Capacity Building task for Smart Grid in City Subdivision of Panipat

August, 2016

THE Power Grid Solution, Ltd.

1. THE, Who We Are ?

Integrate Hitachi's system solutions with TEPCO's expertise

Hitachi × TEPCO

IT **Providing Information Technology Know-how**

OT **Providing Operational Technology Know-how**

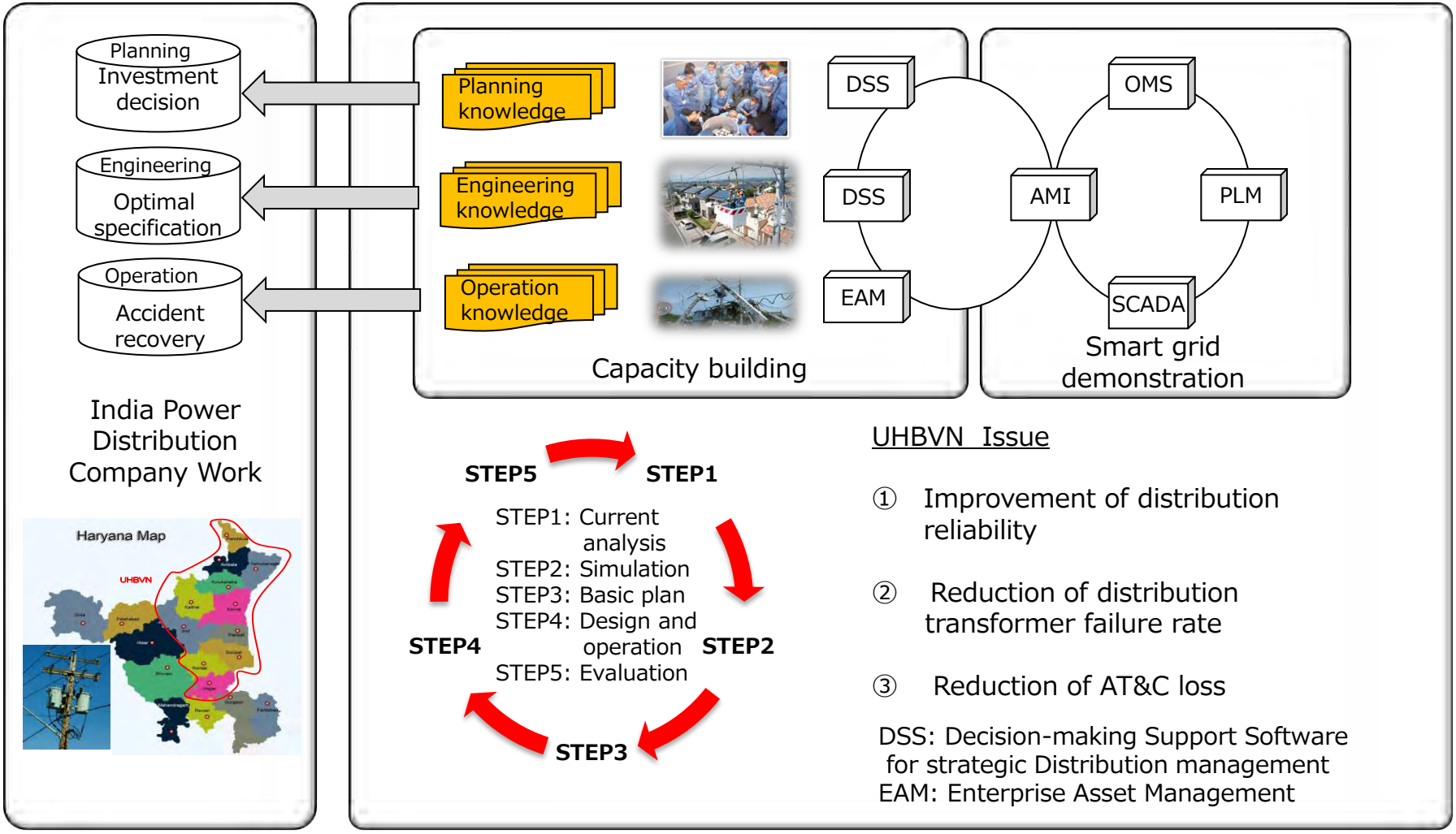
Collaboration

THE Power Grid Solution

- Collaborative Innovation for Energy Supply and Demand
- Generating Smart Energy Systems and Operations

