CASE STUDY : Protection Co-ordination Study

CLIENT NAME : A Multinational company who is the project supplier

END CUSTOMER : Water Treatment Plant

PROJECT TITLE : Protection Co-ordination Study for a Water Treatment Plant

INTRODUCTION

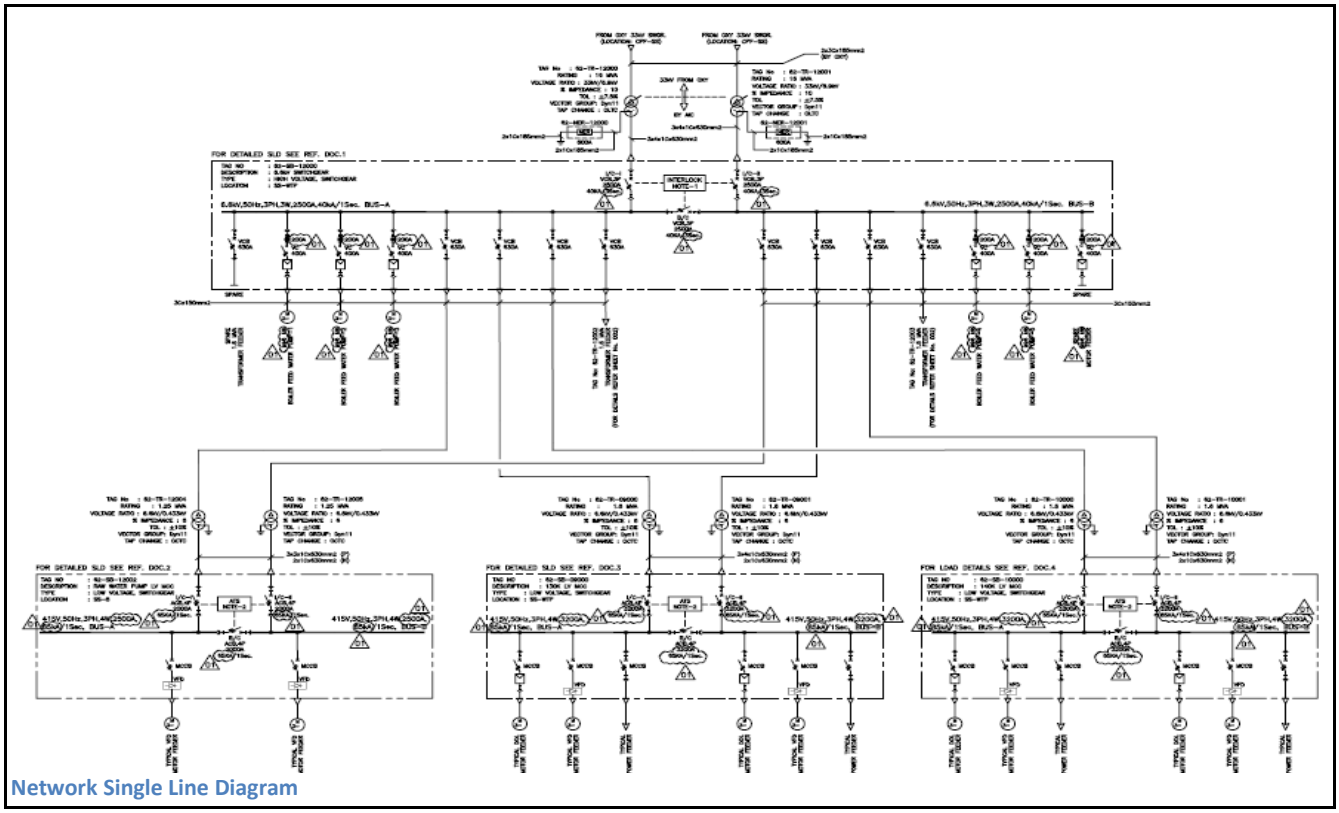
The primary function of protective devices in a power system is to detect short circuits and isolate the fault by activating the appropriate circuit interrupting devices, which increases the reliability and safety of the electrical system. The relay co-ordination study is required to select the protective devices and necessary settings so that circuit interrupter closest to the fault opens before other devices.

SCOPE OF WORK

Perform protective device co-ordination analysis for HV panels including 2 Nos HV incomer panel, 2 Nos 16 MVA, 33 kV/6.9 kV power transformer, 1 No bus coupler, 8 Nos +1 spare distribution transformers (including LV side breaker of the transformers), 5 +1 spare motor feeders etc and provide results and recommendations as required by the specification and client.

NETWORK DETAILS

Network was represented from 33 kV to last relay location at LV side. The Single Line Diagram is shown in the following figure.



