

Vietnam
EVN HANOI

**Collaboration Program with the
Private Sector for Disseminating
Japanese Technology for Electricity
Distribution Planning System
in Vietnam
Final Report**

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Tokyo Electric Power Company Holdings, Incorporated
THE Power Grid Solution Ltd.

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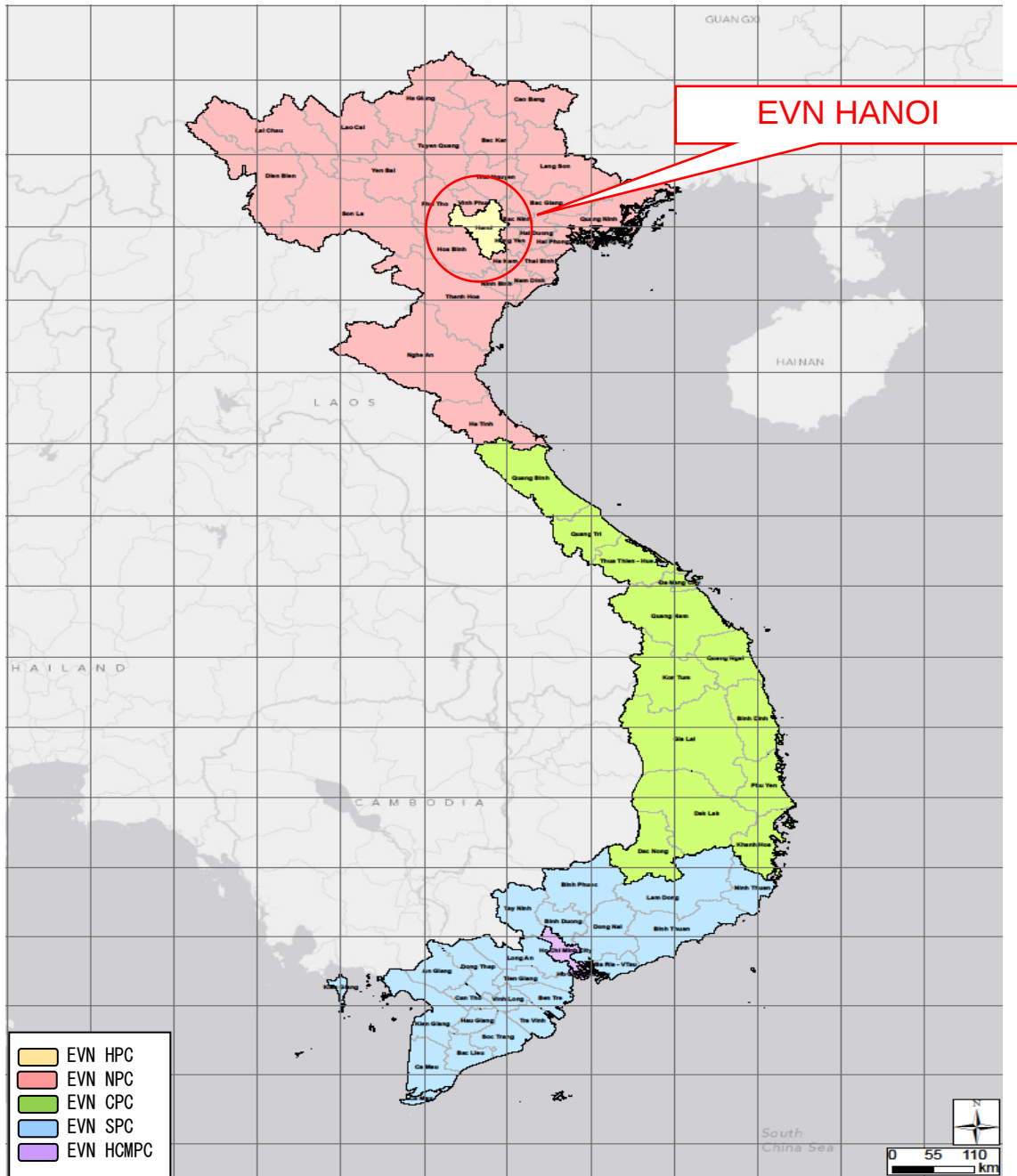
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Map



Location of EVN HANOI

Abbreviations

Abbreviation	Explanation
CPC	Central Power Corporation
DMS	Distribution Management System
DSS	Decision-making Support Software
EVN	Electricity of Vietnam
HCMPC	Ho Chi Minh City Power Corporation
HPC	Hanoi City Power Corporation
MDMC	Multi-Divided and Multi-Connected (non-official word)
MoM	Minutes of Meeting
NPC	Northern Power Corporation
ODA	Official Development Assistance
OT	Operation Technology
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SCADA	Supervisory Control And Data Acquisition
SPC	Southern Power Corporation
TEPCO PG	TEPCO Power Grid, Incorporated
THE	THE Power Grid Solution Ltd.