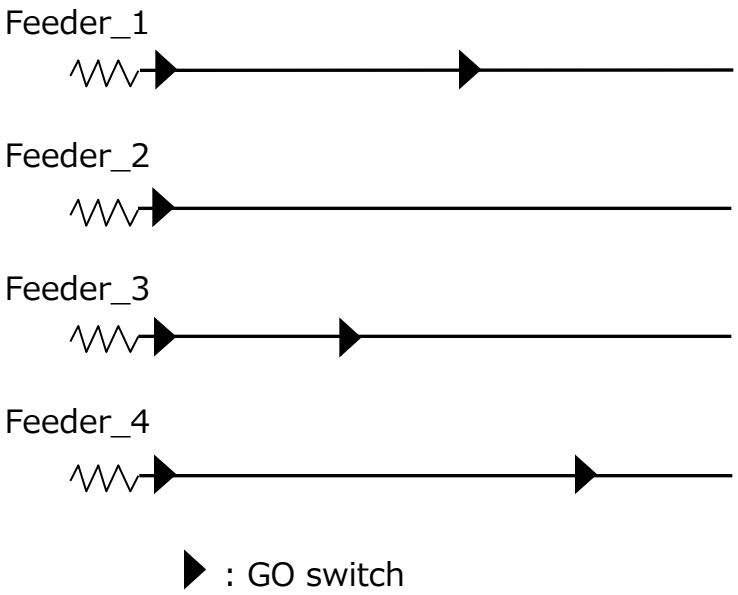
2. Capacity building structure

This article is based on results obtained from a project commissioned by the New Energy and Industrial Technology Development Organization (NEDO).

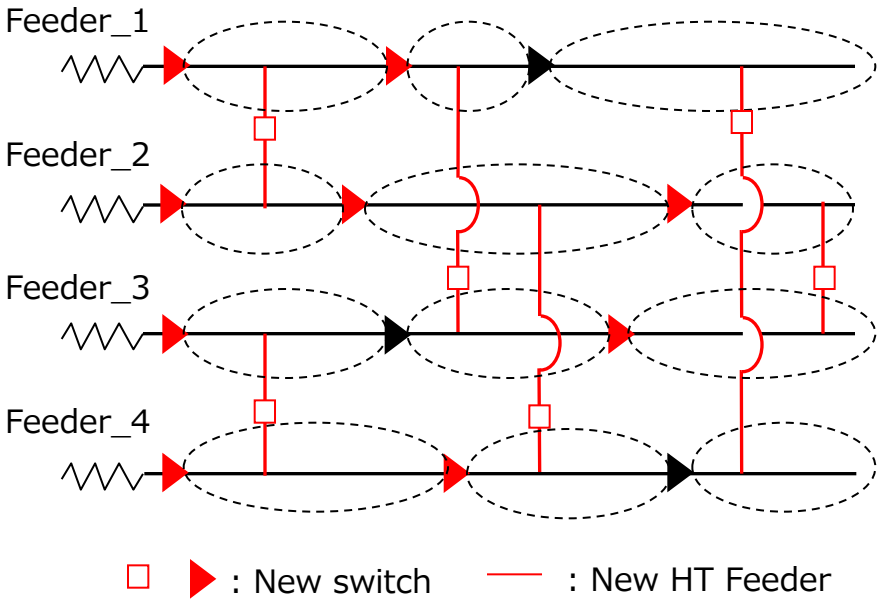


3-1. Capacity building plan for Distribution reliability improvement

Capacity building plan about distribution reliability improvement is installation of **Multi divided and multi connected distribution network with DSS analysis for distribution network management.**



UHBVN current network



Multi divided and multi connected distribution network

3-2. Distribution Reliability improvement
Training for Multi divided and multi connected network operation