Network Single Line Diagram

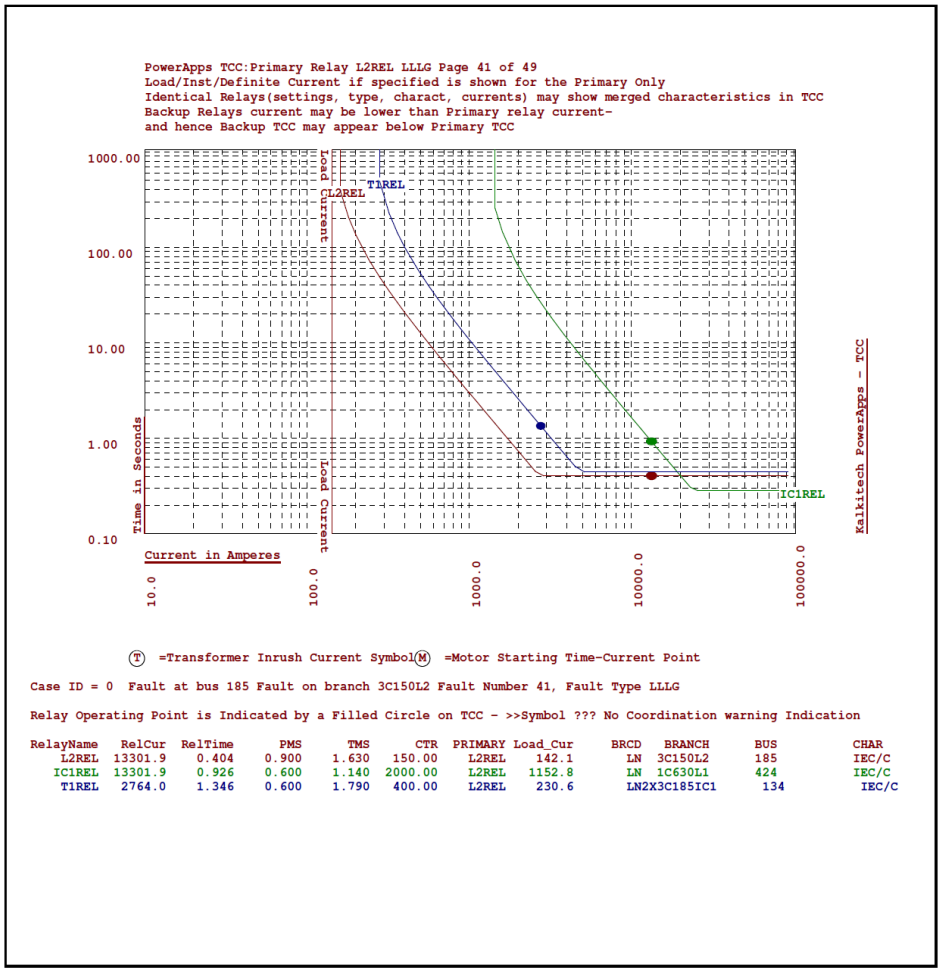
- The incomer transformer panel is equipped with a SEPAM 80 Series relay for integrated transformer protections as follows,
    - 46- Unbalanced load protection relay
    - 50-Instantaneous Over Current Relay
    - 50N-Instantaneous Earth Fault Relay
    - 51- Time Delayed Over Current Relay
    - 51N-Time Delayed Earth Fault Relay
    - 64REF-Restricted Earth Fault Relay
    - 87T Transformer Differential Protection Relay

- The 6.6kV Motor feeders are equipped with a SEPAM 80 Series relay for integrated motor protections as follows
    - 12- Over Speed Relay
    - 14- Under Speed Relay
    - 27- Under Voltage Relay
    - 27D Positive Sequence Under Voltage Relay
    - 38-Temperature Monitoring
    - 46-Negative Sequence Unbalanced Load Protection Relay
    - 48-Excessive start Relay
    - 49RMS-Thermal Over Load Relay
    - 50-Instantaneous Over Current Relay
    - 50N-Instantaneous Earth Fault Relay
    - 51- Time Delayed Over Current Relay
    - 51N-Time Delayed Earth Fault Relay
    - 51LR-Locaked Rotor Relay
    - 66-Number of Starts per hour

- The outgoing Feeders are equipped with a SEPAM 80 Series relay for over current phase and earth fault protections.
- The LV incomer panels are equipped with a SEPAM 80 Series relay for over current phase and earth fault protections.

SOFTWARE DETAILS

KALKITECH PowerApps was used for the Over current and Earth Fault relay Co-ordination studies.



A Sample Time Current Characteristics Curve of Relay Co-ordination Study

SOLUTIONS

Protection & Coordination Studies involved preparing coordination time-current characteristic curves to determine the required settings/sizes of the protective devices to maximize selectivity. It was necessary to achieve proper fault identification and fault clearance sequence. The relays must be able to distinguish between the normal operating currents including short time overcurrents that may appear due to certain equipment normal operation (example: Motor starting currents, Transformer inrush currents) and sustained overcurrent due to fault conditions. During fault conditions, these relays were made to operate quickly, isolating the faulted section of the network only and allowing for continued operation of the healthy circuits. In the event of failure of primary relays meant for isolating the fault within its primary zone of protection, backup relays were tested to operate after providing sufficient time discrimination for the operation of primary relays. Hence, the operation of backup relays was coordinated with those of the operation of the primary relays. The flexible settings of the relays (namely plug or tap setting, the time dial setting and possibly selection of suitable time-current operating characteristics), was set to achieve the objectives stated in this section.

KEY BENEFITS

A Protective Device Coordination Study will show clients the probable and possible values of fault currents within the system and also show the impact of short circuits and failures would have on the fuses, circuit breakers, and facility's operation. Some of the key benefits are:

- Increased facility reliability i.e. minimize system downtime and nuisance device operations
- Increased equipment protection i.e. avoid equipment damage or failure through increased system protection
- Provide settings for all adjustable devices – relay, ground fault equipment, etc.
- Isolate faulty circuits without loss of power to other parts of the system
- Identify and recommend cororective action for under-protected equipment
- Prevent damage by identifying underrated equipment
- Prevent damage by identifying overloaded equipment
- Ensure safety of personnel
- Increased operating efficiency

REFERENCES

1. www.kalkitech.com/offerings/solutions-powerapps
2. http://www.powerapps.org/PAES_PSSystemStudies.aspx