Chapter 1 Background to this Program

1.1. Background to the Program

EVN has a target to improve EVN HANOI's SAIDI from 1,560 minutes to 260 minutes by 2020. Although the amount of outages caused by transmission lines dropped compared with those caused by distribution lines, the amount of outages caused by distribution lines still remains high. Planned outage durations (such as outages for changing distribution equipment) are especially long for the distribution system. One of the factors for this is that some parts of the distribution system have not yet used the MDMC system or loop system, which can minimize the outage area.

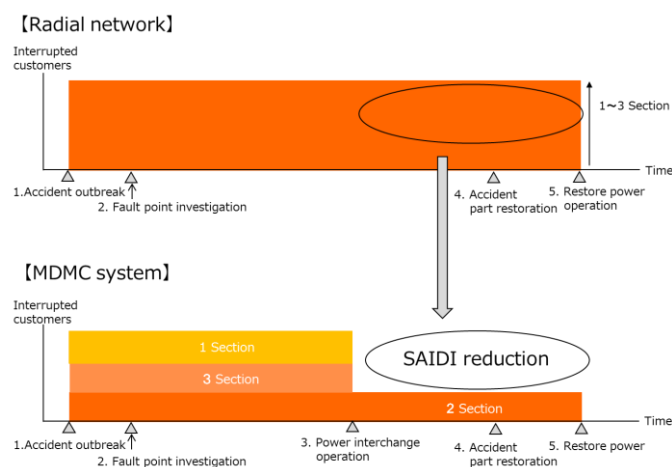
1.2. Disseminating Japanese Technology via the Program

In order to improve supply reliability and achieve efficient investment, technology used in distribution system planning at TEPCO PG and software, DSS, provided by THE, are disseminated to Vietnam. In this way, the foundations for systems such as SCADA and DMS are prepared in Vietnam.

1.3. Possibility of Contribution to Address Problems

Supply reliability is improved via the adoption of an MDMC system, which enables to minimize the size of the outage area for maintenance and distribution equipment exchange when a distribution line accident occurs (see the figure below). In addition, the outage area can be minimized for planned work. For example, SAIDI will be improved by one third when a 3 divided and 3 connected system is used. By adopting software and operation technology, the efficiency of work processes, such as distribution system planning and operation, will be improved. An optimum investment strategy can also be realized by ascertaining investment priorities using software.

It is expected that losses in electricity tariff income and the social costs caused by outages will be reduced by employing the MDMC system developed by this program. The definition of social cost losses due to outages is, for example, economic losses in Vietnam such as lost sales for a huge manufacturer connected to the feeder undergoing outage. Outage reductions will also lead to an improvement in the quality of life for Vietnamese people.



Source: TEPCO PG

Figure 1-1 Reliability Enhancement by Adopting MDMC

Chapter 2 Outline of This Program

2.1. Purpose and Target of the Program

In order to export the Japanese distribution system and its operation techniques as a package, the background for Japanese electricity infrastructure export is to be prepared in Vietnam. The advantages of Japanese distribution system operation know-how and software technology will be understood through the dissemination program.

2.2. Purpose and Outline of Activities

2.2.1. Visit to Japan

Purpose

The objective of the activity is to deepen Vietnamese power officials' understanding of TEPCO's know-how regarding highly reliable operational technology and distribution planning methods.

Outline of Activities

Visit to TEPCO's training center for DMS and SCADA training.

- Visit to TEPCO's control center for introduction to distribution automation systems (DMS, SCADA).
- Exchange of opinions with distribution planning staff and distribution finance staff at TEPCO's head/branch offices.
- Course on DSS usage at THE's office.



