NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Lesson Learned

Generating Station Auxiliary Power Bus Undervoltage

Primary Interest Groups
Generator Operators (GOPs)
Generator Owners (GOs)

Problem Statement
Several events occurred in which under voltage conditions on generating station auxiliary power buses resulted in the loss of one or more units due to degraded performance of the boiler controls under these conditions.

Details

- Example 1: A generating station experienced a close-in 345 kV fault that resulted in a depressed voltage condition on station auxiliary power buses. The uninterruptible power supplies (UPS) for the boiler control systems on both units were out of service at the time of the event; therefore, there was no voltage support to the boiler control systems during the fault. Master fuel trips occurred on both units when the boiler auxiliary relays dropped out due to the low control system voltage conditions experienced during the fault. Sequence-of-events data for the event was not available due to the low control system voltages. All generator protective relaying and plant dc backup power supplies were in service and operational during the event.
- Example 2: A generating station experienced a 345 kV bushing fault on a main power transformer that did not clear high speed due to the failure of a lockout relay. A depressed voltage condition on station auxiliary power buses was present for an extended period until the fault was cleared via remote backup relaying. The voltage on the station auxiliary power buses during the fault was reduced to approximately 0.8 per unit; the 120 V system used for plant control equipment dropped as low as 82.5 V. The 120 V system supplies power to the bag house programmable logic controller (PLC), which has a minimum input detection voltage of 88 V. Each unit is designed with a bag house as part of the environmental controls for removing particulate in the boiler exhaust gas. The depressed power supply voltage to the PLCs caused these systems to improperly position the bag house control dampers, resulting in excessive negative boiler duct pressure on both units.
  - As a result of excessive negative duct pressures, the first unit experienced the loss of an induced draft (ID) fan. The loss of the ID fan initiated a unit runback that failed due to high water wall temperatures and caused the unit to trip due to a master fuel trip.
  - The second unit also experienced the loss of an ID fan due to excessive negative duct pressure. The ID fan trip caused an excessive rate of change in the main steam temperatures and resulted in a unit trip.

Corrective Actions

- Example 1: To ensure that system is returned to service within 48 hours, the entity instituted the following policies in the event of a UPS failure:
  - The plant control room operators must notify the Operations Center of a UPS failure within 30 minutes;
  - The plant shift supervisor must notify engineering to coordinate UPS replacement, if required;
  - UPS repair or replacement efforts will begin immediately; and
  - Spare UPS systems and parts will be stocked at a local warehouse.
- Example 2: The source of power for the bag house PLC controls was connected to an existing UPS for that unit. An identical modification will be made to the bag house PLC controls on the other unit. When complete, these modifications will prevent the loss of bag house PLC controls as was experienced during this event.

Lesson Learned

Power plant control system design should consider providing proper voltage support to vital plant control systems during disturbances on station auxiliary power buses. When properly designed, a UPS or battery system can provide the proper isolation between plant control systems and the station auxiliary power system. Providing a constant voltage supply to control system processors and their related input and output devices is essential to ensuring proper operation of these systems. If the power source to these systems is allowed to fluctuate, unintended results can occur.

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