

NAPTIN is expected.

In addition, NAPTIN will need to implement maintenance and management measures for the distribution training facilities and strive for excellent quality training courses.

### **5-3 Recommendations for Discos**

#### **(1) Systematization of the Education System**

Each Disco needs to systematize the knowledge, skills, and qualifications necessary for its operations. They can then identify which of these cannot be provided in-house or for which NAPTIN training would be more effective, and then proactively utilize NAPTIN's training courses.

#### **(2) Careful Selection of Trainees**

When sending their employees for NAPTIN training, each Disco is required to assimilate the potential benefits, such as the knowledge, skills, and qualifications to be obtained. Employees who require such training and for whom the training is expected to yield significant results should be carefully selected.

#### **(3) Utilization of NAPTIN Training Outcomes**

After completing NAPTIN training, employees should report to their human resources department on how they plan to apply what they have learnt to their jobs. The human resources department is then required to follow up to ensure that the outcomes of the NAPTIN training are being effectively integrated into the company's operational improvements through the trained employees.

#### **(4) Feedback for the Improvement of NAPTIN Training**

If a Disco finds it difficult to apply the benefits of training to its business implementation improvement processes due to inadequacies in the content of NAPTIN's courses, it is important to provide feedback with suggestions for improvement to NAPTIN.

## **Annex**

## **Annex 1. List of deliverables**



## Annex-1 List of deliverables

### (1) For NAPTIN

| No. | Title                                                                      | Contents                                                                                                                                                                        |
|-----|----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | "Loss Reduction" Reference Manual                                          | "Loss Reduction" Reference Manual for instructors<br>See report for details. (P. 2-2)                                                                                           |
| 2   | "Loss Reduction" Training Demonstration Material                           | "Loss Reduction" Training Demonstration Material for trainees<br>See report for details. (P. 2-3)                                                                               |
| 3   | "Improvement Reliability" Reference Manual                                 | "Improvement Reliability" Reference Manual for instructors<br>See report for details. (P. 2-4)                                                                                  |
| 4   | "Improvement Reliability" Training Demonstration Material                  | "Improvement Reliability" Training Demonstration Material for trainees<br>See report for details. (P. 2-4)                                                                      |
| 5   | "Improvement Quality" Reference Manual                                     | "Improvement Quality" Reference Manual for instructors<br>See report for details. (P. 2-5)                                                                                      |
| 6   | "Improvement Quality" Training Demonstration Material                      | "Improvement Quality" Training Demonstration Material for trainees<br>See report for details. (P. 2-5)                                                                          |
| 7   | Design Documents for Distribution Training Facilities                      | Bidding documents for installation of Distribution Training Facilities<br>See report for details. (P. 2-8)                                                                      |
| 8   | "Phase Comparison" Practical Training Demonstration Manual                 | "Phase Comparison" 2nd Practical Training Demonstration Manual<br>See report for details. (P. 2-12)                                                                             |
| 9   | "Overhead Line Fault Location" Practical Training Demonstration Manual     | "Overhead Line Fault Location" 2nd Practical Training Demonstration Manual<br>See report for details. (P. 2-14)                                                                 |
| 10  | "Underground Cable Fault Location" Practical Training Demonstration Manual | "Underground Cable Fault Location" 2nd Practical Training Demonstration Manual<br>See report for details. (P. 2-15)                                                             |
| 11  | Comments of Training Demonstration lectures and sessions                   | Comments of Classroom Training Demonstration lectures and Practical Training Demonstration sessions (1st & 2nd)<br>See report for details. (P. 2-4, 2-5, 2-6, 2-12, 2-14, 2-17) |

### (2) For AEDC

| No.  | Title                                             | Contents                                                                                                       |
|------|---------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| 12-1 | Outline for the Pilot Project                     | Presentation material of Outline for the Pilot Project<br>See report for details. (P. 2-20)                    |
| 12-2 | Newly introduced equipment for the Pilot Project  | Presentation material of newly introduced equipment for the Pilot Project<br>See report for details. (P. 2-20) |
| 12-3 | Task for grasping the effect of the Pilot Project | Explanatory material for grasping the effect of the Pilot Project<br>See report for details. (P. 2-23)         |

|      |                                                    |                                                                                                                          |
|------|----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| 12-4 | Loss reduction calculation sheet                   | Loss reduction calculation sheet for the Pilot Project on very simple network model<br>See report for details. (P. 2-24) |
| 12-5 | Installation plan of Bolt-type connectors          | Installation plan of Bolt-type connectors<br>See report for details. (P. 2-25)                                           |
| 12-6 | Installation result of Bolt-type connectors        | Installation result of Bolt-type connectors (Jumper location list)<br>See report for details. (P. 2-25)                  |
| 12-7 | Result of measuring voltage                        | Result sheet of measuring voltage<br>See report for details. (P. 2-26)                                                   |
| 12-8 | Converted outage duration time calculation sheet   | Converted outage duration time calculation sheet<br>See report for details. (P. 2-27)                                    |
| 13-1 | Outage Management improvement                      | Presentation material of Outage Management improvement<br>See report for details. (P. 2-29)                              |
| 13-2 | Analysis-report (2023 Jun.-2023 Dec.)              | Analysis-report of Outage Management (2023 Jun.-2023 Dec.)<br>See report for details. (P. 2-29)                          |
| 13-3 | Analysis-report (2023 Jun.-2025 Jun., Only Band A) | Analysis-report of Outage Management (2023 Jun.-2025 Jun., Only Band A)<br>See report for details. (P. 2-31)             |
| 13-4 | Recommendations for Reliability improvement        | Presentation material of Recommendations for Reliability improvement (for CTO)<br>See report for details. (P. 2-32)      |

### (3) For WG4

| No.  | Title                                                                                | Contents                                                                                                                  |
|------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| 14-1 | 1st WG4 Meeting                                                                      | Meeting material of 1st WG4 (Outline of activities of WG4)<br>See report for details. (P. 2-34)                           |
| 14-2 | 2nd WG4 Meeting                                                                      | Meeting material of 2nd WG4<br>See report for details. (P. 2-34)                                                          |
| 14-3 | 3rd WG4 Meeting                                                                      | Meeting material of 3rd WG4<br>See report for details. (P. 2-34)                                                          |
| 14-4 | 4th WG4 Meeting                                                                      | Meeting material of 4th WG4<br>See report for details. (P. 2-34)                                                          |
| 14-5 | NAPTIN Online workshop                                                               | Presentation material of the Online workshop<br>See report for details. (P. 2-35)                                         |
| 14-6 | Comments on the existing e-learning contents of "Power System Loss Reduction" course | Comments on the existing e-learning contents of "Power System Loss Reduction" course<br>See report for details. (P. 2-38) |
| 14-7 | Seminar (Public relations activities)                                                | Presentation material of the Seminar (Public relations activities)<br>See report for details. (P. 2-41)                   |

**Annex 2. Report related to conductor covers  
burning and melting**

## Report on Burnout and Melting to Conductor covers

### 1. Background

In the case of Abuja Electricity Distribution Plc (hereinafter referred to as AEDC), which supplies power to the Abuja region, the capital of Nigeria, there have been many faults (ground faults) caused by vegetation contacting conductors. Therefore, the installation of conductor covers was proposed with the aim of reducing the number of ground faults by vegetation.

### 2. Preliminary evaluation of conductor cover's performance

The conductor cover proposed as a measure against ground faults was not a commonly used material in Nigeria. Therefore, it was necessary to obtain a permission for use by NEMSA (Nigeria Electricity Management Service Agency). NEMSA confirmed the necessity of the JICA Expert Team complying with ASTM (American Society for Testing and Materials) standard; so Kansai Transmission and Distribution Inc. reviewed the test items and methodologies specified in ASTM, and confirmed that the conductor covers to be installed meet the requirements (Figure 1, Tables 1). As a result, NEMSA issued the provisional use permission for the 33kV line.



Figure 1 An example of verification by Kansai Transmission and Distribution Inc. (March 9, 2023)

Table 1 List of test results

| No | Study name                | Test conditions                                                                                                                     | Test results |                   |                     |          |
|----|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------------|---------------------|----------|
|    |                           |                                                                                                                                     | No.          | Flashover         | Appearance abnormal | Judgment |
| 1  | Withstanding voltage test | The commercial frequency 60Hz is energized at a rate of 1kV per second and continuously applied for one minute after reaching 32kV. | 1            | None              | None                | Good     |
|    |                           |                                                                                                                                     | 2            | None              | None                | Good     |
|    |                           |                                                                                                                                     | 3            | None              | None                | Good     |
|    |                           |                                                                                                                                     |              |                   |                     |          |
| 2  | Breakdown voltage test    | The commercial frequency 60Hz is energized at a rate of 1kV per second and applied to the end of the flashover.                     | No.          | Breakdown voltage |                     |          |
|    |                           |                                                                                                                                     | 1            | 34.72kV           |                     |          |
|    |                           |                                                                                                                                     | 2            | 34.86kV           |                     |          |
|    |                           |                                                                                                                                     | 3            | 35.20kV           |                     |          |

### 3. Incident on 33kV line (burned on June 6, 2024, melted on June 14, 2024)

#### 2.1 Incident that occurred

The conductor cover was installed on a 33kV line. At the location concerned, the conductor covers were installed on only two phases due to the expiration of the power outage time, and one phase was left as a bare conductor without a conductor cover.

Two days after installation, when AEDC linesmen arrived on site to complete the remaining work, they discovered that the installed covers had burned. Based on testimony from nearby residents, it is estimated that the burnout occurred the day after installation.

The conductor cover had a pinhole-like hole. Moreover, after the burnout, while arranging the aerial work vehicle necessary for removal, a melting incident (not burnout) occurred. It is presumed that the weather immediately before the incidents was rain for both burning and melting.

#### 2.2 Actions in response to incidents

##### 2.2.1 Presumption of cause

As for burnout, it is probable that the pinhole-shaped hole on the conductor cover caused a short circuit between the conductor cover mounting phase and the non-mounting phase by vegetation, leading to ignition and burnout (Figure 2).

As for the melting damage, it is considered that it was caused by the Joule heat associated with the load current, because the shape of the conductor fold remained at the melting point inside the cover (Figure 3). The area was near the drawer port from the substation, and originally was where 150mm<sup>2</sup> conductors should be installed. However, it was 100mm<sup>2</sup> conductor with more resistance than 150mm<sup>2</sup> conductors, which is considered to have resulted in increased Joule heat.

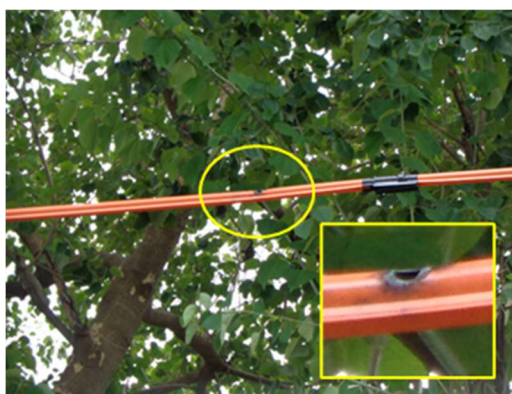


Figure 2 Burnout



Figure 3 Melting

Later, the following two observations were proven by the manufacturer's test.

- The withstand voltage performance at the pin-electrode is about the largest 31kV (therefore, it is not stress-proof against short-circuit at 33kV).
- If an equivalent current is applied as Joule heat to conditions at the time of the melting incident with the cover installed, the internal temperature reaches 130°C, exceeding the melting

temperature of the conductor cover by approximately 120°C (hence there is a risk of melting of the conductor cover if the passing current becomes too large).

### 2.2.2 Change in policy in response to the above

Based on the above estimated causes, the policies were changed as follows.

- ① Install not on 33kV lines, but on 11kV lines to avoid short-circuit.
- ② To prevent the melting by load current, check the load current and the conductor thickness at the location and install them in the appropriate place. (The load current value was estimated by intuition of the AEDC engineer since load management is insufficient. Since the facility management is also insufficient, the conductor thickness was actually measured when installation was complete)

### 2.2.3 Experimental Installation on 11kV line (January-February 2025)

In order to identify the "appropriate locations" in 2.2.2 ② concretely, and to determine the conditions of the locations, conductor covers were attached experimentally to 8 candidate locations where there were no tree contact with the 11kV line, and it was determined whether there was melting inside the conductor covers after two weeks. The results were organized according to the estimated value of the load current in each installation location (AEDC has only the measured value at the outgoing current from the substation, so the AEDC engineer intuitively calculated the load current by multiplying the outgoing current value by the load ratio of each location) and the conductor thickness by the actual measurement.

As a result, no aspect of melting was observed at any location. In response to this, an  $IR$  plane with the horizontal axis representing the estimated current value  $I$  and the vertical axis representing the resistance value  $R$  (determined by the conductor thickness) was shown (Figure 4). From this, it can be seen that, although burnout due to short-circuit and dielectric breakdown could not be avoided, if the conductor had the appropriate thickness (150mm<sup>2</sup>), there was a high possibility that the burnout due to the load current did not occur.

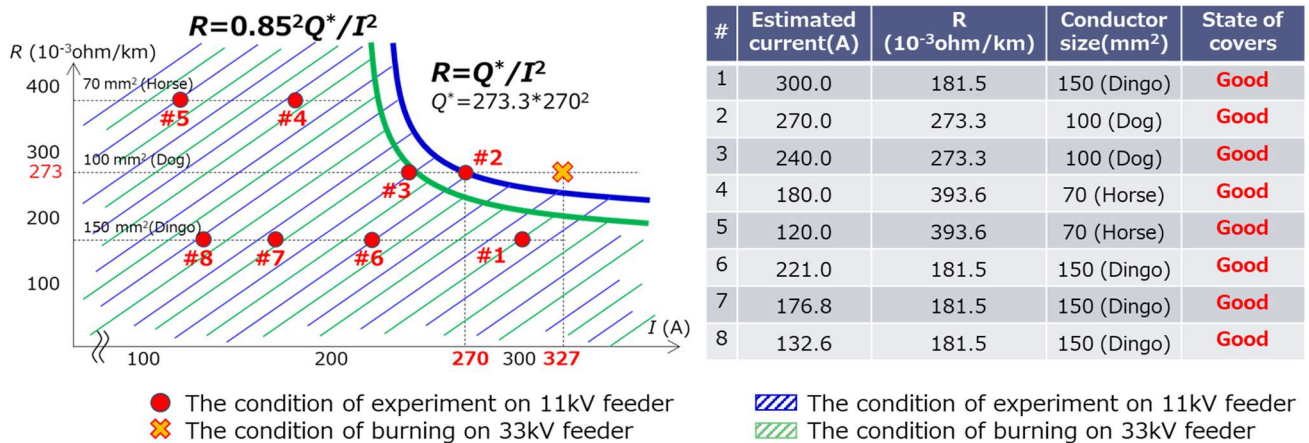


Figure 4 Conditions in which conductor covers will not melt (green hatched part in the figure above)

- Blue hatched part: Range that is considered to be satisfactory theoretically
- Green hatched part: Range considered to be satisfactory on the assumption that there is an error of 15% in the estimated current value
- #1~#8: locations of experimental installation for about 2 weeks

#### 2.2.4 Installation on 11kV lines to tree contacts (February 2025)

For 11kV lines, conductor covers provide sufficient dielectric strength even under short-circuit conditions. Therefore, the primary concern is preventing thermal damage. As shown in Figure 2.2.3, covers were only installed at tree-contact locations where conditions ensured the material would not melt during operation.

### 3 Burnout on 11kV line (first in early June 2025, second in July 1, 2025)

#### 3.1 Incident that occurred

[First time] In early June, the conductor cover was burned (Figures 5 and 6). The load current at the time of the incident was almost at the same level as in January-February 2025 when the covers were installed experimentally.



Figure 5 View of Field after Burnout



Figure 6 Removed Parts

[Second] The conductor cover was burned (Figure 7). It is considered that the conditions at the time of the incident were almost the same as those at the time of the second burnout.





Figure 7 Field conditions at the time of burnout (provided to AEDC by the inhabitants; enlarged on the right-hand side)

It is assumed that the weather immediately before the incident of the first and second burnout in 11kV is rain, as is the case with the incident on the 33kV line.

## 3.2 Actions in response to incidents

### 3.2.1 Presumption of cause

Based on the results of the field survey and what is known up to now, the possibilities of the causes were considered as follows.

#### A) Possibility of overload $\Rightarrow$ Low

- Judging from the load current value when the incident occurred, it is not considered that the Joule heat caused the conductor cover to melt or burn.
- The remaining conductor cover was not melted (if it was melted, it would stick to the conductor, but no such incident was observed).
- There is no abnormality in the conductor cover installed on the upstream side of the burned part.

#### B) Possibility of dielectric breakdown due to short circuit $\Rightarrow$ Low

- As mentioned above, it is difficult to conclude that the conductor cover was short-circuited by 11kV because the voltage withstanding performance of the conductor cover was found to be 31kV by the test conducted by the manufacturer.