Figure 2-1 Training equipment in TEPCO

2.2.2. On-Site Demonstration

Purpose

The objective of our program is to demonstrate optimal investment and reliability improvements in EVN HANOI's pilot feeders by adopting TEPCO's MDMC distribution system and THE's distribution network planning software.

Outline of Activities

A summary of activities is shown in the figure below. First of all, pilot feeders are selected. Then, the technical conditions are analyzed using DSS to prepare the demonstration. In the optimal investment survey, existing construction plans for pilot feeders are prioritized using TEPCO's distribution planning know-how and THE's DSS. In the reliability improvement survey, TEPCO PG introduces the planning and operation know-how needed to adopt the MDMC network at the pilot feeders by using

DSS. Once sufficient understanding has been achieved, EVN HANOI constructs and operates the system to demonstrate the reduction in SAIDI and SAIFI.

2.3. Schedule

The schedule for this program is shown in the figure below. Its target is to enable EVN HANOI to understand the advantages of Japanese operation know-how and software technology and to develop Japanese methods at other distribution companies in Vietnam.

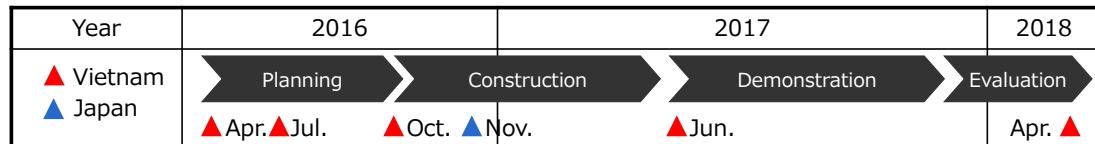


Figure 2-2 Implementation schedule

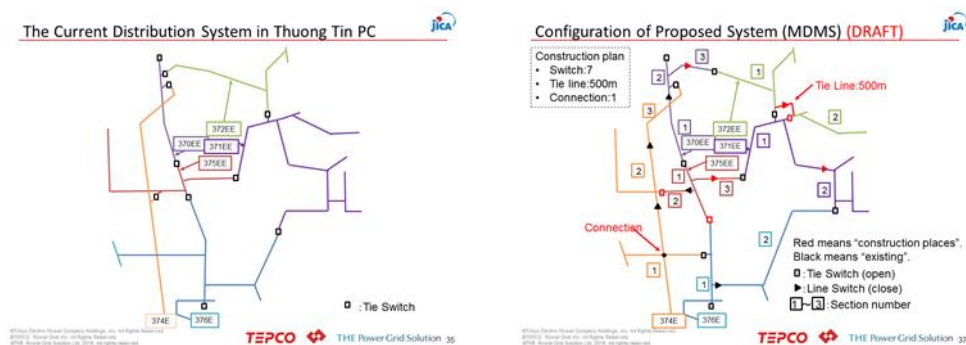
(1) April 2016: Kick-Off Meeting and 1st site survey

- 35kV Feeders, 376E10.4 and 371E1.32, were tentatively selected as the pilot feeders.
- Information collection for the reliability improvement demonstration was almost completed but information collection for the optimal investment demonstration was insufficient.
- Almost all network information necessary for DSS modeling was gathered. The remaining information was sent by email.
- Distribution system reliability was higher than the estimations during TEPCO PG's previous visit because additional lines had been constructed.
- The program team suggested that the plan for the pilot project be proposed during the next visit.
- The program team proposed that, for the Japan tour, 2 managers and 4 engineers attend, and requested EVN HANOI to select these people.

(2) July 2016: 2nd site survey

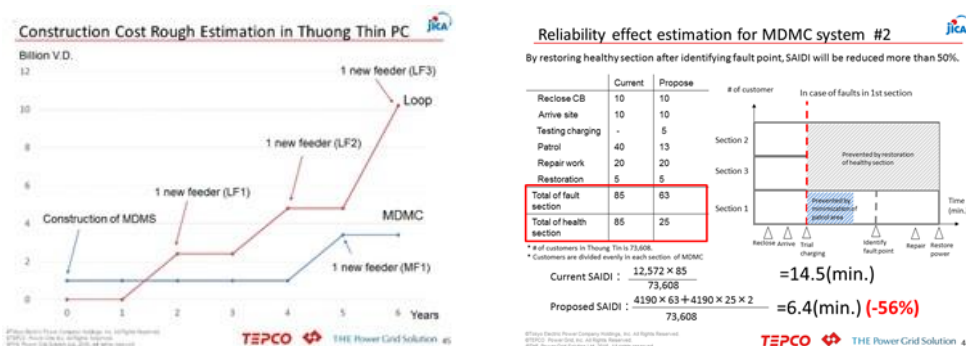
[Reliability improvement]