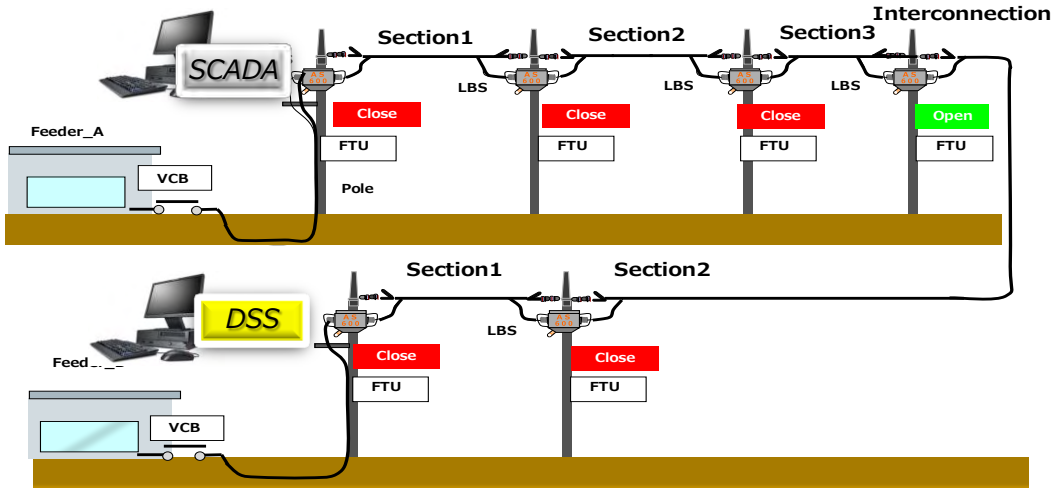
Training of operation use case on Multi divided and multi-connected network in Haryana Power Training Institute(HPTI)

① Fault restoration method on Multi-divided and multi-connected network

② Construction outage work operation on Multi-divided and multi-connected network

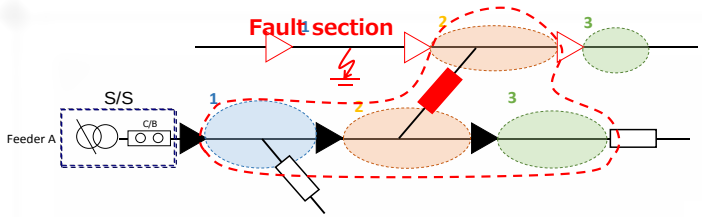
③ System operation method (SCADA, DSS) on Multi-divided and multi-connected network

Haryana Power Training Institute



Training instrument for local switch operation

SCADA: Supervisory Control And Data Acquisition
DSS: Decision-making Support Software for strategic distribution management



[Network Concept]
Condition: Each section's load rate is same.
This network can provide very high supply reliability with ensuring the excess capacity of a feeder for 1 extra section.
⇒ To design a feeder so as to make operation rate in case of fault up to 100%. This means the limitation of operation rate in normal case has to be 75% approximately.

THE Power Grid Solution

3-3. Distribution reliability improvement
System configuration of Multi divided and multi connected network

Planning & Operation Analysis for distribution network management about distribution reliability improvement

Planning
Investment decision

Engineering
Optimal specification

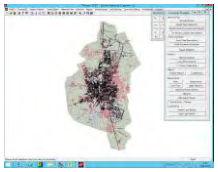
Operation
Accident recovery

India Power Distribution Company Work

Knowledge of Distribution reliability improvement

1. Design concept of Multi divided and multi connected distribution network
2. Normal Operation of Multi divided and multi connected distribution network
3. Switch placement of Multi divided and multi connected distribution network by DSS function
4. Fault operation of Multi divided and multi connected distribution network by DSS function
5. Planned construction outage operation of Multi divided and multi connected distribution network
6. Safety operation

DSS



- Network reconfiguration for loss reduction & load balancing
- Fault /Planned outage restoration procedure

