INTELLIGENT DISTRIBUTION AUTOMATION SYSTEM IMPLEMENTATION TOWARDS MODERN UTILITY MANAGEMENT

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ABSTRACT

Implementation of automation technology in the operation of distribution system equipment is one of the ways to improve performance of reliability of supply, especially in increasing the speed of reaction at the time of outages and decreasing the duration of outages. However, implementation of distribution automation system may not show the expected results because of several obstacles such as communication problems, equipment damage and operations that are not fully integrated. In the current distribution automation system operation, more than 80% remote operational failures caused by communication failures and 15% due to damage to equipment. The system design a system which is not fully integrated causing operation manuever done manually and requires a long time so the utility can not provide prime reliability of power supply to customers. In order to improve reliability of power supply, an Intelligent Distribution Automation System (DAS) has been implemented with improvements in communications systems and equipment, and upgrades to full system integration, so the electric utility can remotely monitor, manage, coordinate and operate distribution components, in a real-time mode from remote locations.

This paper describes the implementation intelligent distribution automation system (IDAS) in Semarang distribution system in order to improve reliability of power supply in the area and have been researching towards modern utility management projects of FLISR. The activities include design, implementation, instalation of and testing of IDAS Master station and application system, distribution system equipment and communication system, and also integration with current SCADA and DAS system. ***The implementation of new IDAS system covers distribution equipment in 6 substations, 18 distribution feeders, and 62 keypoints****. In the early stages, the implementation of the IDAS system has already shown good results with contribution on reduction level of the SAIDI and improvements in the speed of reaction at the time of outages.*

INTRODUCTION

IDAS (Intelligence Distribution Automation System) is a Korea technology SCADA system which is now implemented in Indonesia and also the third generation of Distribution Automation System in Korea. For the whole countries in the world, Indonesia is the first country that is implementing IDAS system. Before IDAS system, DCC Semarang also have Korean Technology such as DAS (Distribution Automation System) which is the second generation.

In order to reduce the losses of electricity distribution system in Semarang and to monitor electricity system which is have to be real-time monitoring system, IDAS is the complete system that have those features. As the basic of SCADA system, controlling remote device is a must because it is removing manual operation to provide a reliability of distribution system.

The good thing in IDAS is FLISR feature. FLISR means Fault Location Isolation and Service Restoration by providing accurate information for dispatcher. FLISR is a subsystem of a centralized DMS (Distribution Management System). This architecture leverages the existing role of the DMS as a repository for network related data such as connectivity, equipment ratings and historical local records. can know which section in distribution system is fault even this system can predict which section is going to be fault. After section is founded, system isolates the fault in network distribution, to decrease outage in bigger areas. Service Restoration provides an analyzation to dispatcher which solution to be implemented.

DISTRIBUTION OVERVIEW

Today, in distribution system planning, increasing attention is being paid to improve customer service reliability.
In a distribution system large number of equipments are installed. Power supply covers industrial, commercial, residential and agricultural consumers. Hence, considerable amount of labour and expense are needed for monitoring and operation of distribution network. Several studies on utility experience suggest that customer satisfaction is closely related with frequency of service interruption and duration of service interruption. On the other hand, utilities are also facing some difficulties due to which they are not able to fulfill the requirement of consumers.

Distribution automation (DA) is a tool used to benefit the consumer as well as utility. DA refers to automation of repetitive tasks on the electric utility distribution system. This definition therefore includes any automation used for distribution and distributed energy resources equipment in substation, along feeders, in distribution networks, and up to the end-user including the meter. Distribution automation thus includes all equipment, communication, as well as the

data and software application needed to utilize, operate and manage the automation.

In DA system, normally closed sectionalizing switches (SSs) and normally open route switches (RSs) are used to automate the distribution feeder functions. These switches restrict the extent of disruption caused by long power interruption when properly positioned. Current transformer and voltage transformers are mounted in each section. The status of load break switches, SS, RS and RMS values and phase angle of section current and voltage are made available from pole top remote terminal unit to substation remote terminal unit (RTU). Avail-ability of this information at substation RTU greatly helps in location of faults in distribution system. Proposed symbolic method is developed using above information. The complete analysis is carried out on these substation feeders. Number of sectionalizing switches is determined so as to minimize the cost of outage. Sectionalizing switches and route switches are remotely operated switches, the status of which can be continuously monitored by sub-station personal computer.

In Semarang, Distribution Automation has been implemented in 2007. This system which known as DAS was the first project that implemented in Indonesia especially Semarang. At that time this system only covering a small area and limited function such as remotely monitor and control breakers and switches on distribution network in real-time covering the distribution substation. It also can support the optimal network operation such as fault processing, loss minimization and load balancing. And the over time, there were many problems with this system such as frequently failure communication, some hardware was damage beside the limited function of this system and the other hand demand the increasing of network service with an automated system has to be fulfilled.
Therefore, the DAS project was developed and enhanced with some additional features. Recently in 2010 the new Distribution System has been successfully implemented and already work well.

