

Primary Interest Groups

Generator Owners (GO), Generator Operators (GOP)

Overview

In two separate events, a single point of failure with the plant instrument air system resulted in the loss of multiple generating units at the same site.

Details

In the first event, the generation facility had three instrument air compressors (#1, #2 & #3) which provided control air to both units via a common air header system. Typically, two air compressors are in operation with the third compressor in automatic start mode as a backup. A portable air compressor is also tied into the instrument air system to provide temporary backup during outages or maintenance on the #1, #2 or #3 compressors.

Sequence of events:

- Pre-event status - “#1” Instrument Air Compressor removed from service due to high temperature on the motor windings; “#2” Instrument Air Compressor placed in service. “#1” compressor placed in manual mode from local control power during maintenance troubleshooting of the motor winding high temperature issue.
- “#2” Instrument Air Compressor tripped on high temperature on the first stage intercooler; “#1” Instrument Air Compressor failed to load due to manual status.
- “#1” Instrument Air Compressor manually loaded. Portable air compressor turned on during event but had 5-minute warm up period.
- Plant Operator manually tripped Unit A due to 100 MW+ swings and exceeding steam temperature limits. Unit B ran back and stabilized at approximately 40% of nameplate rating.

In the second event, two units tripped due to the loss of instrument air when the auxiliary cooling water pumps went off-line due to a bad sump level transmitter.

Sequence of events:

- The auxiliary cooling water intake sump level transmitter went bad and provided a bad indication.
- The primary auxiliary cooling water pump tripped due to unanticipated trip logic in the controls for the bad sump level indication.
- The cooling water header pressure fell when the primary auxiliary cooling water pump tripped.
- The backup auxiliary cooling water pump tripped due to trip logic in the controls due to the low header pressure.
- The primary and secondary instrument air compressors tripped due to the loss of cooling water.
- The backup instrument air compressor was started by plant operators, but also tripped due to the loss of cooling water.
- The loss of instrument air resulted in the unit runbacks and ultimately led to both units tripping on reverse power.

Corrective Actions

For the first event, the entity identified the following corrective actions:

- High ambient temperature conditions contributed to the failure of compressors #1 & #2
- Additional AC cooling was added to compressor #1 and it was placed into service successfully.

- The first stage intercooler on compressor #2 was chemically cleaned and it was returned to service.
- Preventative maintenance (PM) programs for the air compressors were reviewed to assess the potential need for additional PM activities such as motor cleaning, chemical cleaning and/or additional cooling for summer operation.
- The warm-up time for the portable air compressor contributed to the instrument air header pressure degradation and subsequent control system upsets. Options for temporary back-up instrument air with shorter start times were evaluated.
- The entity initiated a project to purchase and install an additional instrument air compressor and provide separation of the instrument air system between units.

For the second event, the entity identified the following corrective actions:

- The level transmitter “trip” logic was removed for the auxiliary cooling water pumps.
- The start logic was modified so that each pump would always have a start permissive.
- Auto-start logic was added for the backup auxiliary cooling water pumps.
- Alarms and control room displays were modified for better control room response.

Lessons Learned

At facilities with multiple generating units, entities should strive to minimize or eliminate, if possible, single points of failure in plant auxiliary systems that can lead to tripping more than one unit. Instrument air is one of the critical systems that entities should consider isolating between units or providing additional redundancy.

NERC Events Analysis also published a lesson learned for a similar event in ERCOT where a single point of failure within the critical AC power supply to the instrument air compressor controls led to the loss of multiple units at the same site. Link: [LL 20130402 - Lack of Separation for Critical Control Power Supply Leads to Loss of Multiple Units at a Power Station](#)

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