CSV file

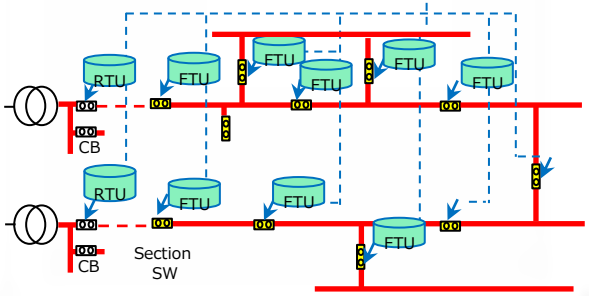
SCADA

- Voltage
- Current
- Active Power
- Reactive Power
- Frequency

Shape file

GIS

Asset Data1 | Asset Data2 | Asset Data3



SCADA: Supervisory Control And Data Acquisition
DSS: Decision-making Support Software for strategic Distribution management
GIS: Geographic Information System

THE Power Grid Solution

4-1. Reduction of distribution transformer failure rate
Work shop for fault cause analysis & repair & mending

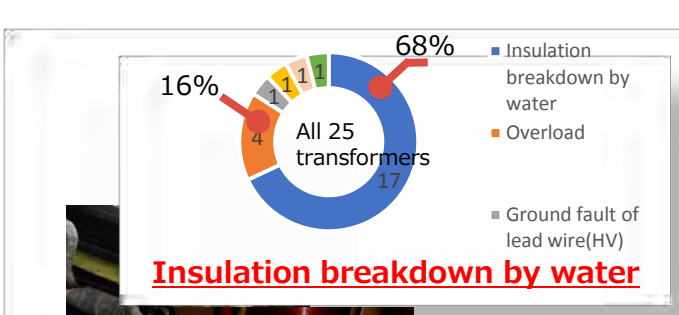
Work shop contents

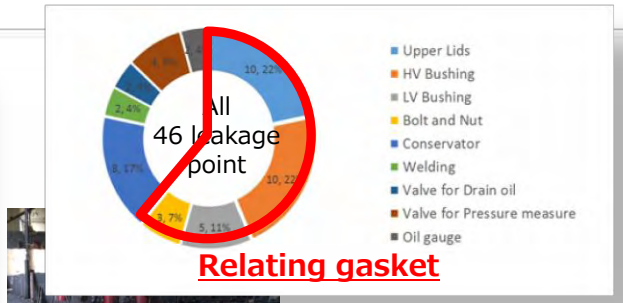
STEP1: Fault Cause Analysis
Diagnosis points are ①Trace of water on the bushing, ②Joint of packing and ③Gap by deformation of the box. By fault cause analysis, main fault cause is insulation breakdown by water penetration to inside of DT.

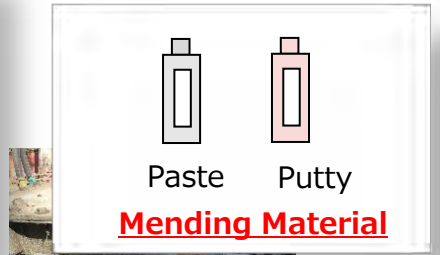
STEP2: Repair Point Analysis
By leakage test with air compressor, main leakage points was gasket parts. Leakage points are judged by bubbling of soup water test material of leakage test.

STEP3: Mending
Implementation of mending to leakage points which are focused on LV bushing connection points with mending material, which are paste and putty.

Transformer Repair Work shop







STEP1
Fault Cause Analysis

STEP2
Repair Point Analysis

STEP3
Mending

THE Power Grid Solution

4-2. Reduction of distribution transformer failure rate Demonstration for DT maintenance with load analysis by DT's AMR

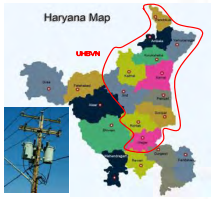
Planning & Operation Analysis for distribution network management about reduction of distribution transformer failure rate

Planning
Investment decision

Engineering
Optimal specification

Operation
Accident recovery

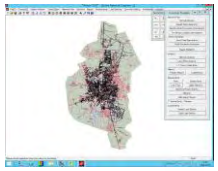
India Power Distribution Company Work



Knowledge of DT Failure improvement

1. Preventive maintenance of DT periodical site patrol work
2. Preventive maintenance of DT periodical inspection work
3. Preventive maintenance of DT mending work
4. Basic concept of DT repair work
5. DT repair work about reuse
6. DT repair work about sealing gasket
7. DT repair work about sealing gasket
8. DT repair work about airtight test