- Additional information collection for planning and operation methods and DSS modeling via interviews with questionnaires.
- Additional site visit to pilot feeders, calculation of necessary costs for pilot feeders' construction and training on MDMC system operation.
- Program team explained the benefits of the MDMC system and EVN HANOI agreed on the MDMC system pilot project.
- Because accurate demand was estimated with additional information from Thuong Tin PC, part of the DSS modeling was revised and the MDMC system was also revised. The implementation of the pilot project demonstration was agreed on this MDMC system structure.
- The results of the visit were reported to EVN HANOI and EVN. Positive comments on deploying the MDMC system at EVN HANOI and the other PCs after this program were collected.



Source: Program team

Figure 2-3 Existing distribution system and proposed distribution system



Source: Program team

Figure 2-4 Economic benefits and estimated reliability improvements

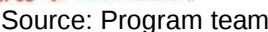
[Optimal investment]

- As a result of hearing problems related to optimal investment, it seemed the budget management method was not suitable for a distribution system.
- Program team proposed introduction of TEPCO PG's budget management method during next visit.

(3) October 2016: 3rd site survey and optimal investment meeting

[Reliability improvement]

- Program team and Thuong Tin PC consolidated the construction details for the pilot project, evaluated the technical issues and calculated the cost merits.
- Program team assisted Thuong Tin PC in making the construction specifications.
- Program team explained the operation methods for the MDMC system in order to improve the supply reliability.
- Program team created the record format and requested Thuong Tin PC to record the outage recovery process during the pilot project period for evaluation.
- Pilot project implementation was scheduled to be approved during the visit in Japan.

[illegible]

Source: Program team

Figure 2-6 Record format

[Optimal investment]

- Program team introduced the budget management methods used by TEPCO PG's distribution department.

(4) November 2016: Japan Tour

- Through the visit to Japan, program team promoted the MDMC system and Japanese DAS. It was ascertained via a questionnaire at the end of the tour that almost all of the attendees were able to understand the content clearly.
- Attendees were interested in training facilities and underground facilities in TEPCO PG. Vice General Director proposed providing advice on planning and programs for EVN HANOI's training.
- At the wrap up meeting, Vice General Director of EVN HANOI approved the implementation of MDMC system construction, which was proposed during 3rd visit. Land acquisition for construction, detailed design and construction were to be completed by April.
- Vice General Director of EVN HANOI signed the MoM on the abovementioned issues and future steps.



Figure 2-7 Visit to training center

(5) June 2017: MDMC system operation training

- Operators in Thuong Tin PC already understood the operation methods for an accident to a greater level than the program team expected, and there were no issues regarding basic operation methods. Program team explained the differences between a loop system and MDMC system and the importance of load management in system operation. Operators had a good impression of the system, as patrol times were shortened due to patrol areas being smaller.
- TEPCO PG subjectively evaluated the operation abilities of Thuong Tin operators and ascertained that they had reached a level sufficient to operate the pilot feeders.
- Program team provided a trial version of DSS to Thuong Tin PC and explained the basic operation.

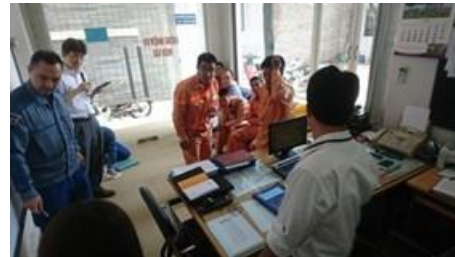


Figure 2-8 Meeting and training for operators



Figure 2-9 Meeting and operators at on-site training

(6) April 2018: Seminar

- Program team discussed the evaluation of pilot feeders with Thuong Tin PC, who implemented the pilot project and actually operated the MDMC system, concurring on the benefits of the MDMC system.

- The evaluation results were reported at a seminar held at EVN HANOI headquarters and EVN HANOI understood the benefits of the MDMC system.
- EVN HANOI said that it intends to adopt the MDMC system with DAS in suburban areas using its own budget. Distribution planning support software and DAS would be adopted on a step by step basis.