#### C) Leakage current may have ignited vegetation $\Rightarrow$ High

- According to the test conducted by the manufacturer, the leakage current when 20kV is applied in the water-injection condition is 2mA even after 60 minutes have elapsed since the test started, so it is difficult to conclude that this degree of current would ignite the tree. However, when looking at the enlarged photograph of Figure 7, it is considered that the tree burned before the



conductor cover burned, and it is difficult to consider that such an incident occurs without current leakage.

- There were many inappropriately-installed covers, where the fitting part was not completely closed, or the fitting part was facing upward due to twisting of the conductor cover (Figure 8). Appropriate creepage distances are not ensured in such locations.



Figure 8 Defective construction confirmed

Since the incident had already occurred, it was impossible to check the condition prior to the burnout. However, based on presumptions A, B, and C, it was concluded that vegetation ignited due to higher-than-expected leakage current. This current resulted from improper creepage distances caused by poor installation (Figure 9) or a sustained leakage state.

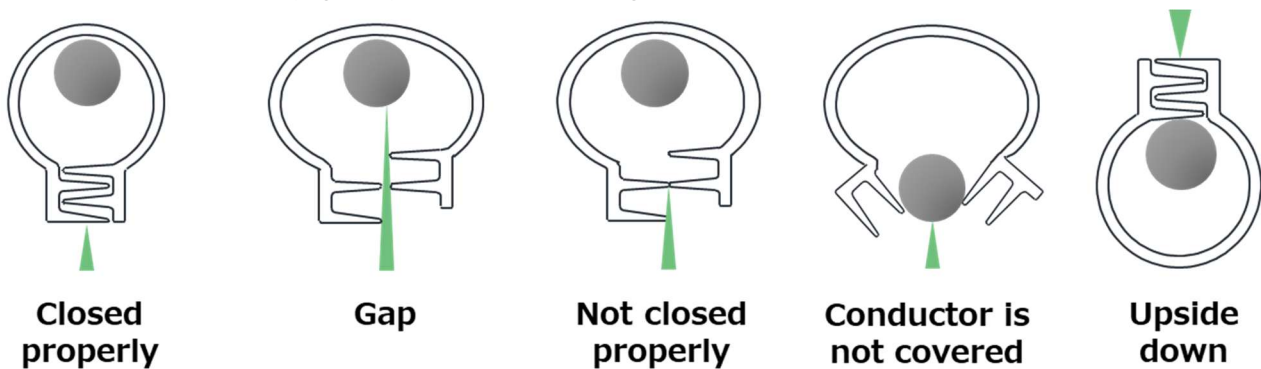


Figure 9 Examples of improper creepage distance retention due to improper installation

### 3.2.2 Response to the above situation

While the appropriate installation methods had been taught at AEDC at every opportunity during the JICA Expert Team's stay in Abuja, it turned out to be difficult to keep the installation quality high for an extended period in Nigeria, given the fact that many installation defects were discovered. Still, the possibility that the original insulation performance of the conductor cover was insufficient in the environment of Nigeria cannot be denied.

Based on the above, AEDC was requested to remove all the installed conductor covers as soon as possible, because it was considered inappropriate to keep the conductor covers installed from the viewpoint that there is a possibility that the conductor covers and vegetation would burnt, or that the burned or melted conductor covers could fall and cause fatal accidents, and that this could negatively affect the reputation of JICA projects.

## **Annex 3. PDM, PO**

Project Design Matrix

Version 0  
Dated 31th August, 2022

Project Title: The project for capacity development of power distribution  
Implementing Agency: National Power Training Institute of Nigeria (NAPTIN), Abuja Electricity Distribution  
Target Group:  
Period of Project: 2022.4 - 2025.3  
Project Site: NAPTIN's Training Centers (Abuja) and Abuja Electricity Distribution Plc. (AEDC)  
Model Site:

| Narrative Summary                                                             |  | Objectively Verifiable Indicators                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Means of Verification                                                                                                                                           | Important Assumption                                                            | Achievement | Remarks |
|-------------------------------------------------------------------------------|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|-------------|---------|
| Overall Goal                                                                  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                 |                                                                                 |             |         |
| To improve Disco's business operations capabilities                           |  | 1 The number of Disco engineers involved in design and construction is 10 or more, using the knowledge acquired in the NAPTIN training to reduce technical loss.<br>2 The number of Disco engineers involved in design and construction is 10 or more, using the knowledge acquired in the NAPTIN training to improve reliability(SAIFI, SAIDI)<br>3 The number of Disco engineers involved in design and construction is 10 or more, using the knowledge acquired in the NAPTIN training for quality improvement (voltage, etc.)                                   | Evaluation of data obtained from Disco                                                                                                                          | The range of the effects of 1 - 3 is limited to the pilot project area in AEDC. |             |         |
| Project Purpose                                                               |  | 1. 70% or more participants in the training courses will be evaluated that they acquired correct knowledge about reducing technical loss.<br>2. 70% or more participants in the training courses will be evaluated that they acquired correct knowledge about improving reliability.<br>3. 70% or more participants in the training courses will be evaluated that they acquired correct knowledge about quality improvement.<br>4. A training system (curriculum, teaching materials, training equipment, instructors, budget measures, etc.) will be established. | Questionnaire, pre-training test, post-training test, technical standards in Disco, evaluation of manual maintenance, Hearing to the boss of the NAPTIN trainer |                                                                                 |             |         |
| To improve the capabilities of engineers in the power distribution department |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                 |                                                                                 |             |         |

|                                                                                 |  |  |  |  |
|---------------------------------------------------------------------------------|--|--|--|--|
| Outputs                                                                         |  |  |  |  |
| Output1: Development and implementation of training for loss reduction measures |  |  |  |  |
| Output2: Development and implementation of training to improve reliability      |  |  |  |  |
| Output3: Development and implementation of training for quality improvement     |  |  |  |  |
| Output4: Confirmation of the utilization of NAPTIN training in Discos           |  |  |  |  |

| Activities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Inputs                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                            | Important Assumption         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | The Japanese Side                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | The Nigeria Side                                                                                                                                                                                                                                                                                                                                                           |                              |
| <p>&lt;For Output1 to Output3&gt;<br/>Activities with NAPTIN</p> <p>1 Planning training courses, teaching materials preparation, TOT</p> <p>2 Conducting training courses</p> <p>3 Evaluating training courses and giving feedback</p> <p>4 Incorporating pilot results into training (Considering training improvement plans)</p> <p>5 Design and construction of training equipment for demonstration</p> <p>Activities with AEDC</p> <p>6 Field survey, Extracting issue in business operations</p> <p>7 Consideration and implementation of pilot proposal</p> <p>8 Incorporate pilot results into business operations (revising technical standards, SOP, etc.)</p> | <p>• Dispatch experts of following specialities;<br/>Leader/Distribution Business Operation: 9 months<br/>Distribution Planning: 9 months<br/>Distribution Design: 9 months<br/>Distribution Maintenance and Management: 9 months<br/>Pilot Project 1 (Procurement survey): 4.5 months<br/>Pilot Project 2 (Construction Supervision): 4 months<br/>Project Coordination and Monitoring/Evaluation: 9 months</p> <p>• Training in Japan</p> <p>• Equipment necessary for pilot projects</p> | <p>The proper Counterparts, office space, necessary permission and tax exemption, etc. for the Project including allocation of necessary counterpart budget to facilitate the smooth project implementation and sustainability after completion.<br/>FMP, NAPTIN and AEDC agreed to arrange those property.<br/>The offices space will be provided at NAPTIN and AEDC.</p> |                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                            | <b>Pre-Conditions</b>        |
| <p>&lt;Output4&gt;<br/>4-1 Collecting information, analysis, and presentation of improvement plans for Career framework in AEDC and application of NAPTIN training</p> <p>4-2 Creating dissemination plans for other Discos</p>                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                            | <Issues and countermeasures> |

## Version 0

**Dated 31st August, 2022**

## Project Title: The project for capacity development of power distribution

[illegible]

[illegible]

**Project Design Matrix**

**Version 1**  
**Dated 22nd June, 2023**

Project Title: The project for capacity development of power distribution  
Implementing Agency: National Power Training Institute of Nigeria (NAPTIN), Abuja Electricity Distribution  
Target Group:  
Period of Project: 2022.4 - 2025.3  
Project Site: NAPTIN's Training Centers (Abuja) and Abuja Electricity Distribution Plc. (AEDC)  
Model Site:

| Narrative Summary                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Objectively Verifiable Indicators | Means of Verification                  | Important Assumption                                                            | Achievement | Remarks |
|----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|----------------------------------------|---------------------------------------------------------------------------------|-------------|---------|
| <b>Overall Goal</b><br>To improve Disco's business operations capabilities | 1 The number of Disco engineers involved in design and construction is 10 or more, using the knowledge acquired in the NAPTIN training to reduce technical loss.<br>2 The number of Disco engineers involved in design and construction is 10 or more, using the knowledge acquired in the NAPTIN training to improve reliability(SAIFI, SAIDI)<br>3 The number of Disco engineers involved in design and construction is 10 or more, using the knowledge acquired in the NAPTIN training for quality improvement (voltage, etc.) |                                   |                                        |                                                                                 |             |         |
|                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                   | Evaluation of data obtained from Disco | The range of the effects of 1 - 3 is limited to the pilot project area in AEDC. |             |         |



|                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                                                                                                 |  |
|---------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <b>Project Purpose</b><br>To improve the capabilities of engineers in the power distribution department | 1. 70% or more participants in the training courses will be evaluated that they acquired correct knowledge about reducing technical loss.<br>2. 70% or more participants in the training courses will be evaluated that they acquired correct knowledge about improving reliability.<br>3. 70% or more participants in the training courses will be evaluated that they acquired correct knowledge about quality improvement.<br>4. A training system (curriculum, teaching materials, training equipment, instructors, budget measures, etc.) will be established. |  | Questionnaire, pre-training test, post-training test, technical standards in Disco, evaluation of manual maintenance, Hearing to the boss of the NAPTIN trainer |  |
|                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                                                                                                 |  |
|                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                                                                                                 |  |
|                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                                                                                                 |  |
|                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                                                                                                 |  |
| <b>Outputs</b>                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                                                                                                 |  |
| Output1: Development and implementation of training for loss reduction measures                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                                                                                                 |  |
| Output2: Development and implementation of training to improve reliability                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                                                                                                 |  |
| Output3: Development and implementation of training for quality improvement                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                                                                                                 |  |
| Output4: Confirmation of the utilization of NAPTIN training in Discos                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                                                                                                 |  |

| Activities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Inputs                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                               | Important Assumption         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | The Japanese Side                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | The Nigeria Side                                                                                                                                                                                                                                                                                                                                                                                              |                              |
| <p>&lt;For Output1 to Output3&gt;<br/>Activities with NAPTIN</p> <p>1 Planning training courses, teaching materials preparation, TOT</p> <p>2 Conducting training courses</p> <p>3 Evaluating training courses and giving feedback</p> <p>4 Incorporating pilot results into training (Considering training improvement plans)</p> <p>5 Design and construction of training equipment for demonstration</p> <p>Activities with AEDC</p> <p>6 Field survey, Extracting issue in business operations</p> <p>7 Consideration and implementation of pilot proposal</p> <p>8 Incorporate pilot results into business operations (revising technical standards, SOP, etc.)</p> <p>&lt;Output4&gt;</p> <p>4-1 Collecting information, analysis, and presentation of improvement plans for Career framework in AEDC and application of NAPTIN training</p> <p>4-2 Creating dissemination plans for other Discos</p> | <p>• Dispatch experts of following specialities;<br/>Leader/Distribution Business Operation: 9 months</p> <p>Distribution Planning: 9 months</p> <p>Distribution Design: 9 months</p> <p>Distribution Maintenance and Management: 9 months</p> <p>Pilot Project 1 (Procurement survey): 4.5 months</p> <p>Pilot Project 2 (Construction Supervision): 4 months</p> <p>Project Coordination and Monitoring/Evaluation: 9 months</p> <p>• Training in Japan</p> <p>• Equipment necessary for pilot projects</p> | <p>The proper Counterparts, office space, necessary permission and tax exemption, etc. for the Project including allocation of necessary counterpart budget to facilitate the smooth project implementation and sustainability after completion.</p> <p>FMP, NAPTIN and AEDC agreed to arrange those property.</p> <p>The offices space will be provided at NAPTIN and AEDC.</p> <p><b>Pre-Conditions</b></p> |                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                               | <Issues and countermeasures> |



[illegible]

**Project Design Matrix**

**Version 2**  
**Dated 6th December, 2023**

Project Title: The project for capacity development of power distribution  
Implementing Agency: National Power Training Institute of Nigeria (NAPTIN), Abuja Electricity Distribution  
Target Group:  
Period of Project: 2022.4 - 2025.10  
Project Site: NAPTIN's Training Centers (Abuja) and Abuja Electricity Distribution Plc. (AEDC)  
Model Site:

| Narrative Summary                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Objectively Verifiable Indicators                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Means of Verification                                                                                                                                           | Important Assumption                                                            | Achievement                                                                                                                                                                                                                                                                                                      | Remarks |
|-------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| <b>Overall Goal</b>                                                           | To improve Disco's business operations capabilities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                 |                                                                                 |                                                                                                                                                                                                                                                                                                                  |         |
|                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1 The number of Disco engineers involved in design and construction is 10 or more, using the knowledge acquired in the NAPTIN training to reduce technical loss.<br>2 The number of Disco engineers involved in design and construction is 10 or more, using the knowledge acquired in the NAPTIN training to improve reliability(SAIFI, SAIDI)<br>3 The number of Disco engineers involved in design and construction is 10 or more, using the knowledge acquired in the NAPTIN training for quality improvement (voltage, etc.) | Evaluation of data obtained from Disco                                                                                                                          | The range of the effects of 1 - 3 is limited to the pilot project area in AEDC. |                                                                                                                                                                                                                                                                                                                  |         |
| <b>Project Purpose</b>                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                 |                                                                                 |                                                                                                                                                                                                                                                                                                                  |         |
| To improve the capabilities of engineers in the power distribution department | 1. 70% or more participants in the training courses will be evaluated that they acquired correct knowledge about reducing technical loss.<br>2. 70% or more participants in the training courses will be evaluated that they acquired correct knowledge about improving reliability.<br>3. 70% or more participants in the training courses will be evaluated that they acquired correct knowledge about quality improvement.<br>4. A training system (curriculum, teaching materials, training equipment, instructors, budget measures, etc.) will be established. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Questionnaire, pre-training test, post-training test, technical standards in Disco, evaluation of manual maintenance, Hearing to the boss of the NAPTIN trainer |                                                                                 | The Joint Technical WG 1-3 meetings were held 35 times (June 2022 - November 2023) to discuss the distribution training facility, the pilot project, and outage management app improvement.<br>TOT meetings were held 33 times (September 2022 - November 2023) to improve textbooks for NAPTIN training course. |         |

|                                                                                                                                                                                                                                                                                                                                                     |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <b>Outputs</b><br>Output1: Development and implementation of training for loss reduction measures<br><br>Output2: Development and implementation of training to improve reliability<br><br>Output3: Development and implementation of training for quality improvement<br><br>Output4: Confirmation of the utilization of NAPTIN training in Discos |  |
|                                                                                                                                                                                                                                                                                                                                                     |  |
|                                                                                                                                                                                                                                                                                                                                                     |  |
|                                                                                                                                                                                                                                                                                                                                                     |  |

The Joint Technical WG 1-3 meetings were held 35 times (June 2022 - November 2023) to discuss the distribution training facility, the pilot project, and outage management app improvement.  
TOT meetings were held 33 times (September 2022 - November 2023) to improve textbooks for NAPTIN training course.

| Activities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Inputs                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                            | Important Assumption         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | The Japanese Side                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | The Nigeria Side                                                                                                                                                                                                                                                                                                                                                           |                              |
| <p>&lt;For Output1 to Output3&gt;<br/>Activities with NAPTIN</p> <p>1 Planning training courses, teaching materials preparation, TOT</p> <p>2 Conducting training courses</p> <p>3 Evaluating training courses and giving feedback</p> <p>4 Incorporating pilot results into training (Considering training improvement plans)</p> <p>5 Design and construction of training equipment for demonstration</p> <p>Activities with AEDC</p> <p>6 Field survey, Extracting issue in business operations</p> <p>7 Consideration and implementation of pilot proposal</p> <p>8 Incorporate pilot results into business operations (revising technical standards, SOP, etc.)</p> | <p>• Dispatch experts of following specialties;<br/>Leader/Distribution Business Operation: 9 months<br/>Distribution Planning: 9 months<br/>Distribution Design: 9 months<br/>Distribution Maintenance and Management: 9 months<br/>Pilot Project 1 (Procurement survey): 4.5 months<br/>Pilot Project 2 (Construction Supervision): 4 months<br/>Project Coordination and Monitoring/Evaluation: 9 months</p> <p>• Training in Japan</p> <p>• Equipment necessary for pilot projects</p> | <p>The proper Counterparts, office space, necessary permission and tax exemption, etc. for the Project including allocation of necessary counterpart budget to facilitate the smooth project implementation and sustainability after completion.<br/>FMP, NAPTIN and AEDC agreed to arrange those property.<br/>The offices space will be provided at NAPTIN and AEDC.</p> |                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                            | <b>Pre-Conditions</b>        |
| <p>&lt;Output4&gt;<br/>4-1 Collecting information, analysis, and presentation of improvement plans for Career framework in AEDC and application of NAPTIN training</p> <p>4-2 Creating dissemination plans for other Discos</p>                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                            | <Issues and countermeasures> |





