

Automatic Transfer Scheme (ATS) Experience in Tenaga Nasional Berhad Distribution Negeri Perak

By: *Engr. Mohd. Hashimi bin Hashim*, *MIEM, P.Eng.*, *Engr. Megat Ahmad Fauzi bin Megat Rasidin*, *Grad. IEM* and *Sahari bin Adullah*

1.0 Abstract

Electricity is distributed to most large power/important consumers via, at least, two feeders of underground/overhead cables. Generally, the main cable is operational while the other is on standby as backup with the bus-section CLOSE. Other configurations such as having both incomers CLOSE and the bus-section OPEN, and no bus-section are also practised. In the event of a fault in the main cable, the switch to transfer load to the backup cable will be done either manually or remotely via control centres. The process might take anywhere from one hour or longer especially during peak hours or night time.

Automatic Transfer Scheme (ATS) is designed to perform safely the automatic switching to minimise interruption down to approximately 1 sec or faster. Remedial work on the faulty cable or equipment can be done at a later time. System normalisation is designed to be done manually.

2.0 Why We Need ATS

The function of ATS is to economically minimise unavoidable supply interruption to the customer. It is a new enhancement of assets by utilising the latest state-of-the-art protection technology. ATS will improve SAIDI and, at the same time, improve the level of customer satisfaction.

3.0 The Benefits of ATS

It will benefit Large Power Consumers (LPCs) with at least two incoming feeders, with or without the bus-section. TNB's important SSUs are not operated in parallel due to system constraints such as the incoming supply comes from two different type of transformers. Transformers with different voltages, impedance, vector group, phase rotation and capacity cannot operate in parallel.

ATS provides fast supply restoration in the event of an incomer fault and improves protection, with protection against busbar fault and downstream breaker failure backup protection. In the event of busbar

fault and downstream fault, ATS will not operate, thus preventing closing on fault and avoiding potentially serious damage to the equipment installed.

Valuable data can be obtained from the relay using built-in recorders in Sequential Events Recorder (SER) and Event Reports (ER).

The ATS system with SCADA-ready for remote control, and system monitoring and built-in metering, function as a reference in the event of an energy meter failure and as a power management facility. This is a potential cost savings if compared with other redundancy methods to achieve higher reliability.

ATS can also optimise the utilisation of manpower and optimise the operational cost. It can be implemented in the existing control panel area of the incoming breaker panel and no extra box is required.

In Perak, two substations have been successfully installed with the ATS system:

- i. SSU Balairong Seri, Kuala Kangsar
- ii. SSU SUK Negeri Perak, Ipoh

4.0 Technical Explanation

The protection scheme for a power system should protect the whole system against all probable types of fault.

Unrestricted forms of feeder protection such as overcurrent relays meet this requirement, although faults in the busbar zone are cleared only after some delay. High fault current levels are characteristic of distribution buses, and if these are faulty, they should be isolated quickly.

Traditionally, IDMT OCEF relays at the incomer are used as backup for busbar protection. However, these relays at the incomer to a distribution bus have a relatively long fault clearing time compared with a typical busbar protection scheme.

This proposal is designed to enhance the protection available at the incomers by retrofitting the relays installed and replacing them with the Directional Overcurrent and Earth Fault relays, SEL-351A. The same relay can be programmed to operate the ATS.

ATS should be implemented to ensure that consumers connected to a particular substation experiences minimal supply interruption during fault. This scheme uses the logic where two out of three combinations of the switchgears – Incomer 1, Bus section or Incomer 2 – will be on.

5.0 Configuration of ATS at SSU Balairong Seri, Kuala Kangsar

An ATS model applied at the PE Balairong Seri uses a logic scheme where two out of

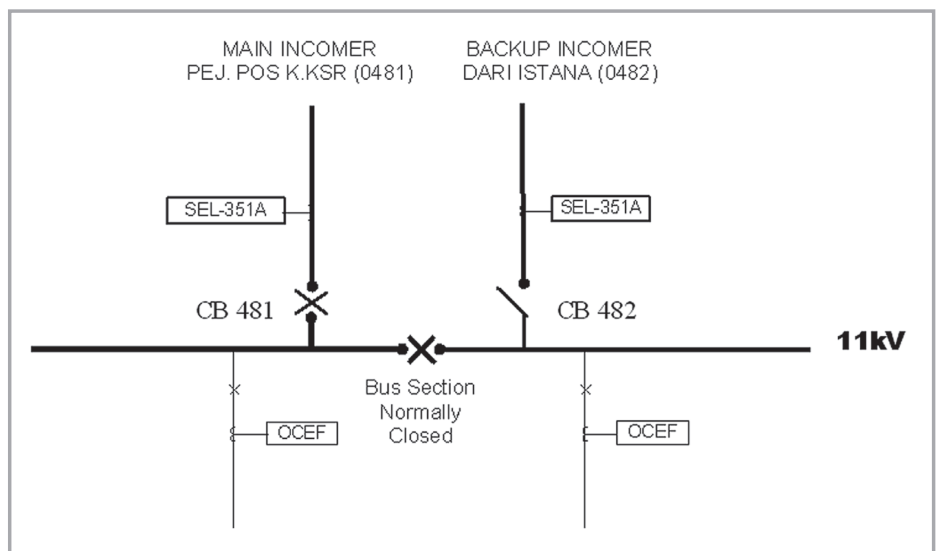


Diagram 1: Schematic Diagram of SSU Balairong Seri, Kuala Kangsar



Above: The ATS indication light is on, showing that it is in operation.
 Below: ATS installation in SSU SUK Negeri Perak, Ipoh.

three combinations of the switchgears – either Incomer 1 or Incomer 2 – will be closed while the Bus section will remain closed in any event.