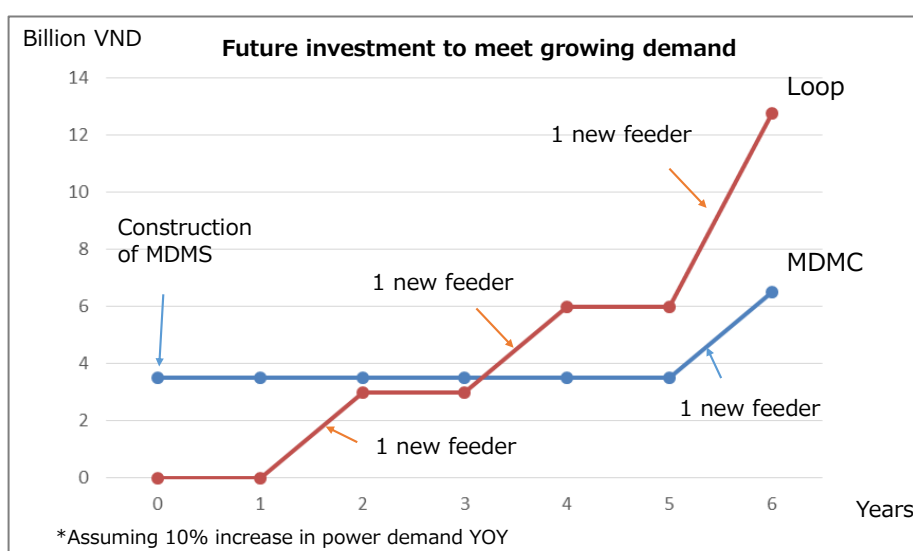


Figure 2-10 Seminar in EVN HANOI headquarters

Chapter 3 Results and outcome of the pilot project

In the project, an MDMC system using DSS was planned and constructed at the pilot feeders. Operation training was carried out and 6 months' outage records were evaluated.

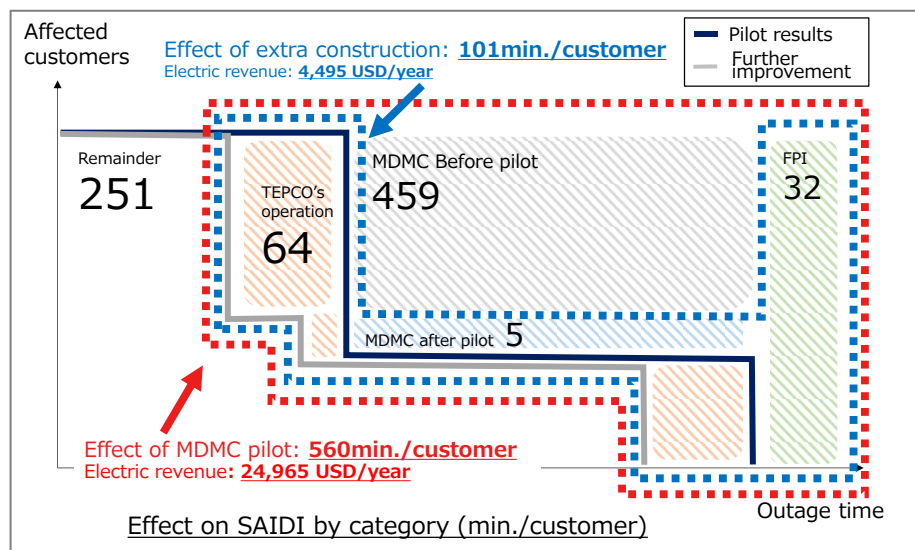
The figure below shows an investment comparison between a loop system and an MDMC system when demand grows at the pilot feeders. The distribution company must install feeders so as not to exceed the feeder limit due to demand growth, and the number of required feeders differs between the existing distribution system and the MDMC system. Therefore, for an MDMC system, initial investment is required but this becomes smaller than for the existing distribution system after 4 years pass. As a result, it was proven that MDMC has an economic advantage. Because there are many locations in which demand growth is higher than 10% in Vietnam, economic benefits are expected if an MDMC system is deployed in other EVN HANOI areas.