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Project Design Matrix

Project Title: The project for capacity development of power distribution

Implementing Agency: National Power Training Institute of Nigeria (NAPTIN), Abuja

Target Group:

Period of Project: 2022.4 - 2025.10

Project Site: NAPTIN's Training Centers (Abuja) and Abuja Electricity Distribution Plc. (AEDC)

Model Site:

Version 3

Dated 25th June, 2024

| Narrative Summary                                                                                       | Objectively Verifiable Indicators                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Means of Verification                                                                                                                                           | Important Assumption                                                            | Achievement                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Remarks |
|---------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| <b>Overall Goal</b><br>To improve Disco's business operations capabilities                              | 1 The number of Disco engineers involved in design and construction is 10 or more, using the knowledge acquired in the NAPTIN training to reduce technical loss.<br>2 The number of Disco engineers involved in design and construction is 10 or more, using the knowledge acquired in the NAPTIN training to improve reliability(SAIFI, SAIDI)<br>3 The number of Disco engineers involved in design and construction is 10 or more, using the knowledge acquired in the NAPTIN training for quality improvement (voltage, etc.)                                   | Evaluation of data obtained from Disco                                                                                                                          | The range of the effects of 1 - 3 is limited to the pilot project area in AEDC. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |         |
| <b>Project Purpose</b><br>To improve the capabilities of engineers in the power distribution department | 1. 70% or more participants in the training courses will be evaluated that they acquired correct knowledge about reducing technical loss.<br>2. 70% or more participants in the training courses will be evaluated that they acquired correct knowledge about improving reliability.<br>3. 70% or more participants in the training courses will be evaluated that they acquired correct knowledge about quality improvement.<br>4. A training system (curriculum, teaching materials, training equipment, instructors, budget measures, etc.) will be established. | Questionnaire, pre-training test, post-training test, technical standards in Disco, evaluation of manual maintenance, Hearing to the boss of the NAPTIN trainer |                                                                                 | The Joint Technical WG 1-3 meetings were held 46 times (June 2022 - June 2024) to discuss the distribution training facility, the pilot project, and outage management app improvement.<br>WG 4 kickoff meeting was held (June 2024) to examine the appropriateness of NAPTIN's training courses and to discuss measures.<br>TOT meetings were held 44 times (September 2022 - June 2024) to upgrade of NAPTIN's training courses.<br>Training Demonstrations for upgrading of training (technical loss reduction, reliability improvement and quality improvement) were conducted from May to June 2024. |         |

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| Activities                                                                             |  |  |  |  | 2021   |    |     | 2022 |    |    | 2023 |     |    | 2024 |     |     | 2025 |    |     | Responsible Organization |       | Achievements                                                                                          | Issue & Countermeasures |
|----------------------------------------------------------------------------------------|--|--|--|--|--------|----|-----|------|----|----|------|-----|----|------|-----|-----|------|----|-----|--------------------------|-------|-------------------------------------------------------------------------------------------------------|-------------------------|
| Sub-Activities                                                                         |  |  |  |  | I      | II | III | IV   | I  | II | III  | IV  | I  | II   | III | IV  | I    | II | III | IV                       | Japan |                                                                                                       |                         |
| Output 1-3 : 1-5 with NAPTIN, 6-7 with AEDC                                            |  |  |  |  |        |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
| 1 Planning training courses, teaching materials preparation, TOT                       |  |  |  |  | Plan   |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       | TOT meetings were held 44 times (September 2022 - June 2024) to upgrade of NAPTIN's training courses. |                         |
| 2 Conducting training course                                                           |  |  |  |  | Plan   |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
| 3 Evaluating training courses and giving feedback                                      |  |  |  |  | Plan   |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       | Training Demonstrations for TOT was held from May to June 2024.                                       |                         |
| 4 Incorporating pilot results into training(Considering training improvement)          |  |  |  |  | Plan   |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
| 5 Design and construction of training equipment for demonstration                      |  |  |  |  | Plan   |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
| 6 Field survey, Extracting issues in business operations                               |  |  |  |  | Plan   |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
| 7 Consideration and implementation of pilot proposal                                   |  |  |  |  | Plan   |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
| 8 Incorporate pilot results into business operations (revising technical standards)    |  |  |  |  | Plan   |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  | Actual |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
| Output 4:                                                                              |  |  |  |  |        |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
| 4.1 Collecting information, analysis, and presentation of improvement plans for Career |  |  |  |  | Plan   |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
| 4.2 Creating dissemination plans for other Discos                                      |  |  |  |  | Actual |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  | Actual |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
| Duration / Phasing                                                                     |  |  |  |  |        |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  | Plan   |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  | Actual |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
| Monitoring Plan                                                                        |  |  |  |  |        |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  | Year   |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  |        | I  | II  | III  | IV | I  | II   | III | IV | I    | II  | III | IV   | I  | II  | III                      | IV    |                                                                                                       |                         |
| Monitoring                                                                             |  |  |  |  |        |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
| Joint Coordinating Committee                                                           |  |  |  |  | Plan   |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  | Actual |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
| Submission of Monitoring Sheet                                                         |  |  |  |  | Plan   |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  | Actual |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
| Post Monitoring                                                                        |  |  |  |  | Plan   |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  | Actual |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
| Reports/Documents                                                                      |  |  |  |  |        |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  |        |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
| Project Completion Report                                                              |  |  |  |  | Plan   |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  | Actual |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
| Public Relations                                                                       |  |  |  |  |        |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  |        |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
| Public Relation Activities                                                             |  |  |  |  | Plan   |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  | Actual |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  |        |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  |        |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  |        |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  |        |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  |        |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  |        |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  |        |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  |        |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  |        |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  |        |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  |        |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  |        |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  |        |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  |        |    |     |      |    |    |      |     |    |      |     |     |      |    |     |                          |       |                                                                                                       |                         |
|                                                                                        |  |  |  |  |        |    |     |      |    |    |      |     |    | </   |     |     |      |    |     |                          |       |                                                                                                       |                         |

Project Design Matrix

Version 4  
Dated 13th February, 2025

Project Title: The project for capacity development of power distribution  
Implementing Agency: National Power Training Institute of Nigeria (NAPTIN), Abuja Electricity Distribution

Target Group:

Period of Project: 2022.4 - 2025.10

Project Site: NAPTIN's Training Centers (Abuja) and Abuja Electricity Distribution Plc. (AEDC)

Model Site:

| Narrative Summary                                                                                       |  | Objectively Verifiable Indicators                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Means of Verification                                                                                                                                           | Important Assumption                                                            | Achievement                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Remarks |
|---------------------------------------------------------------------------------------------------------|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| <b>Overall Goal</b><br>To improve Disco's business operations capabilities                              |  | 1 The number of Disco engineers involved in design and construction is 10 or more, using the knowledge acquired in the NAPTIN training to reduce technical loss.<br>2 The number of Disco engineers involved in design and construction is 10 or more, using the knowledge acquired in the NAPTIN training to improve reliability(SAFI, SAIDI)<br>3 The number of Disco engineers involved in design and construction is 10 or more, using the knowledge acquired in the NAPTIN training for quality improvement (voltage, etc.)                                    | Evaluation of data obtained from Disco                                                                                                                          | The range of the effects of 1 - 3 is limited to the pilot project area in AEDC. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |         |
| <b>Project Purpose</b><br>To improve the capabilities of engineers in the power distribution department |  | 1. 70% or more participants in the training courses will be evaluated that they acquired correct knowledge about reducing technical loss.<br>2. 70% or more participants in the training courses will be evaluated that they acquired correct knowledge about improving reliability.<br>3. 70% or more participants in the training courses will be evaluated that they acquired correct knowledge about quality improvement.<br>4. A training system (curriculum, teaching materials, training equipment, instructors, budget measures, etc.) will be established. | Questionnaire, pre-training test, post-training test, technical standards in Disco, evaluation of manual maintenance, Hearing to the boss of the NAPTIN trainer |                                                                                 | <b>Indicator 1-3</b><br>New classroom training courses for <b>technical loss reduction</b> , <b>reliability improvement</b> and <b>quality improvement</b> have been developed. Since evaluation for the effectiveness of those new training courses has not been conducted, it is difficult to assess the achievement of these indicators at this moment.<br>- Degree of understanding and acquiring knowledge on the new training courses, i.e., technical loss reduction, reliability improvement and quality improvement, will be measured after the official release of new training courses by NAPTIN. NAPTIN will release the training courses in March 2025.<br>- Practical training courses are under development and will be completed after the 6th fieldwork, around the middle of 2025.<br><br><b>Indicator 4</b><br><b>Around 60%</b> of training system for new training courses has been established at NAPTIN based on outputs achieved so far.<br>-New classroom training courses have been developed. NAPTIN has released 2025 official training calendar including new developed training courses. (100% completed)<br>-90% of teaching materials for new classroom training courses have been prepared.<br>-50% of teaching materials for new practical training courses have been developed.<br>-Installation of the distribution training facility has been completed. (100% completed)<br>-70% of instructors' capacity has been developed.<br>-Budget measures for new training courses have not been established yet. |         |

|                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
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| <p><b>Outputs</b></p> <p>Output1: Development and implementation of training for loss reduction measures</p> <p>Output2: Development and implementation of training to improve reliability</p> <p>Output3: Development and implementation of training for quality improvement</p> <p>Output4: Confirmation of the utilization of NAPTIN training in Discos</p> | <p><b>Activities</b></p> <p>&lt;For Output1 to Output3&gt;<br/>Activities with NAPTIN</p> <p>1 Planning training courses, teaching materials preparing training, TOT</p> <p>2 Conducting training courses</p> <p>3 Evaluating training courses and giving feedback</p> <p>4 Incorporating pilot results into training (Considering training improvement plans)</p> <p>5 Design and construction of training equipment for demonstration</p> <p>Activities with AEDC</p> <p>6 Field survey, Extracting issue in business operations</p> <p>7 Consideration and implementation of pilot proposal</p> <p>8 Incorporate pilot results into business operations (revising technical standards, SOP, etc.)</p> <p>&lt;Output4&gt;<br/>4-1 Collecting information, analysis, and presentation of improvement plans for Career framework in AEDC and application of NAPTIN training</p> <p>4-2 Creating dissemination plans for other Discos</p> | <p><b>Inputs</b></p> <p><b>The Japanese Side</b></p> <ul style="list-style-type: none"> <li>• Dispatch experts of following specialties: <ul style="list-style-type: none"> <li>- Leader/Distribution Business Operation: 10 months</li> <li>- Distribution Planning: 9 months</li> <li>- Distribution Design: 9.5 months</li> <li>- Distribution Maintenance and Management: 9.5 months</li> <li>- Pilot Project 1 (Procurement survey): 4.5 months</li> <li>- Pilot Project 2 (Construction Supervision): 4 months</li> <li>- Training Courses Planning: 4.5 months</li> <li>- Project Coordination and Monitoring/Evaluation: 9 months</li> </ul> </li> <li>• Training in Japan</li> <li>• Equipment necessary for pilot projects</li> </ul> <p><b>The Nigeria Side</b></p> <p>The proper Counterparts, office space, necessary permission and tax exemption, etc. for the Project including allocation of necessary counterpart budget to facilitate the smooth project implementation and sustainability after completion.</p> <p>FMP, NAPTIN and AEDC agreed to arrange those property.</p> <p>The offices space will be provided at NAPTIN and AEDC.</p> | <p><b>Important Assumption</b></p> <p><b>Pre-Conditions</b></p> <p>&lt;Issues and countermeasures&gt;</p> | <p>-The Joint Technical WG 1-3 meetings were held <b>59 times (June 2022 - January 2025)</b> to discuss the distribution training facility, the pilot project, and outage management app improvement.</p> <p>-TOT meetings were held <b>58 times (September 2022 - January 2025)</b> to upgrade of NAPTIN's training courses.</p> <p>-First training Demonstrations for upgrading of training (technical loss reduction, reliability improvement and quality improvement) were conducted from May to June 2024. Second training Demonstrations for upgrading of training were conducted from January to February 2025.</p> <p>-Delivery of pilot project equipment and materials for AEDC and NAPTIN has completed in December 2024.</p> <p>-The installation of the training facility for NAPTIN has been completed in December 2024.</p> <p>-Outage Management App was developed by AEDC in June 2023, and it was rolled out company-wide. However, the data entry status of each Regional Office is not satisfactory, and the data entry rate needs to be increased.</p> <p>-WG 4 meetings were held 4 times (June 2024 - January 2025) to examine the appropriateness of NAPTIN's training courses and to discuss measures.</p> <p>-NAPTIN has determined the contents to be E-Learning, and will create the E-Learning contents with a contractor contracted by NAPTIN.</p> <p>-Online workshop to introduce NAPTIN's new training courses to Discos was held in January 2025.</p> | <p>(1)NAPTIN<br/>-Practical training for TOT using the distribution training facility will be conducted during 5th fieldwork.</p> <p>(2)AEDC<br/>-Installation of the bolt type connectors will be completed during 5th fieldwork. In addition, the load break switch will be connected and the new 33 kV distribution feeder will be put into operation and monitoring will begin.</p> <p>-Installation of the conductor covers on 11kV distribution lines will be completed during 5th fieldwork.</p> |
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Tentative Plan of Operation

Version 4

Dated 13th February, 2025

| Project Title: The project for capacity development of power distribution |        |      |      |    |     |    |      |    |     |    |      |    |     |    | Monitoring |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
|---------------------------------------------------------------------------|--------|------|------|----|-----|----|------|----|-----|----|------|----|-----|----|------------|----|-----|----|-----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|--|--|---------|-------|----------|
| Inputs                                                                    |        | Year | 2021 |    |     |    | 2022 |    |     |    | 2023 |    |     |    | 2024       |    |     |    | 2025                                                                                                                  |                                                      |  |  | Remarks | Issue | Solution |
| Expert                                                                    |        |      | I    | II | III | IV | I    | II | III | IV | I    | II | III | IV | I          | II | III | IV | Difficulty in ensuring a period of time to monitor the results of the AEDC pilot project within the project duration. | Discuss the project duration in the 5th JCC meeting. |  |  |         |       |          |
|                                                                           | Plan   |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
|                                                                           | Actual |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
|                                                                           | Plan   |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
|                                                                           | Actual |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
|                                                                           | Plan   |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
|                                                                           | Actual |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
|                                                                           | Plan   |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
|                                                                           | Actual |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
|                                                                           | Plan   |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Plan                                                                      |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |
| Actual                                                                    |        |      |      |    |     |    |      |    |     |    |      |    |     |    |            |    |     |    |                                                                                                                       |                                                      |  |  |         |       |          |



[illegible]

Project Design Matrix

|                                                                                                            |  |
|------------------------------------------------------------------------------------------------------------|--|
| Version 5                                                                                                  |  |
| Dated 30th October, 2025                                                                                   |  |
| Project Title: The project for capacity development of power distribution                                  |  |
| Implementing Agency: National Power Training Institute of Nigeria (NAPTIN), Abuja Electricity Distribution |  |
| Target Group:                                                                                              |  |
| Period of Project: 2022.4 - 2026.2                                                                         |  |
| Project Site: NAPTIN's Training Centers (Abuja) and Abuja Electricity Distribution Plc. (AEDC)             |  |
| Model Site:                                                                                                |  |

| Narrative Summary                                                                                       | Objectively Verifiable Indicators                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Means of Verification                                                                                                                                           | Important Assumption                                                            | Achievement                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Remarks |
|---------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| <b>Overall Goal</b><br>To improve Disco's business operations capabilities                              | 1 The number of Disco engineers involved in design and construction is 10 or more, using the knowledge acquired in the NAPTIN training demonstration to reduce technical loss.<br>2 The number of Disco engineers involved in design and construction is 10 or more, using the knowledge acquired in the NAPTIN training demonstration to improve reliability (SAIFI, SAIDI)<br>3 The number of Disco engineers involved in design and construction is 10 or more, using the knowledge acquired in the NAPTIN training demonstration for quality improvement (voltage, etc.)                               | Evaluation of data obtained from Disco                                                                                                                          | The range of the effects of 1 - 3 is limited to the pilot project area in AEDC. | 1 The number of Disco engineers involved in design and construction is 13, using the knowledge acquired in the NAPTIN training demonstration to reduce technical loss.<br>2 The number of Disco engineers involved in design and construction is 17, using the knowledge acquired in the NAPTIN training demonstration to improve reliability.<br>3 The number of Disco engineers involved in design and construction is 16, using the knowledge acquired in the NAPTIN training demonstration for quality improvement.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |         |
| <b>Project Purpose</b><br>To improve the capabilities of engineers in the power distribution department | 1. 70% or more participants in the training <b>demonstration</b> will be evaluated that they acquired correct knowledge about reducing technical loss.<br>2. 70% or more participants in the training <b>demonstration</b> will be evaluated that they acquired correct knowledge about improving reliability.<br>3. 70% or more participants in the training <b>demonstration</b> will be evaluated that they acquired correct knowledge about quality improvement.<br>4. A training system (curriculum, teaching materials, training equipment, instructors, budget measures, etc.) will be established. | Questionnaire, pre-training test, post-training test, technical standards in Disco, evaluation of manual maintenance, Hearing to the boss of the NAPTIN trainer |                                                                                 | <b>Indicator 1-3</b><br>- New classroom training courses for <b>technical loss reduction, reliability improvement</b> and <b>quality improvement</b> have been developed.<br>- Even though new classroom trainings developed through the project have already been released by NAPTIN, no one has participated in the training. However, judging from the feedback of model trainees who participated in training demonstration, the training provided relevant and necessary information and the materials and teaching method were good enough for them to understand well.<br><br><b>Indicator 4</b><br><b>Around 90%</b> of training system for new training courses has been established at NAPTIN based on outputs achieved so far.<br>- New classroom training courses have been developed. NAPTIN has released 2025 official training calendar including the newly developed training courses. (100% completed)<br>- Teaching materials for new classroom training courses have been completed. (100% completed)<br>- New practical training courses have been developed. (100% completed)<br>- Teaching materials for new practical training courses have been completed. (100% completed)<br>- Installation of the distribution training facility has been completed. (100% completed)<br>- Instructors' capacity has been developed. (100% completed)<br>- The e-learning content of the classroom training course will be created using AFD funding. (40% completed) |         |

