Plant/Unit	CR7	Event Start	5/23/2022 11:44:00 AM

EVENT

Prepared By		Date	1/1/0001

(F030), CR7-ST, Forced Outage, Steam Turbine trip due to generator ground fault.

OPERATIONS EVALUATION

Prepared By	412;#Waters, Mike	Date	7/12/2022

Steam Turbine had a 86 relay trip after we heard a loud bang coming from the Turbine Building. After investigation we found the generator enclosure to be deformed from an explosion. Service Shop and the contractor that had just recently worked on unit was called in for investigation.

MAINTENANCE EVALUATION

Prepared By	387;#Mudd, Sam	Date	7/18/2022

Following the CR7 Spring Outage, the Steam Turbine Generator was brought online with no significant issues. It operated at half load for more than two weeks due to CT1 still waiting for work scope completion. Once CT1 was brought online, the ST operated at full load for approximately 20 hours before tripping offline by an Overall Differential Lockout. There was also a Breaker Failure Lockout rolled.

Plant and Generation Engineering investigated via the Disturbance Monitoring Equipment (DME) and found indications of a phase to ground fault on the B phase at the generator terminals. Field site investigation showed fault evidence at the flex links between the generator terminals and the isophase bus adapter plate. Bolts connecting the flex links to the adapter plate appeared very loose.

Included in the outage scope prior to the failure was a Generator Medium Inspection. The scope was contracted to MD&A with Plant and Central Service Shop oversite. The scope required the flex links to be removed for electrical testing and reinstalled. The disconnection and reinstallation were performed by MD&A, which were included in the contract scope. MD&A could not provide documentation that they torqued the flex link bolts per manufacturer's specification.

Generation Engineering's hypothesis is that the B phase flex links bolts were loose enough to enable small arcs to persist upon bringing the unit online. Over the course of the unit generating the arc damaged the copper connections and once the unit was brought to full load the arcing intensified, releasing carbon dust into the nearby atmosphere enabling a path to ground and subsequent flashover.

The DME showed evidence of this arcing, but the cycle times of these events were shorter than the protective relays are programmed to react (primarily to avoid nuisance trips).

The damaged equipment included copper at the flex link connections, deformed generator acoustic enclosure, Generator CT's, partial discharge monitor equipment, various cables and flexible conduit, iso-phase adapter plate, and carbon coated generator field and stator cooling passages. MD&A performed the scope cleaning and repairing the generator. The scope required disassembly, pulling the field to be sent to MD&A's shop for cleaning and testing, replacing damaged components at site, electrical testing, and reassembly.

RECOMMENDATIONS

Prepared By	387;#Mudd, Sam	Date	7/18/2022

Because installation of flexible links on generators and other high voltage/current circuits is a potential critical point of failure, as in this event, Generation has a team assigned to review existing procedures to evaluate and improve processes to ensure error-free scope completion. The first meeting is scheduled for 7/21/2022 and includes representives from each plant. OEM and EPRI guidance will be referenced when assembling the procedure. The goal is to produce and implement an approved procedure prior the the Fall 2022 outage season.

Note 1 In addition to the above scope specific recommendation, in general for significant contracted efforts, a quality plan will be requested as part of the solicitation process.

Note 2

COMBINED RESULTS	
Prepared By	Date