Source: Program team

Figure 3-1 Investment reduction due to MDMC system

The figure below shows a summary of the time and number of customers when outages occurred during the pilot period (June 2017 – November 2017). SAIDI is almost equal with the area shown in the graph below. In general, the graph becomes a rectangle if the distribution system is a radial structure without sections and connections, because an outage continues until its cause is removed. The pilot results (black bold line) show a SAIDI decrease due to outage area reduction via adoption of the MDMC system and early detection of outages via the adoption of FPI. It should be mentioned that 459 of the 496 minutes were caused by the loop system which was structured before this project by Thuong Tin PC itself. In addition, it was estimated by checking the records more carefully that the SAIDI will improve further via deeper integration of TEPCO PG's operation techniques.



Source: Program team

Figure 3-2 Reliability improvement via MDMC system

The economic effects and reliability improvement due to the construction of a Japanese MDMC system on the pilot feeders, and the use of its support software and planning and operation techniques, were demonstrated and clearly understood. EVN HANOI expected to eventually adopt the support software and MDMC system.

Chapter 4 Business Development Planning after Implementation of this Program

4.1. Business Objectives and Goals

First, the program team aims to deploy MDMC system planning methods, the effectiveness of which has been confirmed through the pilot project, and DAS in specific regions of EVN HANOI where higher power reliability is required due to customer characteristics, such as commercial and industrial areas. On this basis, the program team aims to expand this technology to the entire EVN HANOI area.

4.2. Expected Outcomes in Business

The program team evaluated the impact of DAS installation at the pilot feeders and identified that SAIDI improved by 117 minutes compared to manual operations.

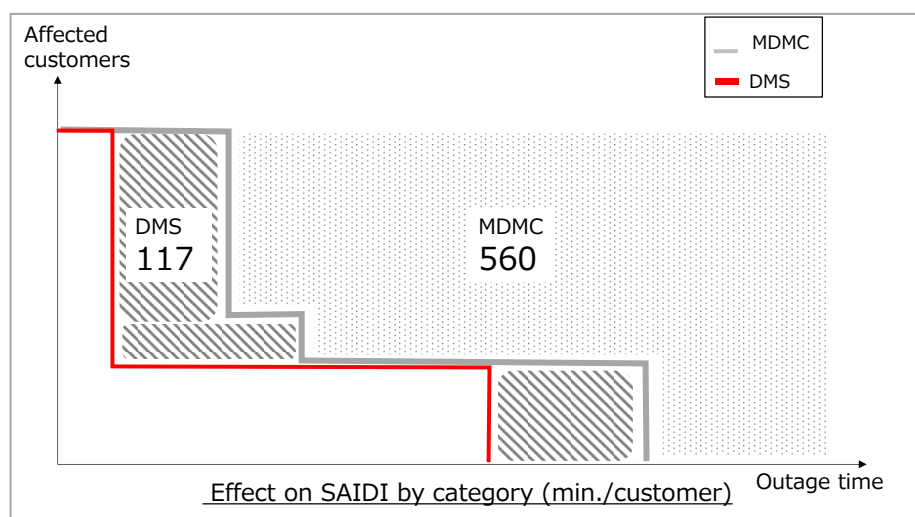


Figure 4-1 Improvement in SAIDI due to installation of DAS at pilot feeders

4.3. Expected Opportunities in Business

Because Japanese DAS has both superior performance and originality, and is an overseas export of sophisticated electric power infrastructure which the government promotes, it is expected to be a promising system in the market. In addition, with the introduction of Japanese DAS, it is expected that Japanese vendors will gain opportunities to enter the market for systems surrounding SCADA, such as Meter Data Management Systems for smart meters and load management, and that this will lead to sales in related software such as distribution network planning software. In this way, DAS will provide continuous business opportunities for Japanese vendors.

4.4. Business Development Plan

The program team promotes DAS installation such as distribution network planning support and operation training. The next step is to install the DAS at one EVN HANOI branch office on a pilot basis, and the pilot site is expected to be specified by EVN HANOI. Based on discussions

with EVN HANOI, we will first target overhead distribution feeders because the construction is relatively affordable. After that, we will move on to underground distribution feeders and other distribution companies in Vietnam.