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**Dated 30th October, 2025**

**Dated 30th October, 2025**

**Dated 30th October, 2025**

[illegible]

## **Annex 4. Minutes of Discussion of JCC meeting**

**MINUTES OF DISCUSSIONS  
BETWEEN  
JAPAN INTERNATIONAL COOPERATION AGENCY  
AND  
RELEVANT AUTHORITIES OF THE FEDERAL GOVERNMENT OF NIGERIA  
ON  
THE PROJECT FOR CAPACITY DEVELOPMENT OF POWER  
DISTRIBUTION**

Abuja, 19<sup>th</sup> October 2022



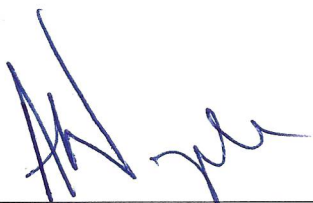
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Mr. Susumu Yuzurio  
Chief representative  
Japan International Cooperation Agency  
(JICA)  
Nigeria Office



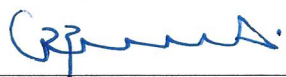
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Engr. Briskilla Sapke  
Director of Distribution  
The Federal Ministry of Power (FMP)  
The Federal Republic of Nigeria



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Mr. Ahmed Bolaji Nagode  
Director General  
National Power Training Institute of  
Nigeria (NAPTIN)  
The Federal Republic of Nigeria



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Mr. Godfrey Aba  
Head of Network Planning and Investment  
Abuja Electricity Distribution Pls. (AEDC)  
The Federal Republic of Nigeria

Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched an expert team (hereinafter referred to as "JICA Team") to the Federal Republic of Nigeria from the 8<sup>th</sup> of September to the 21<sup>st</sup> of October 2022. JICA Team is entrusted by JICA to undertake the consulting services for the project for capacity development of power distribution (hereinafter referred to as "the Project").

The meeting of the Joint Coordinating Committee (hereinafter referred to as "JCC") on the Project was held on the 13<sup>th</sup> of September 2022 and JICA Team and representatives of relevant authorities of the Federal Republic of Nigeria discussed and agreed on the issues related to the Project described in Main Points Discussed.

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## Main Points Discussed

### 1. Approval of project related documents

Work Plan, Project Design Matrix (PDM) and Plan of Operation (PO) presented by JICA Team were approved by JCC. Objectively Verifiable Indicators of PDM were set based on the results of Baseline Survey and agreed by JCC. In addition, minutes of JCC meeting is attached to this Minutes of Discussions as a detailed record of discussions.

### 2. Training equipment for NAPTIN

#### 2.1 Outline

##### (1) Objectives

Objectives of Distribution Training facility for NAPTIN are to improve the capacity of linesmen at distribution companies in terms of;

- (i) fault detection,
- (ii) fault recovery,
- (iii) maintenance and
- (iv) repair

of overhead and underground distribution network in order to reduce outage time and improve reliability of power supply.

##### (2) Location

NAPTIN's headquarters in Abuja

##### (3) Outputs

Expected outputs of the facility are to improved capacity of linesmen in terms of (i) to (iv) described above.

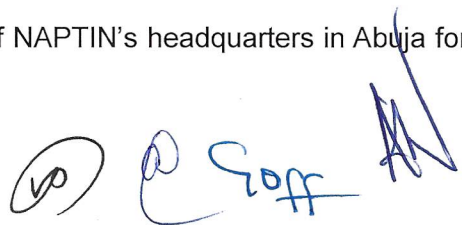
#### 2.2 Scope of procurement

The followings are the tentative list of training equipment to be procured by JICA.

- (1) 33kV overhead lines with accessories
- (2) 33kV underground cables
- (3) 33kV/415-240V distribution transformer
- (4) 33kV section switches
- (5) Cable fault detector (High voltage DC insulation tester)
- (6) Phase detector

#### 2.3 Securing a plot for training equipment

NAPTIN shall secure a plot within the premises of NAPTIN's headquarters in Abuja for the

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installation of training equipment to be procured by JICA. Approximated area required for the installation is approximately 80m x 50m. NAPTIN shall level the plot and remove any obstacles from there at its own cost to make it ready for the installation of the training equipment.

#### **2.4 Budget for installation**

NAPTIN shall secure necessary budget for the installation of training equipment to be procured by JICA.

#### **2.4 Procurement and installation schedule**

The following schedule for procurement and installation was agreed by JCC.

- (1) Bid announcement: December 2022
- (2) Bid opening: January 2023
- (3) Delivery of equipment to the site: June 2023
- (4) Completion of installation: October 2023
- (5) Start training using the procured equipment: January 2024

### **3. Pilot project for AEDC**

#### **3.1 Outline**

##### **(1) Objectives**

Objectives of AEDC's pilot project are;

- (i) to demonstrate the measures of technical loss reduction, reliability improvement and quality improvement (voltage improvement) in AEDC's distribution network and
- (ii) to measure and evaluate the effect of the measures for dissemination at AEDC and other distribution companies.

##### **(2) Location**

33kV feeder H31 for 1 x 45 MVA, 2 x 100MVA, 132/33kV Apo Transmission substation

##### **(3) Outputs**

Outputs of the pilot project are reduced technical losses, reduced down time, reduced frequency of outage and improved voltage profile.

#### **3.2 Scope of procurement**

The followings are the tentative list of equipment to be procured by JICA.

- (1) Power pole
- (2) Conductor
- (3) Underground cable



- (4) Ground wire
- (5) Line post insulator
- (6) Suspension insulator
- (7) Lightning arrestor
- (8) Accessories (Cross arm, Stay wire, etc.)
- (9) Section switch (33kV, PAS)
- (10) Bolt type connector
- (11) Polyethylene conductor cover
- (12) Phase detector

### **3.3 Approval and permission**

AEDC is responsible for obtaining necessary approvals and permissions from relevant authorities to install the pilot equipment.

### **3.4 Budget for installation**

AEDC shall secure necessary budget for the installation of pilot equipment to be procured by JICA.

### **3.5 Procurement and installation schedule**

The following schedule for procurement and installation was agreed by JCC.

- (1) Bid announcement: December 2022
- (2) Bid opening: January 2023
- (3) Delivery of equipment to the site: May 2023
- (4) Completion of installation: June 2023
- (5) Start training using the procured equipment: January 2024

## **4. Other relevant issues**

### **(1) Tax exemption**

The Federal Ministry of Power (FMP) is responsible for tax exemption for the equipment to be procured by JICA. If the FMP pays the tax imposed on the equipment on behalf of the Supplier, the FMP shall secure necessary budget for the fiscal year of 2023 and pay the tax in a timely manner. In case the FMP is not able to pay the tax in a timely manner and the Supplier pays the tax for custom clearance, FMP shall reimburse the paid tax to the Supplier as soon as possible.

### **(2) Donor coordination**

The objective of AFD's vocational training project at NAPTIN is to provide basic skills and knowledge to new or junior employees at Electricity Supply Industry of Nigeria while JICA's

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capacity development project aims at providing practical skills and knowledge on technical loss reduction, reliability improvement and power supply quality improvement (voltage improvement) for experienced engineers at distribution companies. Since objective and target trainees are different between AFD and JICA, there is not overlapping in two projects. However, AFD and JICA will exchange the progress and contents of their project in a timely manner to avoid any duplication and enhance synergy of the projects.

(End)

#### Attachment

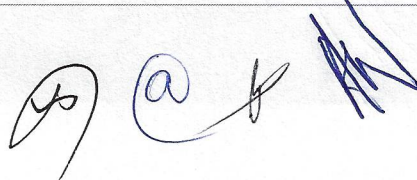
1. Work Plan (Full document)
2. Work Plan (Summary, ppt presentation)
3. Project Design Matrix
4. Monitoring Sheet
5. Minutes of JCC Meeting

A handwritten signature in blue ink, appearing to be 'S. Hoff' followed by a stylized flourish.



Minutes of the JCC Meeting on 13<sup>th</sup> September

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Date</b>       | 13 <sup>th</sup> of September, 2022.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Time</b>       | 2:00 pm –4:00 pm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Venue</b>      | Minister's Conference Room; Federal Ministry of Power<br>Abuja, Nigeria                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Attendance</b> | <u>Federal Ministry of Power</u> <ol style="list-style-type: none"><li>1. Engr. B. Sapke – Director (Distribution Services)</li><li>2. Engr. B. U. Mustapha – Deputy Director (Distribution Services)</li><li>3. Engr. Iyiola M.O.B. – Assistant Director (Distribution)</li><li>4. Engr. David Joshua – Senior Technical Officer</li><li>5. Engr. Gbadebo. J. – Principal Technical Officer</li></ol><br><u>JICA</u> <ol style="list-style-type: none"><li>1. Susumu Yuzurio – Chief Representative, JICA Nigeria Office</li><li>2. Shunsuke Yamashita – Deputy Director, Team 2, Energy and Mining Group, Infrastructure Management Department, JICA Headquarters</li><li>3. Hiroki Miyoshi – Project Formulation Advisor, JICA Nigeria Office</li><li>4. Agidani Gabriel – Senior Programme Officer, JICA Nigeria Office</li></ol><br><u>NAPTIN</u> <ol style="list-style-type: none"><li>1. Mr Ikuono Egwa Adams – Director (Finance and Account)</li><li>2. Engr Muazu Saleh Aminu – Acting Director Training Program</li><li>3. Engr. Bawa Gamiya– Training Department</li><li>4. Engr. Murtala Y. Lawal – Senior Instructor</li></ol><br><u>AEDC</u> <ol style="list-style-type: none"><li>1. Godfrey Aba – Head (Network Planning &amp;Investment)</li><li>2. Engr. Taofeeq Kola Rufai – Network Planning &amp; Investment</li><li>3. Engr. Frederick Obuye – Operation &amp; Maintenance</li><li>4. Mr. Andy Chinenye Mba – Dispatch, Technical Services</li><li>5. Yusuf Mudi – Operation &amp; Maintenance</li><li>6. Gideon Alade – Regional Head (Technical)-FCT South-East region</li></ol> |



|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p>7. Ifeadiachi Obiejesi – Strategy &amp; Compliance</p> <p><u>ANED</u></p> <p>1. Bar. Adetunji Adeyeye – Regulatory Specialist</p> <p><u>NERC</u></p> <p>1. A. B. Mohammed – General Manager (Engineering Performance and Monitoring)</p> <p>2. Aluko Ayodele – Senior Manager (Engineering and Performance Monitoring)</p> <p><u>TCN</u></p> <p>1. Safya Asuku – Project Manager (JICA Project Implementation Unit)</p> <p><u>JICA Expert Team</u></p> <p><u>YACHIYO ENG CO.</u></p> <p>1. Kyoji Fujii – Chief Advisor/ Distribution business operation</p> <p>2. Kazuhiko Koeda – Distribution Design</p> <p>3. Aoyagi Hiroki – Procurement Survey</p> <p>4. Ruriko Suezawa – Project Coordinator</p> <p>5. Adebanke Agboola – Project Coordinator (Local)</p> <p><u>Kansai Transmission and Distribution</u></p> <p>1. Akihiro Kashiwagi – Distribution Planning</p> <p>2. Seiro Nishiki – Distribution Maintenance &amp; Management</p> <p><u>Kinden Cooperation</u></p> <p>1. Kazunori Doi – Training courses planning</p> |
|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

***The meeting begins***

(YACHIYO)

**Mr. Fujii:** Starts with the presentation by explaining how we plan to realize our concept.



He goes on to explain how the project works using the existing H31 feeder, noting how JICA intend to minimize the downtime outage on the feeder.

He explains that JICA will be introducing new equipment such as the Bolt Type Connector and the Conductor Cover. Noting that the Conductor cover would prevent the conductors from touching each other of vegetation the conductor, and the Bolt Type Connector would make it easy to connect and disconnect the jumper.

He then speaks on the Outage Management System, stating that currently AEDC has two types of Fault recording system.

Namely;

- Fault Recording Dashboard, and the
- Outage Management System.

Notes that the Outage Management System seems to be a more comprehensive one.

Although when the functions are looked at, the fault recording system can export the nature of faults or the root cause of the fault information to excel. Therefore, making it easy for the staff to extract the information for analysis.

Introduces a new concept for the DISCO after improving the H31 feeder and the completion of the PILOT project, the network can be restored step by step. If the current network is down, but after the modification they would be able to send power faster by using section switches and battery. Explaining that they can calculate the converted duration mathematically.

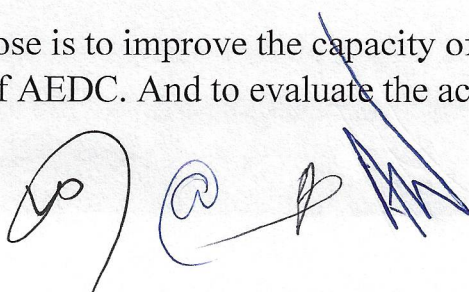
Draws attention to a part of the project's design matrix, noting that we have an overall goal as well as the project's purpose.

He states following that the overall goal is to improve the DISCOs business operations capability and reset the vegetation indicators.

The number of DISCO engineers involved in design and construction will be trained and equipped with using the knowledge acquired in the NAPTIN training to;

1. Reduce technical loss,
2. Improve reliability, and
3. Improve quality.

Goes on to say that the project purpose is to improve the capacity of engineers in the power distribution department of AEDC. And to evaluate the achievement of

Handwritten signature and initials in blue ink, located at the bottom right of the page. The signature appears to be 'AN' followed by some less legible characters.



this purpose, we had set the indicators from 1-12. 70% or more participants in the training courses will be evaluated.

He also goes over the planned dispatching of experts to Nigeria, explaining that there are 8 experts, although currently in Nigeria there are 7 as the others soon be joining us.

Briefly goes over the Project Implementation schedule, pinpointing where we currently are.

Says that there will be training in Japan for 10 counterparts in July 2023. States that we are still in the design phase, although we would soon commence the procurement, so installation would take place in September/October next year.

Goes on to state that in the initial demarcation, JICA is to procure the facilities needed for the PILOT project at NAPTIN's facilities, but the installation is to be done by the counterpart (NAPTIN).

Lastly, he speaks about the customs duty exemption, explaining that we have already spoken with the ministry.

(FMP)

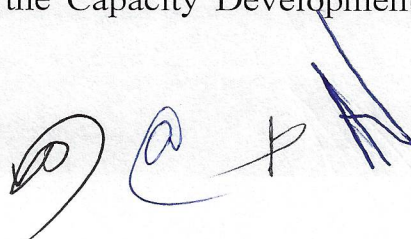
**Engr. Sapke:** Thanks, Mr. Fujii, then asks AEDC and NAPTIN if there is anything that wasn't clear.

(ANED)

**Mr. Adetunji:** Asks about the human element, explaining that it has to do with "Revenue assurance" which is one of the problems being faced in the power sector in Nigeria. Suggests that it would have been nice to have a form of Commercial Loss Reduction.

(YACHIYO)

**Mr. Fujii:** Before the capacity development project was developed, there was an internal discussion in JICA as to whether to incorporate Commercial Loss Reduction or not. After everything JICA decided to concentrate on the technical side, as on the commercial side it is difficult to achieve a certain target within a short period of time. Notes that it is the Capacity Development Project, not Capital Assistance Project.





(JICA)

**Mr. Yamashita:** Backs Mr. Fujii up saying we can assist with the technical field but not much with the commercial field as in Japan they do not have a lot of solutions on that.

(ANED)

**Mr. Adetunji:** State that he is aware that in some countries the type of conductors used makes it almost impossible for any interventions by an external person to steal electricity. Asks if those would be considered, since there would be constructions of lines in the project by JICA.