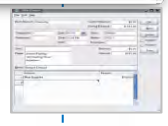
DSS



- Distribution transformer load usage rate
- Overload distribution transformer list

CSV file

MDMS

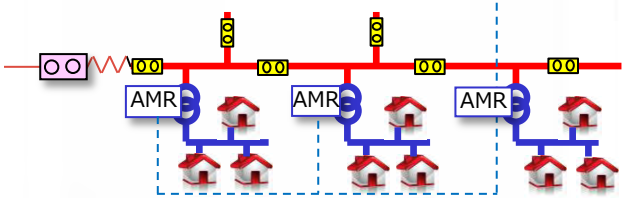


- Active Power
- Reactive Power

Shape file

GIS

Asset Data1 | Asset Data2 | Asset Data3



MDMS: Meter Data Management System
DSS: Decision-making Support Software for strategic Distribution management
GIS: Geographic Information System

THE Power Grid Solution

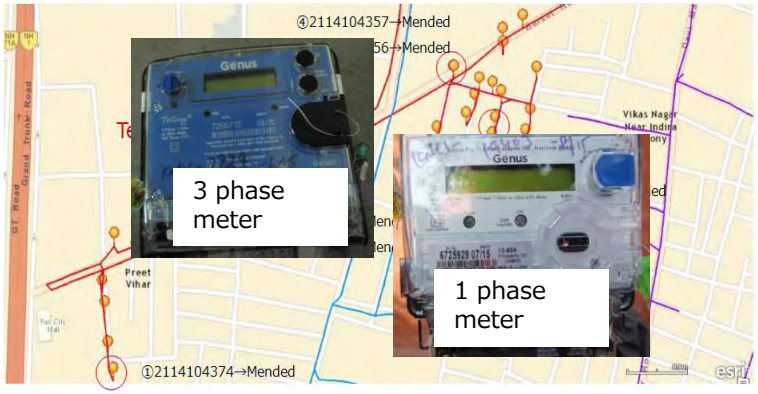
5-1. Reduction of AT&C loss
Consumer load analysis by gathering of existing digital meter data

Consumer load analysis

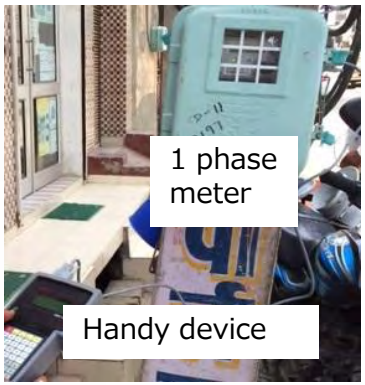
STEP1: Data gathering by handy meter reader device
Local engineer get consumer load data from each digital meter under DTs of demonstration camp feeder by handy meter reader.

STEP2: Data exchange by PC
IT engineer exchange data from handy device to PC, and create Excel format of consumer load data.

STEP3: Consumer data analysis
Analysis of all categories of consumers load trend(e.g. Domestic, None domestic consumer etc.)

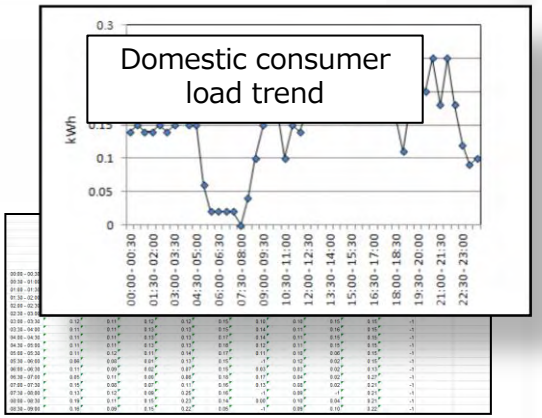


Exisiting digital meter under demonstration feeder



STEP1
Meter Data gathering by handy device

STEP2
Data exchange by PC



STEP3
Consumer data analysis

5-2. Reduction of AT&C loss
None technical loss reduction by smart meter solution with DSS