Step 1 (Implemented in this program):

First, the program team will conduct distribution network planning for EVN HANOI pilot feeders and promote the effectiveness of the proposed distribution system based on its economic and technical advantages. After gaining the understanding of EVN HANOI, the proposed system is constructed and its outcome evaluated. We will promote the proposed system to other companies based on the benefits seen in the pilot project. From these activities, we will develop a route for Japanese technology to expand in the region.

Step 2:

Based on the pilot model established in Step 1, we aim to introduce Japanese power distribution systems to specific areas where relatively high power reliability is required, such as commercial and industrial districts. On this basis, we will aim to deploy Japanese distribution systems across the whole EVN HANOI area. In addition, the program team will aim to secure direct contracts with EVN HANOI for DSS sales and consulting services for advanced management improvements using a combination of IT systems (SCADA, DMS) and OT.

4.5. Business Targets

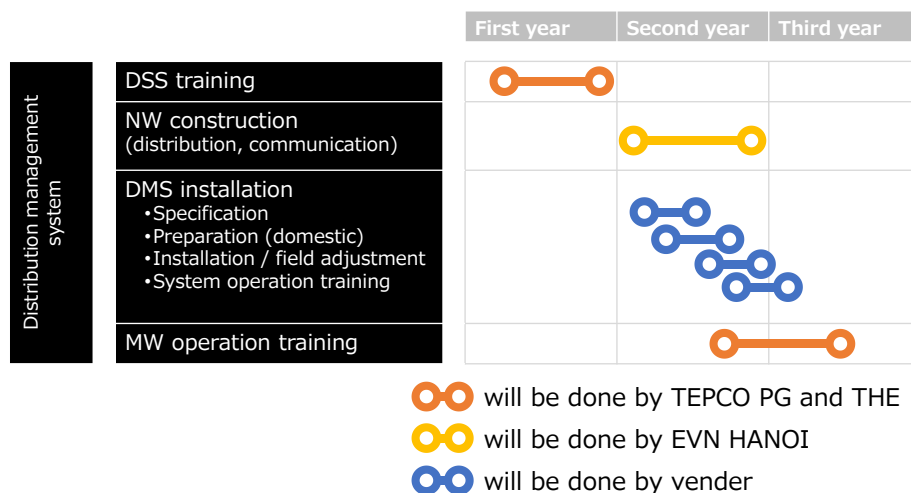
The program team will focus on working with EVN HANOI for the time being, but after obtaining positive results in the pilot project, we will proceed with development in other areas of Vietnam. The program team's focus will then spread to neighboring countries with the aim of Japan's system becoming the standard in Southeast Asia.

4.6. Business Implementation Structure

Together with the deployment of TEPCO PG and the DAS supplier, the program team will establish a system which responds to customers' needs in hardware and software. Based on this scenario, the program team expects to gain the trust of our potential clients.

4.7. Business Development Schedule

The future schedule is as shown in the figure below.



Source: Program team

Figure 4-2 Business deployment schedule

4.8. Business Development Estimations at Current Stage

DAS installation is implemented, support for system planning and operation training. The next step will be DAS installation at one of EVN HANOI's sales offices. The target sales office is to be assigned by EVN HANOI later. During the first stage, an overhead area where the MDMC system can be easily adopted will be the target area for installing DAS, and DAS will be installed in an underground area during the second stage.

Because EVN HANOI expressed the intention to adopt the Japanese MDMC system in both overhead and underground distribution systems, it is expected that EVN HANOI recognizes the benefits of Japanese distribution systems.

4.9. Remaining Issues and Countermeasures

The DAS is not only necessary for coordination with other existing systems, but it also has many other functions, so it was found that the initial investment is higher than for other European and US-manufactured products. Therefore, Japanese suppliers need to focus on further efforts and improvements. For this reason, although the advantages are well understood, there is a risk that the Japanese DAS will not be adopted as a standard for EVN HANOI, or that its introduction will be delayed. From now on, it seems it will be necessary to provide an affordable DAS which meets EVN HANOI's required functions and price range.

4.10. Possibility of ODA

Basically, the program team is planning to develop the business based on EVN HANOI's budget. Providing the proposed DAS and its operation know-how will enable optimum use of the budget, which it is thought will lead to more effective use of an ODA loan project (sector loan). In addition, if the idea of the network design, its operation method and the system become standard in the target countries for ODA loans, it will become easier to promote Japanese equipment and materials, and provide support for the introduction of Japanese products.