(YACHIYO)

**Mr. Fujii:** Asks if he is talking about insulated conductors.

(ANED)

**Mr. Adetunji:** Yes

(YACHIYO)

**Mr. Fujii:** States that in Japan, most of the distribution lines have insulated conductors. Notes that they are very costly, and that Nigeria has something else to do before moving on to Insulated conductors, which is why we are introducing the conduction covers.

(FMP)

**Engr. Sapke:** Gave her opinion that what he is suggesting would have been possible if we were the ones doing the project end to end.

Says that the DISCOs will have to reduce the commercial losses on their own.

(NERC)

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**Engr. A.B Muhammed:** Gave his remark, saying all questions has been asked by ANED. Says; if revenue was put in place, commercial loss would have been solved by 50% or more.

Says; concentration should be on ATC&C (Aggregate Technical Commercial and Commercial), the working group member should concentrate on both technical and commercial losses so that the collation can be complete, because the Commission is worried about this.

System protection wasn't talked about in technical loss, and this is another key area! We would like to know how system protection is been done in Japan.

Points out human management; visitation is another key area to be discussed.

(YACHIYO)

**Mr. Fujii:** Thanks all for the comments. Then agrees that commercial loss should be considered. Notes that we would like to utilize the knowledge and experience of Japanese utilities as much as possible, but there is not much knowledge on commercial loss improvement.

Notes that there is another project ongoing, under which there will be a procurement of meters to be distributed. Suggests that commercial loss reduction can be achieved a bit through that project.

Asks for any other questions.

(FMP)

**Engr. Sapke:** Asks if all that has been said has been approved as all. Points out item 5 on the agenda. Notes that they had asked the counterparts AEDC and NAPTIN to comment, which they didn't. Therefore, everyone is satisfied with the points noted so far.

(NAPTIN)

**Mr. Adams:** Says we had had a meeting concerning that with the JICA team, and will still be having another the next week. Notes that it has been agreed upon that NAPTIN will take care of the construction.

(AEDC)

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**Engr. Aba:** Discussion have been had in the topic, where a lot had been discussed and agreed upon.

(FMP)

**Engr. Sapke:** All being said, asks the two counterparts if the presentation has been agreed upon (approved).

(JICA Nigeria)

**Mr. Yuzurio:** Gives the closing remark, by briefly going over what is to be done again then noting that we appreciate their cooperation. Strongly requests FMP to take initiatives and its full responsibility for supervising the project activities to realize close collaboration between NAPTIN and AEDC for the sake of success of the Project. In addition, also strongly requested full commitments of both NAPTIN and AEDC. Then thanks everyone for attending the meeting.

(FMP)

**Engr. Sapke:** Appreciates all and says how efficient the distribution departments are on the power loss. Says that the Minister is taking the bull by the horn in terms of leadership, as every two weeks they gather with all the stakeholders because this issue is important.

Wishes everyone a safe trip to their hotels/ offices.

*With no further input, the meeting ends.*

Three handwritten signatures in blue ink are visible at the bottom of the page. The first signature on the left is a simple circle with a horizontal line through it. The middle signature is a stylized 'a' followed by a horizontal line. The signature on the right is a more complex, scribbled mark.

**MINUTES OF DISCUSSIONS  
BETWEEN  
JAPAN INTERNATIONAL COOPERATION AGENCY  
AND  
RELEVANT AUTHORITIES OF THE FEDERAL GOVERNMENT OF NIGERIA  
ON  
THE PROJECT FOR CAPACITY DEVELOPMENT OF POWER  
DISTRIBUTION**

Abuja, 22<sup>nd</sup> June 2023



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Mr. Susumu Yuzurio  
Chief representative  
Japan International Cooperation Agency  
(JICA)  
Nigeria Office



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f Engr. Briskilla Sapke  
Director of Distribution  
The Federal Ministry of Power (FMP)  
The Federal Republic of Nigeria



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Mr. Ahmed Bolaji Nagode  
Director General  
National Power Training Institute of  
Nigeria (NAPTIN)  
The Federal Republic of Nigeria



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Mr. Godfrey Aba  
Head of Network Planning and Investment  
Abuja Electricity Distribution Plc. (AEDC)  
The Federal Republic of Nigeria

Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched an expert team (hereinafter referred to as "JICA Team") to the Federal Republic of Nigeria from the 15<sup>th</sup> of May to the 25<sup>th</sup> of June 2023. JICA Team is entrusted by JICA to undertake the consulting services for the project for capacity development of power distribution (hereinafter referred to as "the Project").

The meeting of the Joint Coordinating Committee (hereinafter referred to as "JCC") on the Project was held on the 22<sup>nd</sup> of June 2023 and JICA Team and representatives of relevant authorities of the Federal Republic of Nigeria discussed and agreed on the issues related to the Project described in Main Points Discussed.

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## Main Points Discussed

### 1. Approval of project monitoring report No.2

Outline of the project monitoring report No.2 was explained at the JCC meeting and it was approved by JCC members.

### 2. Installation of Distribution Training Facilities for NAPTIN

It was agreed in the 1<sup>st</sup> JCC that NAPTIN shall secure necessary budget for the installation of Distribution Training Facilities for NAPTIN. However, NAPTIN was not able to secure the budget for the year 2023. NAPTIN shall apply the budget for the installation in the year 2024 budget and the Federal Ministry of Power shall make necessary arrangement for the budget to be approved.

In case the budget for the installation is approved in the year 2024 budget, the installation work shall commence from the middle of May 2024. NAPTIN shall make necessary preparation for the procurement of a contractor who will undertake the installation work in a timely manner so that the installation can be commenced without delay.

### 3. Installation work for AEDC's pilot project

One of the obstacles for the installation of equipment and materials for AEDC's pilot project is FCDA approval for new 33kV distribution lines from Apo substation. AEDC shall accelerate the approval process with close monitoring and intervention.

The installation of equipment and materials for AEDC's pilot project shall be completed by the end of October 2023.

### 4. Monitoring and control by NAPTIN's management

Improvement and development of NAPTIN's training programs is a joint work between NAPTIN's trainers and JICA Expert Team. NAPTIN's management shall monitor the progress of the work and control the work load of NAPTIN's trainers who engage in the work to keep the planned schedule and maintain the quality of the work.

(End)

## Attachment

1. Monitoring Sheet
2. Minutes of 1<sup>st</sup> JCC Meeting (Main documents)



**MINUTES OF DISCUSSIONS  
BETWEEN  
JAPAN INTERNATIONAL COOPERATION AGENCY  
AND  
RELEVANT AUTHORITIES OF THE FEDERAL GOVERNMENT OF NIGERIA  
ON  
THE PROJECT FOR CAPACITY DEVELOPMENT OF POWER  
DISTRIBUTION**

Abuja, 6<sup>th</sup> December 2023

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Mr. Hiroyuki Matsuda  
Director  
Team 2, Energy and Mining Group  
Infrastructure Management Department  
Japan International Cooperation Agency  
(JICA)

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Engr. Baba Umara Mustapha  
Acting Director of Distribution  
The Federal Ministry of Power (FMP)  
The Federal Republic of Nigeria

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Mr. Ahmed Bolaji Nagode  
Director General  
National Power Training Institute of  
Nigeria (NAPTIN)  
The Federal Republic of Nigeria

---

for Mr. Christopher Ezeafulukwe  
Managing Director/ Chief Executive Officer  
Abuja Electricity Distribution Plc. (AEDC)  
The Federal Republic of Nigeria

Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched an expert team (hereinafter referred to as "JICA Team") to the Federal Republic of Nigeria from the 28<sup>th</sup> of November to the 10<sup>th</sup> of December 2023. JICA Team is entrusted by JICA to undertake the consulting services for the project for capacity development of power distribution (hereinafter referred to as "the Project").

The meeting of the Joint Coordinating Committee (hereinafter referred to as "JCC") on the Project was held on the 6<sup>th</sup> of December 2023 and JICA Team and representatives of relevant authorities of the Federal Republic of Nigeria discussed and agreed on the issues related to the Project described in Main Points Discussed.





## Main Points Discussed

### 1. Approval of project monitoring report No.3

Outline of the project monitoring report No.3 was explained at the JCC meeting and it was approved by JCC members.

### 2. Extension of project period

The end of project will be extended from March 2025 to October 2025 to accommodate to the delay of undertakings by the Nigerian side.

### 3. Commitment and monitoring by the Nigerian side

JICA strongly requested the Nigerian side to prevent further delay of their undertakings with stronger commitment and closer monitoring by the top management. NAPTIN and AEDC shall report the progress of the following undertakings every two weeks to the Project Director (Acting Director of Distribution, the Federal Ministry of Power). The Project Director shall instruct the counterpart organizations to take necessary measures if any delay is foreseen.

[Undertakings to be reported]

- (1) Land levelling and compaction of project site by NAPTIN
- (2) Procurement of a contractor for the installation of distribution training facilities by NAPTIN including budget preparation
- (3) Installation work of pilot project by AEDC

### 4. Installation of Distribution Training Facilities for NAPTIN

NAPTIN applied the budget for the installation of Distribution Training Facilities in the year 2024 budget and the Federal Ministry of Power shall make necessary arrangement for the budget to be approved.

In case the budget for the installation is approved in the year 2024 budget, the installation work shall commence from the middle of September 2024. NAPTIN shall make necessary preparation for the procurement of a contractor who will undertake the installation work and necessary civil works such as site slope protection, drainage facilities, fences, etc. in a timely manner so that the installation can be commenced without delay. Technical requirements for the procurement of a contractor shall be reviewed by the JICA Expert Team so that all necessary requirements are incorporated into the bidding documents. Procurement process of the contractor including contract negotiation, approval by the Bureau of Public Procurement and contract signing shall be completed by the end of July 2024. If advance payment is required for the mobilization of a contractor, NAPTIN shall make the payment without delay.



NAPTIN shall complete the levelling and compaction of the project site by the end of January 2024. The surface of the land shall be leveled flat and smooth enough and the soil shall be compacted firm and tight enough so that vehicles can carry heavy goods such as concrete poles and conductor drums into the site and construction machinery can enter and work at the site without sinking and being caught in the soil. The ideal condition of the soil is the same as the AFD's substation construction site at NAPTIN headquarters. JICA will inspect the site around the end of January to confirm the completion.

#### **5. Installation work for AEDC's pilot project**

The installation of equipment and materials for AEDC's pilot project shall be completed by the end of January 2024. The definition of the completion is not only installing all supplied equipment and materials but the newly installed 33kV lines are energized and the existing H31 feeder at Apo is separated into two segments and operated as two independent feeders. Pilot equipment procured by JICA such as bolt type connectors, conductor covers and a load breaking switch shall be delivered to AEDC around the end of December 2023. AEDC shall install these pilot equipment to the pilot project site from the middle of May 2024 under the instruction by the JICA Expert Team.

(End)

#### **Attachment**

1. Project Monitoring Report No. 3
2. Revised Project schedule



**MINUTES OF DISCUSSIONS  
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JAPAN INTERNATIONAL COOPERATION AGENCY  
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RELEVANT AUTHORITIES OF THE FEDERAL GOVERNMENT OF NIGERIA  
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THE PROJECT FOR CAPACITY DEVELOPMENT OF POWER  
DISTRIBUTION**

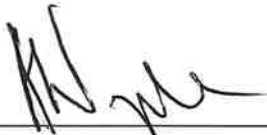
Abuja, 25<sup>th</sup> June 2024



Mr. Susumu Yuzurio  
Chief Representative  
Japan International Cooperation Agency  
(JICA)  
Nigeria Office



Engr. Baba Umara Mustapha  
Acting Director of Distribution  
The Federal Ministry of Power (FMP)  
The Federal Republic of Nigeria



Mr. Ahmed Bolaji Nagode  
Director General  
National Power Training Institute of  
Nigeria (NAPTIN)  
The Federal Republic of Nigeria



Engr. Godfrey Ana  
Chief Technical Executive Officer  
Abuja Electricity Distribution Plc. (AEDC)  
The Federal Republic of Nigeria

Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched an expert team (hereinafter referred to as "JICA Team") to the Federal Republic of Nigeria from the 15<sup>th</sup> of May to the 26<sup>th</sup> of June 2024. JICA Team is entrusted by JICA to undertake the consulting services for the Project for Capacity Development of Power Distribution (hereinafter referred to as "the Project").

The meeting of the Joint Coordinating Committee (hereinafter referred to as "JCC") on the Project was held on the 25<sup>th</sup> of June 2024 and JICA Team and representatives of relevant authorities of the Federal Republic of Nigeria discussed and agreed on the issues related to the Project described in Main Points Discussed.



## Main Points Discussed

### 1. Approval of project monitoring report No.4

Outline of the project monitoring report No.4 was explained at the JCC meeting and it was approved by JCC members.

### 2. Installation of Distribution Training Facilities for NAPTIN

NAPTIN applied the budget for the installation of Distribution Training Facilities in the year 2024 budget and it was approved by the Federal Government. However, the release of the 2024 budget has been delayed because of the late disbursement progress of the year 2023 budget. To cope with this challenge, NAPTIN applied an expedited procurement process for a contractor to BPP (Bureau of Public Procurement) at the end of May 2024. NAPTIN shall follow up the status of approval and initiate procurement process as soon as the approval is granted.

Procurement process of the contractor including contract negotiation and contract signing shall be completed by the end of July 2024. If advance payment is required for the mobilization of a contractor, NAPTIN shall make the payment without delay.

NAPTIN shall complete the levelling and compaction of the project site and necessary civil works such as drainage, slope protection, foundations of a distribution transformer and feeder pillar, etc. by the end of August 2024. The surface of the land shall be leveled flat and smooth enough and the soil shall be compacted firm and tight enough so that vehicles can carry heavy goods such as concrete poles and conductor drums into the site and construction machinery can enter and work at the site without sinking and being caught in the soil. The ideal condition of the soil is the same as the AFD's substation construction site at NAPTIN headquarters. JICA will inspect the site around the end of August 2024 to confirm the completion.

### 3. Corrective work for AEDC's pilot project

The installation of equipment and materials for AEDC's pilot project was completed at the end of January 2024. NEMSA inspected the completed new 33kV lines at the end of April 2024 and made observations and recommendations. AEDC shall consult with NEMSA and address critical pending items before energizing the feeder. AEDC shall energize the newly installed 33kV lines, separate the existing H31 feeder at Apo into two segments and operate them as two independent feeders by the end of August 2024.

(End)





**MINUTES OF DISCUSSIONS  
BETWEEN  
JAPAN INTERNATIONAL COOPERATION AGENCY  
AND  
RELEVANT AUTHORITIES OF THE FEDERAL GOVERNMENT OF NIGERIA  
ON  
THE PROJECT FOR CAPACITY DEVELOPMENT OF POWER  
DISTRIBUTION**

Abuja, 13<sup>th</sup> February 2025



Mr. Susumu Yuzurio  
Chief Representative  
Japan International Cooperation Agency  
(JICA)  
Nigeria Office



Engr. Baba Umara Mustapha  
Director of Distribution  
The Federal Ministry of Power (FMP)  
The Federal Republic of Nigeria



Mr. Ahmed Bolaji Nagode  
Director General  
National Power Training Institute of  
Nigeria (NAPTIN)  
The Federal Republic of Nigeria



Engr. Godfrey Ana  
Chief Technical Executive Officer  
Abuja Electricity Distribution Plc. (AEDC)  
The Federal Republic of Nigeria



Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched an expert team (hereinafter referred to as "JICA Team") to the Federal Republic of Nigeria from the 12<sup>th</sup> of January to the 21<sup>st</sup> of February 2025. JICA Team is entrusted by JICA to undertake the consulting services for the Project for Capacity Development of Power Distribution (hereinafter referred to as "the Project").

The meeting of the Joint Coordinating Committee (hereinafter referred to as "JCC") on the Project was held on the 13<sup>th</sup> of February 2025 and JICA Team and representatives of relevant authorities of the Federal Republic of Nigeria discussed and agreed on the issues related to the Project described in Main Points Discussed.



## Main Points Discussed

### 1. Approval of project monitoring report No.5

Outline of the project monitoring report No.5 was explained at the JCC meeting and it was approved by JCC members.

### 2. Release of classroom training for NAPTIN

NAPTIN shall release the newly developed classroom training courses, namely, (1) Technical Loss Reduction, (2) Reliability Improvement and (3) Power Quality Improvement, by the end of March 2025 for (2) and (3) and by the end of April 2025 for (1). NAPTIN shall complete the preparation of e-learning contents of those new training courses before they are released.

### 3. Preparation for Practical Training Courses

NAPTIN shall continue the practice for practical training courses, i.e. (1) Fault identification for underground cables and (2) Phase comparison, and be ready for training demonstration by the end of May 2025.

### 4. Installation of pilot equipment for AEDC's pilot project

AEDC shall complete the installation of pilot equipment such as conductor covers on 11 kV feeder and bolt type connectors on H31 feeder, and transfer some load from Kukwaba L33 to Apo H31 by opening jumper connections. Then, AEDC shall separate H31 feeder into two and start the operation of the independent feeders by the end of March 2025.