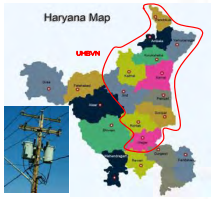
Planning & Operation Analysis for distribution network management about reduction of distribution transformer failure rate

Planning
Investment decision

Engineering
Optimal specification

Operation
Accident recovery

India Power Distribution Company Work



Knowledge of AT&C loss improvement

1. General information about distribution loss
2. HT loss reduction solution
   - 2.1 DSS HT loss calculation
   - 2.2 HT Loss reduction countermeasure
3. LT loss reduction solution
   - 3.1 DSS LT loss calculation
   - 3.2 LT Loss reduction countermeasure

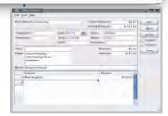
DSS

- LT line none technical loss including theft volume
- LT line none technical loss including theft rate

CSV file

- Active Power
- Reactive Power

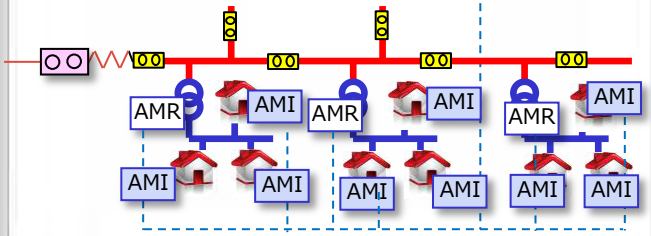
MDMS



Shape file

GIS

Asset Data1 | Asset Data2 | Asset Data3



MDMS: Meter Data Management System
DSS: Decision-making Support Software for strategic Distribution management
GIS: Geographic Information System

THE Power Grid Solution

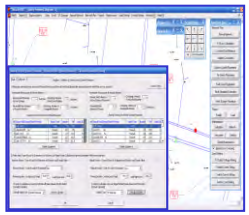
A1. Optimal PV installation
PV installation based on Japanese experience

Problem of PV installation

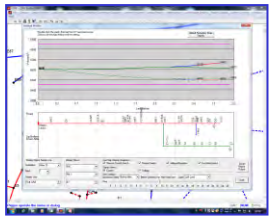
① Maintenance of distribution network voltage quality
② Calculation of PV installation permission capacity
③ Demand forecast of PV generation

Countermeasure for PV installation problem

Japanese distribution utility utilize two kinds of analysis tool, “Planning DSS” and “Analysis DSS”.