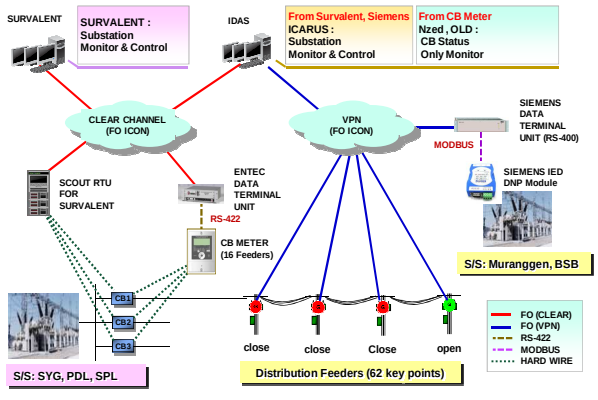

Fig 1 Communication Network

Fig. 1 shows the communication network in Semarang Distribution Control Centre. There are distribution feeders includes 62 keypoints connected through route by VPN ICON provide the link communication into a Master Station IDAS. The complete analysis is carried out on these substation feeders. Number of sectionalizing switches is determined so as to minimize the cost of outage. Sectionalizing switches and route switches are remotely operated switches, the status of which can be continuously monitored by sub-station personal computer.

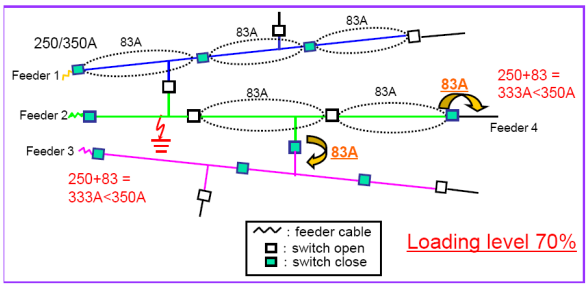

Fig. 2 Automated Distribution System Network

In Semarang distribution consists with 3 phase line and 1 neutral line (3 phases 4 wires). The feeder standars of switch installation is 3 section 2 links. Because of the minimum for FLISR is 3 sections 2 tie, for optimal IDAS operation it need to expand the number of keypoints. 4 section 3 tie or 6 sections 3 tie is better than 3 sections 2 tie. The number is recommended to increase the high network performance.. As shown by Fig 2, the number of links in each feeder should be 3 with the normal capacity is 280 A and emergency capacity is 400 A. The effect of this feeder segmentation is about recovery rate and reliability. It can increase loading level means that the configuration can improve the performance of fault recovering and service restoration.

FUNCTION OF IDAS

The basic functions of IDAS are mostly similar with DAS such as controlling, monitoring, measuring and setting parameters of keypoint device. The main difference are function of FLISR, diagnosing monitoring, power quality monitoring, power ouotage management and micro grid which is become to be smart grid technology. The IDAS features also can remote operation of facilities from substation to customer, management of medium voltage and low voltage networks on GIS, online data acquisition of distribution facilities with deterioration detection sensor, Network optimal operation program for loss minimization, load balancing, voltage and VAR control.

According to the LBS/Recloser protection setting, there are some suggestion about outgoing Circuit Breaker and Recloser. Instantaneous trip setting of outgoing CB should be higher than maximum fault current of Recloser. And then TC-Curve type must be set as a same type. Beside, in between two reclosers, recloser 1 high set setting higher than maximum fault current at the other one recloser

position. If recloser use fast curve, the reclosing success ratio will be increased dramatically. Recloser should be operated in the normal close point.

FAULT RECOVERY

This section describes how IDAS to find the fault and the procedure to recover the fault

Knowing Fault On System

When fault happened in a network, dispatcher has to define what kind of fault whether it is single fault or multiple fault. This fault can be sensed on HMI by:

- Alarm/Event is generated by receiving the information of CB trip or F1 (feeder 1)
- Single line diagram of fault feeder is displayed immediately with topology.
- The information of fault indicator and fault current be displayed in SLD. Faulty section is displayed automatically CB/Switch colour is changed in distribution network.
- Operator know the linked feeder and power margin capacity.
- Operator can commands to control the keypoints remotely for load transfer by the application program.
- After repair by crew, operator commands to restore for original feeder by application operator.

Fault Recovery Flowchart

This flowchart describes how dispatcher of DCC should implement to recover the fault.