(End)

## Attachment

1. Project Monitoring Report No. 5
2. Presentation materials of 5<sup>th</sup> JCC meeting





**MINUTES OF DISCUSSIONS  
BETWEEN  
JAPAN INTERNATIONAL COOPERATION AGENCY  
AND  
RELEVANT AUTHORITIES OF THE FEDERAL GOVERNMENT OF NIGERIA  
ON  
THE PROJECT FOR CAPACITY DEVELOPMENT OF POWER  
DISTRIBUTION**

Abuja, 30<sup>th</sup> October 2025



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Mr. Keiji Ishigame  
Chief Representative  
Japan International Cooperation Agency  
(JICA)  
Nigeria Office



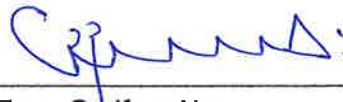
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Engr. Baba Umara Mustapha  
Director of Distribution  
The Federal Ministry of Power (FMP)  
The Federal Republic of Nigeria



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Mr. Ahmed Bolaji Nagode  
Director General  
National Power Training Institute of  
Nigeria (NAPTIN)  
The Federal Republic of Nigeria



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Engr. Godfrey Aba  
Chief Technical Executive Officer  
Abuja Electricity Distribution Plc. (AEDC)  
The Federal Republic of Nigeria



Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched an expert team (hereinafter referred to as "JICA Team") to the Federal Republic of Nigeria from the 20<sup>th</sup> to the 30<sup>th</sup> of October 2025. JICA Team is entrusted by JICA to undertake the consulting services for the Project for Capacity Development of Power Distribution (hereinafter referred to as "the Project").

The meeting of the Joint Coordinating Committee (hereinafter referred to as "JCC") on the Project was held on the 30<sup>th</sup> of October 2025 and JICA Team and representatives of relevant authorities of the Federal Republic of Nigeria discussed and agreed on the issues related to the Project described in Main Points Discussed.

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## Main Points Discussed

### 1. Approval of project monitoring report No. 6

Outline of the project monitoring report No. 6 was explained at the JCC meeting and it was approved by JCC members.

### 2. Release of practical training and e-learning courses for NAPTIN

NAPTIN shall finalize and release the newly developed practical training courses, namely, (1) Phase comparison work on distribution lines, (2) Overhead line fault location and (3) Underground cable fault location, by the end of March 2026. NAPTIN shall complete the preparation of e-learning contents of three new classroom training courses developed through the Project, namely, (1) Technical loss reduction, (2) Reliability improvement and (3) Quality improvement, taking the recommendations from JICA Team into consideration and release them by the end of February 2026.

### 3. Procurement of Hipot Tester for NAPTIN

NAPTIN shall procure a DC Hipot Tester (ex. 40kV Hipot Tester, Hipotronics 840PL-HD) to be used for "Overhead line fault detection" training course by the end of December 2025.

### 4. Reinforcement of security measures at NAPTIN corporate headquarters

NAPTIN shall take the following security measures around the Distribution Training Facility by the end of December 2025 to prevent further theft of training equipment and materials. NAPTIN shall restore the damaged Distribution Training Facility to full operational status.

- (1) Installation of barbed wires along the security fences
- (2) Installation of security lights
- (3) Installation of security camera
- (4) Frequent patrol by security guards, in particular, during the night time

### 5. Completion of a ring shape network for AEDC's pilot project

AEDC shall complete a ring shape network consisting of Apo H31 and H13 feeders by opening jumpers between Kukwaba L33 and Apo H31, and closing jumper connections to bridge the open sections of Apo H31 by the end of December 2025.

It is recommended to AEDC to deploy the ring shape network to other areas where high reliability is required such as Band-A feeders because it will help reduce down time when prolonged outages happen.

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## **6. Way forward**

### **6.1 Recommendations for NAPTIN**

#### **(1) Proactive Promotion of Training Courses**

Proactive promotional activities are not being conducted, and newly developed and improved training courses are not sufficiently publicized to the Discos. It is desirable that NAPTIN carry out more proactive promotion to enhance the capacity of Discos and attract more trainees.

#### **(2) Voluntary Improvement and Development of Training Courses**

NAPTIN is required to take the initiative to voluntarily improve and develop its training courses by actively gathering and analyzing feedback from participants and opinions and requests from Discos at every opportunity.

#### **(3) Skill Improvement for NAPTIN Instructors**

It is necessary to develop NAPTIN instructors who are capable of voluntarily improving and developing training courses. Also, it is necessary to arrange for technology transfer from experienced Disco engineers to NAPTIN instructors as needed.

#### **(4) Expansion to Regional Training Centers**

By creating a package of the distribution training facilities and the practical training courses, and installing similar facilities at regional training centers, it will be possible to expand these practical training packages to other Discos far from NAPTIN Corporate Headquarters in Abuja.

### **6.2 Recommendations for Discos**

#### **(1) Systematization of the Education System**

Each Disco needs to systematize the knowledge, skills, and qualifications necessary for its operations. It should then identify which of these cannot be provided in-house or for which NAPTIN training would be more effective, and then proactively utilize NAPTIN's training courses.

#### **(2) Careful Selection of Trainees**

When sending their employees for NAPTIN training, each Disco must fully grasp the potential benefits, such as the knowledge, skills, and qualifications to be gained. They must carefully select employees who require such training and for whom the training is expected to yield significant results.

#### **(3) Utilization of NAPTIN Training Outcomes**

After completing NAPTIN training, employees should report to their human resources department on how they plan to apply what they have learned to their jobs. The human resources department must then follow up to ensure that the outcomes of the NAPTIN training are being effectively integrated into the company's operational improvements

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through the trained employees.

**(4) Feedback for the Improvement of NAPTIN Training**

If a Disco finds it difficult to apply the benefits of the training to its business improvements due to inadequacies in the content of NAPTIN's courses, it must provide feedback with suggestions for improvement to NAPTIN.

(End)

**Attachment**

1. Project Monitoring Report No. 6
2. Presentation materials of 6<sup>th</sup> JCC meeting

Handwritten signatures and initials in blue ink at the bottom right corner of the page.

## **Annex 5. Monitoring sheet**

**TO JICA NIGERIA OFFICE****Project Monitoring Sheet****Project Title: The project for capacity development of power distribution****Version of the Sheet: Ver.0 (Term: April, 2022 - August, 2022)****Name: Kyoji FUJII****Title: Leader****Submission Date: 31th August, 2022****I. Summary****1 Progress****1-1 Progress of Inputs**

The following JICA Experts have been dispatched:

- Leader/Distribution Business Operation: 1<sup>st</sup> Dispatch 17<sup>th</sup> May-30<sup>th</sup> June, 2022
- Distribution Planning: 1<sup>st</sup> Dispatch 17<sup>th</sup> May-30<sup>th</sup> June, 2022
- Distribution Design: 1<sup>st</sup> Dispatch 17<sup>th</sup> May-30<sup>th</sup> June, 2022
- Distribution Maintenance and Management: 1<sup>st</sup> Dispatch 17<sup>th</sup> May-30<sup>th</sup> June, 2022
- Pilot Project 1 (Procurement Survey): 1<sup>st</sup> Dispatch 17<sup>th</sup> May-30<sup>th</sup> June, 2022
- Pilot Project 2 (Construction Supervision): None
- Training Courses Planning: 1<sup>st</sup> Dispatch 17<sup>th</sup> May-30<sup>th</sup> June, 2022
- Project Coordination / Monitoring Evaluation: 1<sup>st</sup> Dispatch 17<sup>th</sup> May-30<sup>th</sup> June, 2022

**1-2 Progress of Activities**

A baseline survey was conducted.

**(1)NAPTIN**

- Existing texts for training and requests from AEDC to training courses for NAPTIN were investigated.
- Capacity assessment for NAPTIN trainers was conducted.
- The training facilities for demonstration has been proposed.

**(2)AEDC**

- Current status of AEDC's organization, planning, facilities, "loss", "reliability", and "quality" was investigated.
- Capacity assessment for AEDC technicians was conducted.
- The pilot project for AEDC has been proposed.

The summarized results of the baseline survey will be reported at the 1<sup>st</sup> JCC.

Quantitative indicators to evaluate the achievement of the project on the Project Design Matrix (PDM) was set.

The Joint Technical WG 1-3 was formed by 3 NAPTIN members and 4 AEDC members and JICA Experts. And, the WG meetings were held 5 times to discuss the training facilities for demonstration, the pilot project, and outage management system improvement.

### **1-3 Achievement of Output**

<Output1>

Development and implementation of training for loss reduction measures

<Output2>

Development and implementation of training to improve reliability

<Output3>

Development and implementation of training for quality improvement

- The Joint Technical WG 1-3 meetings were held 5 times to discuss the training facilities for demonstration, the pilot project, and outage management system improvement.

<Output4>

Confirmation of the utilization of NAPTIN training in Discos

- None.

### **1-4 Achievement of the Project Purpose**

To improve the capabilities of engineers in the power distribution department

- The Joint Technical WG 1-3 meetings were held 5 times to discuss the training facilities for demonstration, the pilot project, and outage management system improvement.

### **1-5 Changes of Risks and Actions for Mitigation**

None.

### **1-6 Progress of Actions undertaken by JICA**

None.

### **1-7 Progress of Actions undertaken by Gov. of Nigeria**

None.

### **1-8 Progress of Environmental and Social Considerations (if applicable)**

Not applicable for this project.

### **1-9 Progress of Considerations on Gender/Peace Building/Poverty Reduction, disability, disease infection, social system, human wellbeing, human right, and gender equality (if applicable)**



None.

**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.)**

None.

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

### **2-1 Detail**

None.

### **2-2 Cause**

None.

### **2-3 Action to be taken**

None.

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

None.

## **3 Modification of the Project Implementation Plan**

### **3-1 PO**

None.

### **3-2 Other modifications on detailed implementation plan**

*(Remarks: The amendment of R/D, Project Description, and PDM (title of the project, duration, project site(s), target group(s), implementation structure, overall goal, project purpose, outputs, activities, input , and change of Environmental category) should be authorized by JICA HDQs. If the project team deems it necessary to modify any part of R/D,Project Description, and PDM, the team may propose the draft.)*

None.

## **4 Current Activities of Gov. of Nigeria to Secure Project Sustainability after its Completion**

None.

**II. Project Monitoring Sheet I & II** as Attached

TO JICA NIGERIA OFFICE

**Project Monitoring Sheet****Project Title: The project for capacity development of power distribution****Version of the Sheet: Ver.1 (Term: September, 2022 - June, 2023)****Name: Kyoji FUJII****Title: Leader****Submission Date: 22nd June, 2023****I. Summary****1 Progress****1-1 Progress of Inputs**

The following JICA Experts have been dispatched:

- Leader/Distribution Business Operation:  
2<sup>nd</sup> Dispatch 7<sup>th</sup> September-27<sup>th</sup> October, 2022  
Additional Dispatch 14<sup>th</sup>-28<sup>th</sup> January, 2023  
3<sup>rd</sup> Dispatch 14<sup>th</sup> May-24<sup>th</sup> June, 2023
- Distribution Planning:  
2<sup>nd</sup> Dispatch 7<sup>th</sup> September-22<sup>nd</sup> October, 2022  
3<sup>rd</sup> Dispatch 14<sup>th</sup> May-25<sup>th</sup> June, 2023
- Distribution Design:  
2<sup>nd</sup> Dispatch 7<sup>th</sup> September-22<sup>nd</sup> October, 2022  
Additional Dispatch 14<sup>th</sup>-28<sup>th</sup> January, 2023  
3<sup>rd</sup> Dispatch 14<sup>th</sup> May-25<sup>th</sup> June, 2023
- Distribution Maintenance and Management:  
2<sup>nd</sup> Dispatch 7<sup>th</sup> September-22<sup>nd</sup> October, 2022  
Additional Dispatch 14<sup>th</sup>-28<sup>th</sup> January, 2023  
3<sup>rd</sup> Dispatch 14<sup>th</sup> May-25<sup>th</sup> June, 2023
- Pilot Project 1 (Procurement Survey):  
2<sup>nd</sup> Dispatch 7<sup>th</sup> September-22<sup>nd</sup> October, 2022  
3<sup>rd</sup> Dispatch 14<sup>th</sup> May-15<sup>th</sup> June, 2023
- Pilot Project 2 (Construction Supervision):  
3<sup>rd</sup> Dispatch 14<sup>th</sup> May-25<sup>th</sup> June, 2023
- Training Courses Planning:  
2<sup>nd</sup> Dispatch 7<sup>th</sup> September-22<sup>nd</sup> October, 2022  
3<sup>rd</sup> Dispatch 14<sup>th</sup> May-25<sup>th</sup> June, 2023
- Project Coordination / Monitoring Evaluation:

2<sup>nd</sup> Dispatch 7<sup>th</sup> September-22<sup>nd</sup> October, 2022

3<sup>rd</sup> Dispatch 14<sup>th</sup> May-25<sup>th</sup> June, 2023

## 1-2 Progress of Activities

<Output1>

Development and implementation of training for loss reduction measures

<Output2>

Development and implementation of training to improve reliability

<Output3>

Development and implementation of training for quality improvement

(1)Activities with NAPTIN

a. Upgrading of NAPTIN's training courses

NAPTIN counterparts are working on the upgrading of training materials with JICA Expert Team regarding technical loss reduction, reliability improvement and quality improvement.

b. Distribution training facility for NAPTIN

Technical specifications of the distribution training facility were finalized, bidding for procurement of equipment was held, and the result was successful.

NAPTIN has conducted land leveling work at the site where the training equipment is installed.

(2)Activities with AEDC

a. AEDC pilot project (Apo H31 Feeder)

Technical specifications of the pilot project were finalized, bidding for procurement of equipment was held, and the result was successful.

Federal Capital Development Authority (FCDA) shall approve the new feeder route but it is taking a long time. AEDC contracted with a contractor to install the pilot project facility and the construction work has just been started. The completion of the installation work is scheduled by the end of July 2023.

b. Improvement of AEDC's business operation

Discussed operation of improved outage management system (OMS). AEDC completed the improvement of OMS. Data input and recording by using the improved OMS is in progress.

<Seminar>

The seminar was held on 31<sup>st</sup> May, 2023 to introduce project activities to stakeholders in Power Distribution Industries.

<Training in Japan>

Training in Japan will be held in July and August, 2023. Preparation for the training in Japan

is in progress.

### 1-3 Achievement of Output

<Output1>

Development and implementation of training for loss reduction measures

<Output2>

Development and implementation of training to improve reliability

<Output3>

Development and implementation of training for quality improvement

- The Joint Technical WG 1-3 meetings were held 21 times (September 2022 - June 2023) to discuss the distribution training facility, the pilot project, and outage management system improvement.

- TOT meetings were held 22 times (September 2022 - June 2023) to improve textbooks for NAPTIN training course.

<Output4>

Confirmation of the utilization of NAPTIN training in Discos

- None.

### 1-4 Achievement of the Project Purpose

To improve the capabilities of engineers in the power distribution department

- The Joint Technical WG 1-3 meetings were held 21 times (September 2022 - June 2023) to discuss the distribution training facility, the pilot project, and outage management system improvement.

- TOT meetings were held 22 times (September 2022 - June 2023) to improve textbooks for NAPTIN training course.

### 1-5 Changes of Risks and Actions for Mitigation

None.

### 1-6 Progress of Actions undertaken by JICA

None.

### 1-7 Progress of Actions undertaken by Gov. of Nigeria

Tax exemption process for the imported equipment is in progress.

### 1-8 Progress of Environmental and Social Considerations (if applicable)

Not applicable for this project.

**1-9 Progress of Considerations on Gender/Peace Building/Poverty Reduction, disability, disease infection, social system, human wellbeing, human right, and gender equality (if applicable)**

None.

**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.)**

None.

**1 Delay of Work Schedule and/or Problems (if any)**

**4-1 FCDA approval**

**4-1-1 Detail**

After the AEDC Pilot Project site was determined, it was discovered that there was a plan to construct an interchange on the road in front of the site, and that there was a legal dispute with some landowners regarding compensation in connection with the construction of the interchange. Federal Capital Development Authority (FCDA) approval was required. However, the approval is not granted yet and delaying progress on the pilot project currently.

**4-1-2 Cause**

Information on land issues was not shared by AEDC during the target site selection phase.

**4-1-3 Action to be taken**

The letter was submitted to FCDA to request for approval on the construction of new feeder from AEDC. AEDC needs to follow up the approval from FCDA.

**4-1-4 Roles of Responsible Persons/Organization (JICA, Gov. of Nigeria, etc.)**

None.

**4-2 Budgeting for installation costs for the distribution training facility**

**4-2-1 Detail**

NAPTIN has been repeatedly requested to bear the cost of installation of power distribution training equipment since the start of the technical program. In the minutes of the first JCC meeting held September 2022, NAPTIN was also asked to secure a budget for the installation work. The completion of the installation work for the distribution training facility

is scheduled by the end of September 2023, however NAPTIN doesn't have a budget for the installation work.

#### **4-2-2 Cause**

Budgeting process for installation costs has not been done.

#### **4-2-3 Action to be taken**

JICA will discuss the budget with the Nigerian side (FMP) and try to secure the budget.

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

JICA will discuss the budget with the Nigerian side (FMP) and try to secure the budget.

## **2 Modification of the Project Implementation Plan**

### **5-1 PO**

None.