The SSU Balairong Seri, Kuala Kangsar normally operates with one incomer [PEJABAT POS K. KANGSAR (0481)] closed, the other incomer [DARI ISTANA (0482)] opened and the bus tie closed. The configuration is not interchangeable (refer to Diagram 1.0).

An incomer cable fault will be detected by the upstream OCEF relays. These relays will trip and clear the fault first because it is discriminated against the SEL-351A at the incomer.

5.1 Upon inception of the incomer cable fault:

At upstream, the OCEF protection detects the fault and begins to time. It should trip the breaker and clear the fault once its timer expires.

At the main incomer, the SEL-351A will not detect the fault or in the case of backfeed will trip slower than the upstream relay. If the SEL-351A detects the current fault, then it will operate IDMT trip to the breaker (In this case, ATS will not operate).

Once the upstream relay trips its breaker and disrupts supply, the SEL-351A would detect a loss of supply condition.

The SEL-351A would then initiate its Automatic Transfer Scheme (ATS) logic to restore supply to its consumers.

Tripping event at SSU Balairong Seri, Kuala Kangsar

	Date of tripping	Feeder Trip	Tripping Time	Interruption
1	03 Mar 2007 (Sat)	Main 11kV Incommer, 1K5	2037hrs	outage
2	18 April 2007 (Wed)	Main 11kV Incommer, 1K5	1223hrs	outage
ATS installed at SSU Balairong Seri, Kuala Kangsar on 12 May 2007				
3	10 Nov 2007 (Sat)	Main 11kV Incommer, 1K5	0610hrs <i>(ATS operated)</i>	Nil

***No tripping record at SSU Pejabat DUN incoming feeder*

The SEL-351A at the main incomer would open its breaker and initiate a signal to SEL-351A at the backup incomer in order to close its respective breaker. This would allow the healthy incomer to feed the load.

5.2 Upon inception of a busbar fault:

At the incomer, the OCEF protection detects the fault and begins to time. It will then operate and trip the breaker. At the outgoing feeder, the IDMT OCEF protection does not detect the fault.

Clearance of fault is through the SEL-351A relay at the incomer. Automatic Transfer Scheme (ATS) is disabled in the event of the SEL-351A operating on busbar fault.

5.3 Inception of a Downstream Fault

At the incomer, the SEL-351A relay will begin to time its IDMT element and trip the incomer if the outgoing feeder OCEF relay does not clear the fault. At the outgoing feeder, the IDMT OCEF protection detects the fault and begins to time.

It will then operate and trip the breaker first if the fault is sustained. The clearance of fault is through the outgoing feeder OCEF relay and the incomer is not tripped.

6.0 Alarm and Indication Signal

When an ATS is being operated, an alarm message stating ‘ATS OPERATED’ will be shown on the LCD front display panel of the SEL-351A Relay. The message can be reset by pressing the RESET pushbutton.

When the overcurrent and earth fault protection operates, the TRIP and LEDs will come on, as well as the LEDs for the phases involved in the fault. Besides the faulted phase LEDs coming on, the relay will also display ‘O/C OPERATED’ for Overcurrent Trip or ‘E/F OPERATED’ for Earth Fault Trip. Both messages and LEDs can be reset by pressing the RESET push button.

Meanwhile, the message ‘ATS ENABLED’ will be displayed on the LCD when the ATS selector switch is in the ON position with other ATS conditions

(Incomer Breaker closed, Incomer voltage healthy, Bus Tie Breaker closed and no VT fail), while the message ‘ATS OFF’ will be displayed when the switch is in the OFF position.

With this facility, identifying which type of faults uses the SEL-351A is made easier for the person reading the LEDs and the LCD display panel. In addition, two pilot lamps are installed to indicate when the ATS switch is in the ON position and when the ATS is in operation. A buzzer is also installed as an audio indication when the latter is in operation.

7.0 System Normalisation

The process to normalise the supply source from backup back to main feeder is designed to be done manually. This is to avoid a situation where the TNB cannot keep track of their systems off points.

8.0 Conclusion

The implementation of the ATS scheme in selected TNB distribution network substations will provide tremendous benefits and advantages in increasing supply reliability. The scheme is designed with personnel and equipment safety in mind.

The scheme is quick to implement and provide value for money, compared to implementing major infrastructure work to increase redundancy in the primary equipment. Since its inception in the TNB Perak distribution network, the ATS system has been operated once at SSU Balairong Seri. The affected customer did not experience any interruption in power.

Based on its success in Perak, the ATS system is suitable to be installed in distribution networks. Therefore, additional ATS systems can be implemented at other substations with multiple sources of supply. ■

REFERENCE

[1] Distribution Protection System, SEL Engineering Laboratories, SEL Solutions 2007.