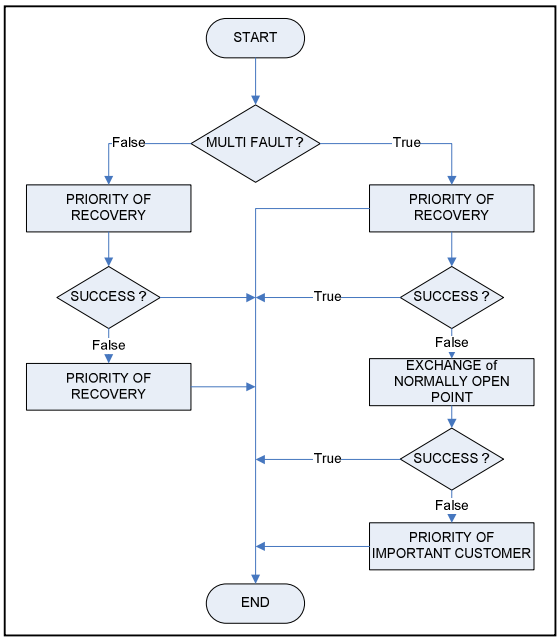

Fig 3 Fault Recovery Flowchart

Single Point Fault

Fault recovery system is handled by find the candidates for FLISR solution. FLISR solution uses six types basic of pattern by seeing this information such as: Maximum feeder loading capacity, Voltage drop limitation, Prohibit of loop operation. Furthermore, system finds the optimal FLISR solutions by using fuzzy logic by considering Load balancing in each section, Minimization switching numbers and the constraint of load transfer of healthy section. When this method is not enough to recover the fault, then system makes priority restoration of important customers.

Multi Fault Process

Faults at several points at a same time by typhoon or flood. This outage is maybe caused by medium voltage transformation (trafo) trip. This fault can be recovered by three solutions in step by step. First, selecting a priority fault recovery by using estimation of overlapped tie feeder. Second, calculating the optimal for load balancing of overload occurrence. When all solutions mentioned above is not enough, system makes priority restoration of important customers. Figure 4 describes an example of multi fault happened

First Dispatchers have to isolate the area, so the outage does not have wider area impact then dispatchers make priority which section has priority customer such as, Industrial factories or Government.

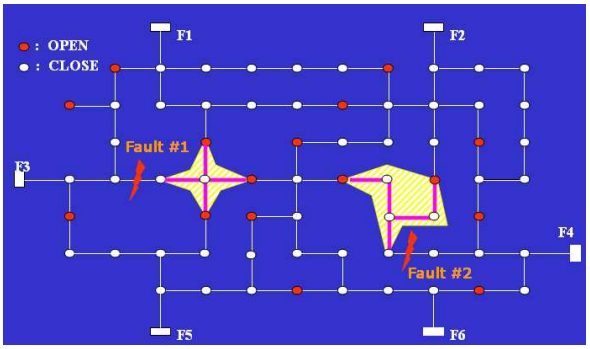

Fig 4 Example of Fault Isolation Diagram

When fault happened, a tie feeder automatically supplies the line until find the normally open LBS found. Therefore, there are two ways to reduce outage area in distribution network. The first way is dispatchers have to open LBS by remote system and accurate information should be provided. The second way, remote device senses current, voltage and frequency between normal line and fault line. If the normal line can supply normally on fault line then the remote device (LBS) open or close automatically. Figure 5 represents tie feeder supplies the fault line.

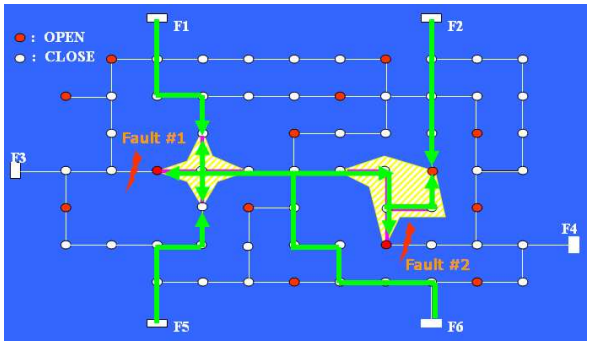

Fig 5 Example of Fault Recovery Diagram

The second way is difficult to be implemented in Semarang. The current and voltage between each section is different, it depends on the protection coordination in each feeder. Each feeder has unbalanced current between three phases line so if the automation happened, it will take a big risk to each feeder, because of switching process happened in the section that each source feeder has different protection coordination.

The risk is very high if protection setting is not set to accurate enough, therefore so many faults will be happened and even incoming feeder medium transformer (150 KV) may also can to be trip. PLN Semarang does not this happened and so on, the automation switch of remote device (LBS/Recloser) is to be shutdown for safety reason and to avoid wider area outage.

CONCLUSION

In this paper, an algorithm based on the IDAS DMS 600 configuration that have been suggested for solving the service restoration problem in our distribution system. The algorithm has been developed to guide the sequence of operation required for correct fault location and isolation. Further the procedure allows to overcome the present limitation in the maximum number of telecontrolled switch breakers that can be used in the same feeder in order to perform fault location and isolation procedures, thus reducing the extension of the isolated faulted area.

From the technical viewpoint, the benefits deriving from the implementation of the DMS 600 by IDAS are outage section and outage current easy to identify, facilitate distribution system operation, saving operational cost. The method proposed would be significant for the distribution operator. In fact the procedure allows to drastically reduce the time required by fault location since the isolation of the faulted feeder section would be done.

In other side, when this system is implemented in Semarang, we found some difficulties to improve the performance of this system it self such as frequently failure communication and difficult to adapt a new brand remote device which is not associated in IDAS system.

A good news when this system is applied in Semarang, we found that IDAS system is already in line with smart grid which is includes an intelligent monitoring system that keeps track of all electricity flowing in the system. and we know that this system is made possible by applying sensing, measurement and control devices.

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