### **5-2 Other modifications on detailed implementation plan**

*(Remarks: The amendment of R/D, Project Description, and PDM (title of the project, duration, project site(s), target group(s), implementation structure, overall goal, project purpose, outputs, activities, input, and change of Environmental category) should be authorized by JICA HDQs. If the project team deems it necessary to modify any part of R/D, Project Description, and PDM, the team may propose the draft.)*

None.

## **3 Current Activities of Gov. of Nigeria to Secure Project Sustainability after its Completion**

None.

## **II. Project Monitoring Sheet I & II as Attached**

TO JICA NIGERIA OFFICE

**Project Monitoring Sheet****Project Title: The project for capacity development of power distribution****Version of the Sheet: Ver.2 (Term: July - November, 2023)****Name: Kyoji FUJII****Title: Leader****Submission Date: 6th December, 2023****I. Summary****1 Progress****1-1 Progress of Inputs**

The 4<sup>th</sup> field work was planned from October to December 2023, but JICA Expert Team was unable to pursue the planned activities due to the delay of the undertakings to be completed by the counterpart organizations as below.

- (1) Delay of installation work for AEDC Apo pilot project
- (2) Delay of land levelling and compaction at NAPTIN's project site
- (3) Delay of tax exemption

The following JICA Expert has been dispatched:

- Leader/Distribution Business Operation: 29th November-10thDecember (Additional)
- Distribution Planning: None
- Distribution Design: None
- Distribution Maintenance and Management: None
- Pilot Project 1 (Procurement Survey): None
- Pilot Project 2 (Construction Supervision): None
- Training Courses Planning: None
- Project Coordination / Monitoring Evaluation: None

**1-2 Progress of Activities**

<Output1>

Development and implementation of training for loss reduction measures

<Output2>

Development and implementation of training to improve reliability

<Output3>

Development and implementation of training for quality improvement

(1)Activities with NAPTIN

a. Upgrading of NAPTIN's training courses

NAPTIN counterparts are working on the upgrading of training materials with JICA Expert Team regarding technical loss reduction, reliability improvement and quality improvement.

b. Distribution training facility for NAPTIN

Most of the equipment and materials procured by JICA other than items to be imported from abroad have been delivered to NAPTIN. The remaining items (cable fault locator, phase detector, load breaking switch, bolt type connectors and conductor covers) will be delivered by the end of December.

NAPTIN has conducted land leveling work at the site where the training equipment is installed. The completion of the land leveling work is scheduled by the end of November 2023.

(2)Activities with AEDC

a. AEDC pilot project (Apo H31 Feeder)

Most of the equipment and materials procured by JICA other than items to be imported from abroad have been delivered to AEDC. The remaining items (phase detector, load breaking switch, bolt type connectors and conductor covers) will be delivered by the end of December.

Temporary approval from Federal Capital Development Authority (FCDA) has been granted on 5<sup>th</sup> July, 2023.

The installation work was commenced in the middle of June 2023. The completion of the installation work is scheduled by the end of December 2023.

b. Improvement of AEDC's business operation

Discussed operation of improved Outage Management App (OMA). AEDC completed the improvement of OMA by July 2023. Data input and recording by using the improved OMA is in progress.

<Training in Japan>

Training in Japan was held from 25<sup>th</sup> July to 3<sup>rd</sup> August, 2023. (13 participants)

**1-3 Achievement of Output**

<Output1>

Development and implementation of training for loss reduction measures

<Output2>

Development and implementation of training to improve reliability

<Output3>

Development and implementation of training for quality improvement

- The Joint Technical WG 1-3 meetings were held 9 times (July - November 2023) to discuss the distribution training facility, the pilot project, and outage management app



improvement.

- TOT meetings were held 11 times (July - November 2023) to improve textbooks for NAPTIN training course.

<Output4>

Confirmation of the utilization of NAPTIN training in Discos

- None.

#### **1-4 Achievement of the Project Purpose**

To improve the capabilities of engineers in the power distribution department

- The Joint Technical WG 1-3 meetings were held 9 times (July - November 2023) to discuss the distribution training facility, the pilot project, and outage management app improvement.

- TOT meetings were held 11 times (July - November 2023) to improve textbooks for NAPTIN training course.

#### **1-5 Changes of Risks and Actions for Mitigation**

None.

#### **1-6 Progress of Actions undertaken by JICA**

None.

#### **1-7 Progress of Actions undertaken by Gov. of Nigeria**

Tax exemption process for the imported equipment was completed on 13<sup>th</sup> November, 2023.

#### **1-8 Progress of Environmental and Social Considerations (if applicable)**

Not applicable for this project.

#### **1-9 Progress of Considerations on Gender/Peace Building/Poverty Reduction, disability, disease infection, social system, human wellbeing, human right, and gender equality (if applicable)**

None.

#### **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.)**

None.

## 1 Delay of Work Schedule and/or Problems (if any)

### 4-1 Budgeting for installation costs for the distribution training facility

#### 4-1-1 Detail

NAPTIN has been repeatedly requested to bear the cost of installation of power distribution training equipment since the start of the technical program. In the minutes of the first JCC meeting held September 2022 and the second JCC meeting held June 2023, NAPTIN was also asked to secure the budget for the installation work. NAPTIN has submitted the budget for the installation in the year 2024. However, it's uncertain whether the budget will be secured.

#### 4-1-2 Cause

Delay of budgeting process for installation costs

#### 4-1-3 Action to be taken

JICA will discuss the budget with the Nigerian side (FMP) and try to secure the budget.

#### 4-1-4 Roles of Responsible Persons/Organization (JICA, Gov. of Nigeria, etc.)

JICA will discuss the budget with the Nigerian side (FMP) and try to secure the budget.

## 2 Modification of the Project Implementation Plan

### 5-1 PO

None.

### 5-2 Other modifications on detailed implementation plan

*(Remarks: The amendment of R/D, Project Description, and PDM (title of the project, duration, project site(s), target group(s), implementation structure, overall goal, project purpose, outputs, activities, input, and change of Environmental category) should be authorized by JICA HDQs. If the project team deems it necessary to modify any part of R/D, Project Description, and PDM, the team may propose the draft.)*

None.

## 3 Current Activities of Gov. of Nigeria to Secure Project Sustainability after its Completion

None.

TO JICA NIGERIA OFFICE

**Project Monitoring Sheet****Project Title: The project for capacity development of power distribution****Version of the Sheet: Ver.3 (Term: December, 2023 - June, 2024)****Name: Kyoji FUJII****Title: Leader****Submission Date: 25th June, 2024****I. Summary****1 Progress****1-1 Progress of Inputs**

The following JICA Experts have been dispatched:

- Leader/Distribution Business Operation:  
Additional Dispatch 27<sup>th</sup> November - 15<sup>th</sup> December, 2023  
4<sup>th</sup> Dispatch 14<sup>th</sup> May-27<sup>th</sup> June, 2024
- Distribution Planning:  
4<sup>th</sup> Dispatch 14<sup>th</sup> May-16<sup>th</sup> June, 2024
- Distribution Design:  
4<sup>th</sup> Dispatch 14<sup>th</sup> May-16<sup>th</sup> June, 2024
- Distribution Maintenance and Management:  
4<sup>th</sup> Dispatch 14<sup>th</sup> May-16<sup>th</sup> June, 2024
- Project Coordination / Monitoring Evaluation:  
4<sup>th</sup> Dispatch 14<sup>th</sup> May-13<sup>th</sup> June, 2024

**1-2 Progress of Activities**

&lt;Output1&gt;

Development and implementation of training for loss reduction measures

&lt;Output2&gt;

Development and implementation of training to improve reliability

&lt;Output3&gt;

Development and implementation of training for quality improvement

(1)Activities with NAPTIN

a. Upgrading of NAPTIN's training courses

- NAPTIN counterparts are working on the upgrading of training courses (classroom training) with JICA Expert Team regarding technical loss reduction, reliability improvement and quality improvement.

- Training Demonstrations in each part were conducted from May to June 2024.
  - b. Distribution training facility for NAPTIN
    - Delivery of all equipment and materials was completed.
    - Leveling work at the site has been reported complete but further grading and compaction is needed and is stated to be done during the installation work budgeted for Fiscal Year 2024. The site preparation will be included in the scope of the construction work to be undertaken by the Contractor.
    - JICA experts prepared a draft bill of quantities, drawings, and technical requirements for installation and sent it to NAPTIN (addressed to the Training Program Department) in early April 2024, requesting that the information be reflected in the bidding documents.
    - A Procurement Committee has been established within NAPTIN and has begun preparing bidding documents. The release of the budget for Fiscal Year 2024 was anticipated in April 2024, but it has been delayed. To avoid further delay, NAPTIN submitted the bidding documents for the installation of NAPTIN training equipment (including civil works such as foundations for a transformer and feeder pillar, drainage, fence, land levelling and compaction and slope protection) to the Bureau of Public Procurement and requested the approval for an expedited selection procedure.
    - Although JICA experts cannot be involved in the contractor procurement process, they will follow up on the progress of contractor procurement so that installation of training facilities can begin immediately after the start of the 5th field work (scheduled for September-October 2024).
  - c. Practical training using power distribution training equipment
    - NAPTIN has agreed to the three courses proposed by the JICA experts (1) Fault Point Identification and Restoration of Overhead Lines, (2) Fault Point Identification and Restoration of Underground Lines, and (3) Measurement and Phase Verification Using Equipment.
    - Development of these training courses will be initiated after the 5th field work, when the power distribution training facilities are completed and TOT for NAPTIN instructors is conducted.
- (2)Activities with AEDC
- a. AEDC pilot project (Apo H31 Feeder)
    - Delivery of pilot project equipment and installation of distribution lines (new H31 feeder) by AEDC and self-inspection by AEDC were completed (mid-February 2024).
    - NEMSA conducted an inspection at the end of April 2024, but it has not granted permission yet because NEMSA has made some observations and recommendations.

- The installation of additional facilities (load breaking switch and bolt type connectors) will be delayed because the new distribution lines cannot be energized until AEDC confirms the comments and takes necessary corrective action.
  - The installation of conductor covers was commenced but JICA expert instructed AEDC to suspend the installation as of the 7<sup>th</sup> of June 2024 because AEDC reported that some of the covers burnt down. JICA expert together with AEDC counterparts examined the scene of the accident and will analyze the cause of ignition.
- b. Improvement of AEDC's business operation
- A proposal was made by the JICA expert to AEDC to add input items to AEDC's Outage Management System (OMS), such as the area affected by the outage, the nature of the incident, and the root cause of the incident, and an Outage Management App was developed by AEDC to replace the OMS, and began trials in some areas of the FCT in June 2023.
  - After a briefing session on the App was held in June 2023, it was rolled out company-wide. However, the data entry status of each Regional Office is not satisfactory (e.g., Kogi has zero data entry), and the data entry rate needs to be increased. In order to do so, it is necessary to have the senior management of AEDC understands the benefits of utilizing the outage information, i.e., what kind of analysis can be done with the outage data and how it can help AEDC improve the efficiency of its capital investment.

### 1-3 Achievement of Output

<Output1>

Development and implementation of training for loss reduction measures

<Output2>

Development and implementation of training to improve reliability

<Output3>

Development and implementation of training for quality improvement

- The Joint Technical WG 1-3 meetings were held 11 times (December 2023 - June 2024) to discuss the distribution training facility, the pilot project, and outage management app improvement.

- TOT meetings were held 11 times (December 2023 - June 2024) to upgrade of NAPTIN's training courses.

<Output4>

Confirmation of the utilization of NAPTIN training in Discos

- WG 4 kickoff meeting was held (June 2024) to examine the cause of low utilization of NAPTIN's training courses. Questionnaire about the human resources development and

training plan of AEDC was sent to AEDC's human resources department and the answer was sent back to JICA expert on the 7<sup>th</sup> of June 2024.

#### **1-4 Achievement of the Project Purpose**

To improve the capabilities of engineers in the power distribution department

- The Joint Technical WG 1-3 meetings were held 11 times (December 2023 - June 2024) to discuss the distribution training facility, the pilot project, and outage management app improvement.
- TOT meetings were held 11 times (December 2023 - June 2024) to upgrade of NAPTIN's training courses.
- WG 4 kickoff meeting was held (June 2024) to examine the appropriateness of NAPTIN's training courses and to discuss measures.

#### **1-5 Changes of Risks and Actions for Mitigation**

None.

#### **1-6 Progress of Actions undertaken by JICA**

None.

#### **1-7 Progress of Actions undertaken by Gov. of Nigeria**

None.

#### **1-8 Progress of Environmental and Social Considerations (if applicable)**

Not applicable for this project.

#### **1-9 Progress of Considerations on Gender/Peace Building/Poverty Reduction, disability, disease infection, social system, human wellbeing, human right, and gender equality (if applicable)**

None.

#### **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.)**

None.

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

**2-1 Budget notification for the installation of the training facility****2-1-1 Detail**

- The notification of the budget for Fiscal Year 2024 was scheduled for April, but has been delayed.
- A Procurement Committee has been established within NAPTIN and has begun preparing bid documents. NAPTIN submitted a request of an expedited selection procedure to BPP (Bureau of Public Procurement) at the end of May 2024.
- To keep the project on track, selection for a contractor shall be completed by July 2024.

**2-1-2 Cause**

Delay of budget notification for the installation of the training facility.

**2-1-3 Action to be taken**

NAPTIN shall proceed with bidding procedures as soon as no objection for expedited bidding process is granted by BPP.

**2-1-4 Roles of Responsible Persons/Organization (JICA, Gov. of Nigeria, etc.)**

BPP: Approval for the expedited bidding procedure

NAPTIN: Bidding procedures and contractor contract

**2-2 NEMSA's inspection for AEDC pilot project****2-2-1 Detail**

- Installation of distribution lines (new H31 feeder) by AEDC was completed in January 2024.
- NEMSA conducted an inspection at the end of April 2024, but it has not granted permission yet because NEMSA has made some observations and recommendations which required AEDC's corrective work. The installation of additional facilities (load breaking switch and bolt type connectors) will be delayed because the new distribution lines cannot be energized until AEDC confirms the comments and takes necessary corrective action.
- Monitoring for AEDC pilot project shall be carried out for one year from the start of operation of new distribution line after the installation of additional facilities.
- After obtaining the monitoring data, the results of the pilot project shall be incorporated into the NAPTIN's classroom training courses, and the training courses shall be finalized.

**2-2-2 Cause**

NEMSA has not granted permission for AEDC to use the new distribution line because the results of the inspection were not satisfactory.

### **2-2-3 Action to be taken**

AEDC shall confirm the comments and take necessary corrective action as soon as possible.

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

AEDC: Action for NEMSA's comments

## **2-3 Burning accident of conductor covers for AEDC pilot project**

### **2-3-1 Detail**

- The installation of conductor covers was commenced on 5<sup>th</sup> June 2024 but JICA expert instructed AEDC to suspend the installation as of the 7<sup>th</sup> of June 2024 because AEDC reported that some of the covers burnt down. There has been neither equipment nor personal damage other than the damage to the conductor covers themselves.
- The installation work is suspended due to the accident.

### **2-3-2 Cause**

Investigation is ongoing.

### **2-3-3 Action to be taken**

JICA expert team shall investigate and take action as soon as possible.

### **2-3-4 Roles of Responsible Persons/Organization (JICA, Gov. of Nigeria, etc.)**

JICA expert team: Analyze the cause of ignition to the conductor covers and take countermeasures.

## **3 Modification of the Project Implementation Plan**

### **3-1 PO**

None.

### **3-2 Other modifications on detailed implementation plan**

*(Remarks: The amendment of R/D, Project Description, and PDM (title of the project, duration, project site(s), target group(s), implementation structure, overall goal, project purpose, outputs, activities, input, and change of Environmental category) should be authorized by JICA HDQs. If the project team deems it necessary to modify any part of R/D,*



*Project Description, and PDM, the team may propose the draft.)*

None.

**4 Current Activities of Gov. of Nigeria to Secure Project Sustainability after its Completion**

None.