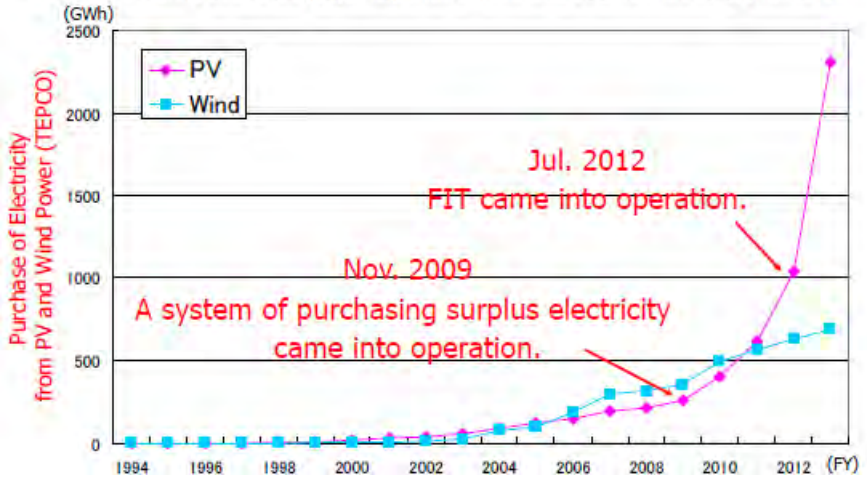


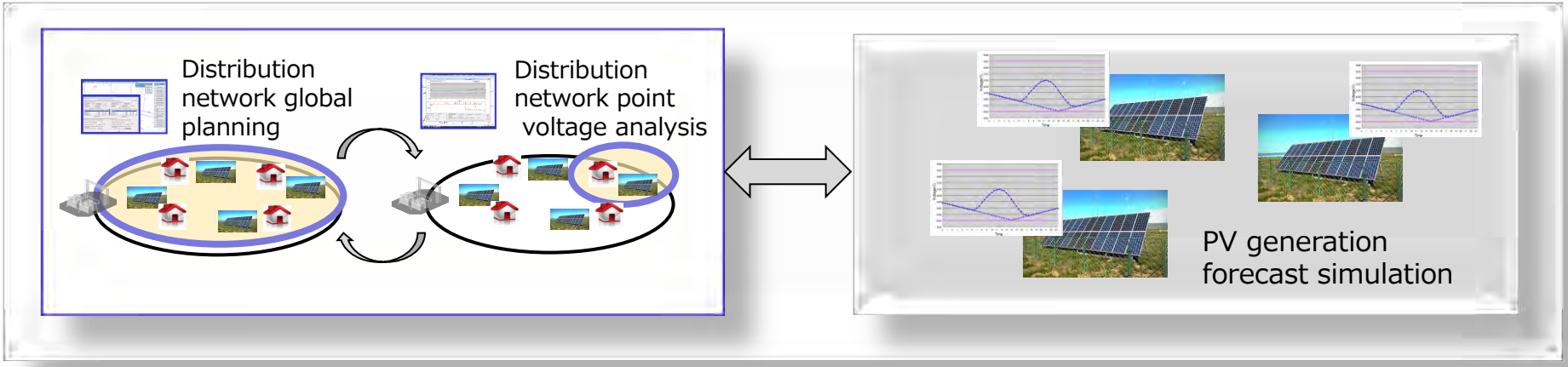
Network Planning DSS



Distribution Generation Analysis DSS

In Japan, the number of the applications of PV connection to the grid has been increasing drastically, quality management becomes more significant.





DSS: Decision-making Support Software for strategic Distribution management

A2. Optimal PV installation
Countermeasure of PV problem based on Japanese experience

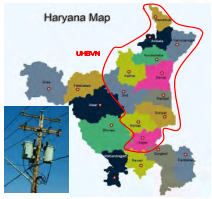
Planning & Operation Analysis for distribution network management about optimal PV installation

Planning
Investment decision

Engineering
Optimal specification

Operation
Accident recovery

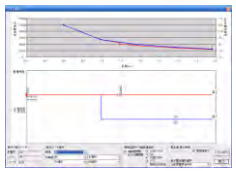
India Power Distribution Company Work



Knowledge for Optimal PV installation

1. Distribution generation demand forecast
2. Investigation of reverse power flow
3. Network configuration that assumed PV introduction
   - ・Distribution line thickening
   - ・Timing of facility investment
   - ・Increasing of allowable current

DSS



- ・Analysis of allowable distributed generation capacity
- ・Calculation of voltage fluctuation

CSV file

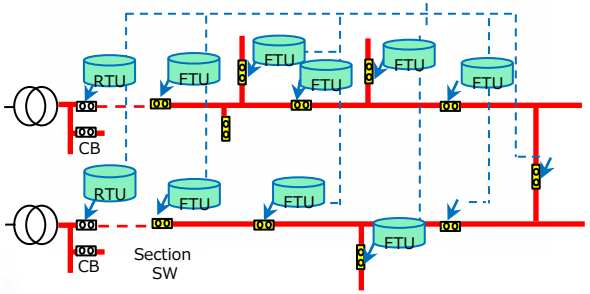
SCADA

- ・Voltage
- ・Current
- ・Active Power
- ・Reactive Power
- ・Frequency

Shape file

GIS

Asset Data1 | Asset Data2 | Asset Data3



SCADA: Supervisory Control And Data Acquisition
DSS: Decision-making Support Software for strategic Distribution management
GIS: Geographic Information System

THE Power Grid Solution

THE Power Grid Solution