**II. Project Monitoring Sheet I & II**      *as Attached*

**TO JICA NIGERIA OFFICE**

## **Project Monitoring Sheet**

**Project Title: The project for capacity development of power distribution**

**Version of the Sheet: Ver.4 (Term: July, 2024 - February, 2025)**

**Name: Kyoji FUJII**

**Title: Leader**

**Submission Date: 13th February, 2025**

### **I. Summary**

#### **1 Progress**

##### **1-1 Progress of Inputs**

The following JICA Experts have been dispatched:

- Leader/Distribution Business Operation:  
4.5<sup>th</sup> Dispatch 4<sup>th</sup> - 20<sup>th</sup> November, 2024  
5<sup>th</sup> Dispatch 12<sup>th</sup> January – 20<sup>th</sup> February, 2025
- Distribution Planning  
5<sup>th</sup> Dispatch 12<sup>th</sup> January - 21<sup>st</sup> February, 2025
- Distribution Design:  
4.5<sup>th</sup> Dispatch 16<sup>th</sup> November - 12<sup>th</sup> December, 2024  
5<sup>th</sup> Dispatch 12<sup>th</sup> January - 21<sup>st</sup> February, 2025
- Distribution Maintenance and Management:  
5<sup>th</sup> Dispatch 12<sup>th</sup> January - 21<sup>st</sup> February, 2025
- Pilot Project 1 (Procurement Survey):  
5<sup>th</sup> Dispatch 12<sup>th</sup> January - 21<sup>st</sup> February, 2025
- Training Courses Planning:  
5<sup>th</sup> Dispatch 18<sup>th</sup> January - 31<sup>st</sup> January, 2025

##### **1-2 Progress of Activities**

<Output1>

Development and implementation of training for loss reduction measures

<Output2>

Development and implementation of training to improve reliability

<Output3>

Development and implementation of training for quality improvement

(1)Activities with NAPTIN

a. Upgrading of NAPTIN's training courses

- NAPTIN counterparts have almost completed the upgrading of training courses (classroom training) with JICA Expert Team regarding technical loss reduction, reliability improvement and quality improvement.
- The 2<sup>nd</sup> training demonstrations were conducted inviting AEDC's young engineers as model trainees from January to February 2025
- Newly developed classroom training courses will be released by NAPTIN between March and April 2025.
- b. Distribution training facility for NAPTIN
  - Installation of equipment started in November 2024 and completed in December 2024.
- c. Practical training using power distribution training equipment
  - Practical training for TOT using the distribution training facility is conducted during 5<sup>th</sup> fieldwork. ((1) Fault Point Identification and Restoration of Overhead Lines, (2) Fault Point Identification and Restoration of Underground Lines, (3) Measurement and Phase Verification Using Equipment.)
- (2) Activities with AEDC
  - a. AEDC pilot project (Apo H31 Feeder)
    - Remedial work was performed by the AEDC's contracted construction company to address NEMSA's inspection findings for the AEDC pilot project. NEMSA conducted re-inspection in December 2024.
    - Jumper connections using the bolt type connectors and phase comparison work before connecting jumpers at the connection points of existing and new 33kV lines will not be completed by the end of the 5<sup>th</sup> fieldwork. Remaining works need to be completed by AEDC. The load breaking switch needs to be connected to the 33kV line and stay wires need to be removed from the poles which the switch is installed and an earth wire needs to be connected from the body of the switch as NEMSA commented. After completing all works, AEDC shall commence the separate operation of H31 feeder and start monitoring and keeping records.
    - During the removal of a 132 kV tower in front of Apo transmission substation in January 2025, the line dropped onto the pilot project's 33kV distribution line, causing the tower to fall. FCDA is responsible for the accident and its contractor shall reinstall the tower and restore the line. FCDA promised to complete the restoration by the end of January 2025 but the deadline was extended to the 14<sup>th</sup> of February 2025. Still, no site work has commenced by FCDA and it is highly likely that further delay will be announced. This has caused considerable delay of AEDC pilot project.
    - Explained the test results and future response policy to FMP, NERC, NEMSA, and AEDC regarding burnt and melted conductor covers, and issued explanatory letter in November 2024. On the 3<sup>rd</sup> of February 2025, NEMSA inspected conductor covers

installed on 11kV distribution lines as experimental purposes and observed no abnormality on the covers. Thus, NEMSA provisionally approved the application of the covers on 11kV lines as pilot project. Installation of the conductor covers on 11kV distribution lines shall be completed by AEDC.

b. Improvement of AEDC's business operation

- Outage Management App was developed by AEDC in June 2023, and it was rolled out company-wide. However, the data entry status of each Regional Office is not satisfactory, and the data entry rate needs to be increased.

<Output4>

Confirmation of the utilization of NAPTIN training in Discos

- In order to convert the training course to E-Learning, NAPTIN sorted the contents to be E-Learning and the contents to be physical training. Then, NAPTIN has determined the contents to be E-Learning, and create the E-Learning contents with a contractor contracted by NAPTIN.
- Online workshop to introduce NAPTIN's new training courses to Discos was held in January 2025.

### 1-3 Achievement of Output

<Output1>

Development and implementation of training for loss reduction measures

<Output2>

Development and implementation of training to improve reliability

<Output3>

Development and implementation of training for quality improvement

- The Joint Technical WG 1-3 meetings were held 13 times (July 2024 - January 2025) to discuss the distribution training facility, the pilot project, and outage management app improvement.

- TOT meetings were held 14 times (July 2024 - January 2025) to upgrade of NAPTIN's training courses.

- The 2<sup>nd</sup> training demonstrations for TOT were conducted from January to February 2025.

- The installation of the training facility has been completed in December 2024.

<Output4>

Confirmation of the utilization of NAPTIN training in Discos

- WG 4 meetings were held 4 times (June 2024 - January 2025) to examine the appropriateness of NAPTIN's training courses and to discuss measures.

- Online workshop to introduce NAPTIN's new training courses to Discos was held in January 2025.

#### **1-4 Achievement of the Project Purpose**

To improve the capabilities of engineers in the power distribution department

<Indicator 1-3>

1. 70% or more participants in the training courses will be evaluated that they acquired correct knowledge about reducing technical loss.

2. 70% or more participants in the training courses will be evaluated that they acquired correct knowledge about improving reliability.

3. 70% or more participants in the training courses will be evaluated that they acquired correct knowledge about quality improvement.

New classroom training courses for technical loss reduction, reliability improvement and quality improvement have been developed. Since evaluation for the effectiveness of those new training courses has not been conducted, it is difficult to assess the achievement of these indicators at this moment.

- Degree of understanding and acquiring knowledge on the new training courses, i.e., technical loss reduction, reliability improvement and quality improvement, will be measured after the official release of new training courses by NAPTIN. NAPTIN will release the training courses in March 2025.

- Practical training courses are under development and will be completed after the 6<sup>th</sup> fieldwork, around the middle of 2025.

<Indicator 4>

4. A training system (curriculum, teaching materials, training equipment, instructors, budget measures, etc.) will be established.

Around 60% of training system for new training courses has been established at NAPTIN based on outputs achieved so far.

- New classroom training courses have been developed. NAPTIN has released 2025 official training calendar including new developed training courses. (100% completed)

-90% of teaching materials for new classroom training courses have been prepared.

-50% of teaching materials for new practical training courses have been developed.

-Installation of the distribution training facility has been completed. (100% completed)

-70% of instructors' capacity has been developed.

-Budget measures for new training courses have not been established yet.

### **1-5 Changes of Risks and Actions for Mitigation**

None.

### **1-6 Progress of Actions undertaken by JICA**

None.

### **1-7 Progress of Actions undertaken by Gov. of Nigeria**

None.

### **1-8 Progress of Environmental and Social Considerations (if applicable)**

Not applicable for this project.

### **1-9 Progress of Considerations on Gender/Peace Building/Poverty Reduction, disability, disease infection, social system, human wellbeing, human right, and gender equality (if applicable)**

None.

### **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.)**

None.

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

### **2-1 Project duration**

#### **2-1-1 Detail**

- Difficulty in ensuring a period of time to monitor the results of the AEDC pilot project within the project duration.

#### **2-1-2 Cause**

- Delay of the AEDC pilot project

#### **2-1-3 Action to be taken**

- Discuss the project duration in the 5<sup>th</sup> JCC meeting.

#### **2-1-4 Roles of Responsible Persons/Organization (JICA, Gov. of Nigeria, etc.)**

- Discuss the project duration in the 5<sup>th</sup> JCC meeting.

## **3 Modification of the Project Implementation Plan**

### **3-1 PO**

None.

**3-2 Other modifications on detailed implementation plan**

*(Remarks: The amendment of R/D, Project Description, and PDM (title of the project, duration, project site(s), target group(s), implementation structure, overall goal, project purpose, outputs, activities, input , and change of Environmental category) should be authorized by JICA HDQs. If the project team deems it necessary to modify any part of R/D, Project Description, and PDM, the team may propose the draft.)*

None.

**4 Current Activities of Gov. of Nigeria to Secure Project Sustainability after its Completion**

None.

**II. Project Monitoring Sheet I & II**      *as Attached*

TO JICA NIGERIA OFFICE

**Project Monitoring Sheet****Project Title: The project for capacity development of power distribution****Version of the Sheet: Ver.5 (Term: March - October, 2025)****Name: Kyoji FUJII****Title: Leader****Submission Date: 30th October, 2025****I. Summary****1 Progress****1-1 Progress of Inputs**

The following JICA Experts have been dispatched:

- Leader/Distribution Business Operation:
  - 5.5th Dispatch: 11th May – 15th May, 2025
  - 6th Dispatch: 15th June – 13th July, 2025
  - 7th Dispatch: 20th October – 1st November, 2025 (Plan)
- Distribution Planning
  - 6th Dispatch: 15th June – 13th July, 2025
  - 7th Dispatch: 19th October – 1st November, 2025 (Plan)
- Distribution Design:
  - 6th Dispatch: 15th June – 13th July, 2025
  - 7th Dispatch: 19th October – 1st November, 2025 (Plan)
- Distribution Maintenance and Management:
  - 6th Dispatch: 15th June – 13th July, 2025
  - 7th Dispatch: 19th October – 1st November, 2025 (Plan)
- Pilot Project 1 (Procurement Survey):
  - 6th Dispatch: 15th June – 13th July, 2025
  - 7th Dispatch: 19th October – 1st November, 2025 (Plan)

**1-2 Progress of Activities**

&lt;Output1&gt;

Development and implementation of training for loss reduction measures

&lt;Output2&gt;

Development and implementation of training to improve reliability

&lt;Output3&gt;

Development and implementation of training for quality improvement



## (1)Activities with NAPTIN

## a. Upgrading of NAPTIN's training courses

- The newly developed classroom training courses for technical loss reduction, reliability improvement and quality improvement were released by NAPTIN and are included in its 2025 training calendar.

## b. Training demonstration session of the practical training

- The 1st training demonstration session of the practical training was held for underground cable fault location on 8th July, 2025, and for overhead line fault location, and phase comparison works on distribution lines on 10th July, 2025.
- The 2nd training demonstration session of the practical training was held for underground cable fault location on 23rd October, 2025, and for overhead line fault location, and phase comparison works on distribution lines on 28th October, 2025.
- Some copper cables and copper wires were stolen at the distribution training facility. JICA requested NAPTIN to restore the facility and implement security measures. (barbed wire, security lights, security cameras, security patrols, etc.)

## (2)Activities with AEDC

## a. AEDC pilot project (Apo H31 Feeder)

- Conductor covers installed on 33kV, Apo H31 feeder were found burnt and melted soon after the installation in June 2024. After the failure on the 33kV line, the analysis was conducted including tests at the manufacturer's laboratory. It was concluded that a phase-to-phase short circuit between the bare and covered conductors was the cause of the burning, and the melting was caused by a heavy load on the conductor. Based on the analysis above, the JICA Team and AEDC decided to change the target from 33kV to 11kV and select lines for experimental installation which were not heavily loaded. The results of the experimental installation were successful but the cover was burnt on the 11kV line again when the rainy season started in June 2025. The JICA expert team and AEDC agreed to suspend the installation of the covers and remove them to prevent further accident.
- The operation of a ring shape network consisting of the Apo H31/H13 feeders has not commenced yet. To establish the ring shape network, it is necessary to transfer some large scale customers from the Kukwaba L33 feeder to the Apo H31 feeder but it will entail the reduction of load at Kukwaba L33. This load transfer was not accepted by the Chief Business Officer (CBO) of Apo region saying that this would not work under the feeder manager scheme. Upon the request from JICA Expert Team, Chief Technical Officer organized a meeting inviting all concerned parties of AEDC and discussed this issue. Finally, CTO concluded that AEDC would make the ring shape

network.

b. Improvement of AEDC's business operation

- The new Outage Management App has been used, and training is currently underway within AEDC. The new App requires the entry of the outage reason and the upload of photos showing the situation before and after the outage. Historical incident data has been obtained, and data analysis related to Band-A will be conducted.
- The JICA expert team has given the presentation for the data analysis report and suggestions to the Chief Technical Officer (CTO) on 21st October 2025.

<Output4>

Confirmation of the utilization of NAPTIN training in Discos

- The newly developed training courses are listed in NAPTIN's 2025 training plan, but they have not yet been conducted due to lack of applications. FMP issued a letter to Discos inviting them to participate and plans to send FMP staff to the training. NAPTIN intends to hold the training once a sufficient number of participants have registered.
- The e-learning conversion of the newly developed training courses for this project has commenced content creation in September 2025, using AFD budget. Effective e-learning approaches are explored with NAPTIN.

### 1-3 Achievement of Output

<Output1>

Development and implementation of training for loss reduction measures

<Output2>

Development and implementation of training to improve reliability

<Output3>

Development and implementation of training for quality improvement

- New contents, exercise and explanation were added to the existing classroom training course and it was released as a new training course named "DISTRIBUTION NETWORK POWER LOSS REDUCTION TECHNIQUES" (D16).

- New contents, exercise and explanation were added to the existing classroom training course and it was released as new training course named "RELIABILITY IMPROVEMENT FOR POWER DISTRIBUTION NETWORKS (D23).

- New contents, exercise and explanation were added to the existing classroom training course and it was released as new training course named "POWER QUALITY IMPROVEMENT FOR DISTRIBUTION NETWORKS" (D22).

<Output4>

Confirmation of the utilization of NAPTIN training in Discos

- AEDC, as a model Disco, utilizes NAPTIN training courses in case;
  - (i) whose contents are not covered by AEDC's internal training or
  - (ii) external training is more efficient.

**1-4 Achievement of the Project Purpose**To improve the capabilities of engineers in the power distribution department

<Indicator 1-3>

1. 70% or more participants in the training demonstration will be evaluated that they acquired correct knowledge about reducing technical loss.

2. 70% or more participants in the training demonstration will be evaluated that they acquired correct knowledge about improving reliability.

3. 70% or more participants in the training demonstration will be evaluated that they acquired correct knowledge about quality improvement.

- New classroom training courses for technical loss reduction, reliability improvement and quality improvement have been developed.

- Even though new classroom trainings developed through the project have already been released by NAPTIN, no one has participated in the training. However, judging from the feedback of model trainees who participated in training demonstration, the training provided relevant and necessary information and the materials and teaching method were good enough for them to understand well.

<Indicator 4>

4. A training system (curriculum, teaching materials, training equipment, instructors, budget measures, etc.) will be established.

Around 90% of training system for new training courses has been established at NAPTIN based on outputs achieved so far.

- New classroom training courses have been developed. NAPTIN has released 2025 official training calendar including the newly developed training courses. (100% completed)

- Teaching materials for new classroom training courses have been completed. (100% completed)

- New practical training courses have been developed. (100% completed)

- Teaching materials for new practical training courses have been completed. (100% completed)

- Installation of the distribution training facility has been completed. (100% completed)

- Instructors' capacity has been developed. (100% completed)

- The e-learning contents of the classroom training course will be created using AFD

funding. (40% completed)

### **1-5 Changes of Risks and Actions for Mitigation**

None.

### **1-6 Progress of Actions undertaken by JICA**

None.

### **1-7 Progress of Actions undertaken by Gov. of Nigeria**

None.

### **1-8 Progress of Environmental and Social Considerations (if applicable)**

Not applicable for this project.

### **1-9 Progress of Considerations on Gender/Peace Building/Poverty Reduction, disability, disease infection, social system, human wellbeing, human right, and gender equality (if applicable)**

None.

### **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.)**

None.

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

### **2-1 Monitoring of the AEDC pilot project**

#### **2-1-1 Detail**

- The operation as a looped distribution line for the Apo H31/H13 feeder has not commenced. To establish a looped distribution line, it is necessary to transfer some consumers from the Kukwaba L33 feeder to the Apo H31 feeder.
- There is difficulty in ensuring a period of time to monitor the results of the AEDC pilot project within the project duration.

#### **2-1-2 Cause**

- The cause is the delay in transferring some consumers from the Kukwaba L33 feeder to the Apo H31 feeder.

#### **2-1-3 Action to be taken**

- AEDC shall commence the operation for the Apo H31/H13 feeder by the end of December 2025.

#### **2-1-4 Roles of Responsible Persons/Organization (JICA, Gov. of Nigeria, etc.)**

- JICA will follow up on AEDC's action.

## **2-2 Vandalization of the distribution training facility**

### **2-2-1 Detail**

- Some copper cables and copper wires were stolen at the distribution training facility.

### **2-2-2 Cause**

- Vandalization

### **2-2-3 Action to be taken**

- NAPTIN shall implement security measures by the end of December 2025. (barbed wire, security lights, security cameras, security patrols, etc.)

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

- JICA will follow up on NAPTIN's action.

## **3 Modification of the Project Implementation Plan**

### **3-1 PO**

None.

### **3-2 Other modifications on detailed implementation plan**

*(Remarks: The amendment of R/D, Project Description, and PDM (title of the project, duration, project site(s), target group(s), implementation structure, overall goal, project purpose, outputs, activities, input, and change of Environmental category) should be authorized by JICA HDQs. If the project team deems it necessary to modify any part of R/D, Project Description, and PDM, the team may propose the draft.)*

None.

## **4 Current Activities of Gov. of Nigeria to Secure Project Sustainability after its Completion**

None.

## **II. Project Monitoring Sheet I & II as Attached**