UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
OFFICE OF NEW REACTORS
WASHINGTON, DC 20555-0001

June 20, 2016

NRC INFORMATION NOTICE 2016-07: OPERATING EXPERIENCE REGARDING IMPACTS ON SITE ELECTRICAL POWER DISTRIBUTION FROM INADEQUATE OVERSIGHT OF CONTRACTOR ACTIVITIES

ADDRESSEES

All holders of an operating license or construction permit for a nuclear power reactor under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," except those that have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.

All holders of and applicants for a power reactor combined license under 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

PURPOSE

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice (IN) to inform addressees of adverse effects to off-site power availability that have resulted from inadequate licensee oversight of contractor activities. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this IN are not NRC requirements; therefore, no specific action or written response is required.

DESCRIPTION OF CIRCUMSTANCES

Wolf Creek Generating Station, Unit 1

On January 13, 2012, Wolf Creek Generating Station (Wolf Creek) experienced an automatic reactor trip after the catastrophic failure of the main generator output breaker. The start-up transformer assumed nonsafety-related loads, but subsequently experienced a differential relay actuation on its "B" phase. This caused a lockout of the start-up transformer and a loss of off-site power (LOOP). Both emergency diesel generators started and supplied power to the safety-related 4160 volt busses as expected.

The LOOP resulted in several complications, including:

- erratic source range nuclear instrumentation indications resulting from the loss of power to containment cavity cooling fans

- containment sump high level alarms caused by a through-wall leak in essential service water (ESW) piping in containment resulting from a known issue with water hammer caused by the stop-start sequence of ESW pumps following a LOOP

- a loss of firefighting capability for 4 hours because of the loss of power to normal fire pumps in conjunction with the long-term inoperability of the installed diesel-powered fire pump and inadequacies with the procedure for starting a temporary fire pump

- a loss of reactor coolant pumps necessitating a natural circulation cooldown, and

- a loss of instrument air complicating operator control of pressurizer level and pressure

The cause of the LOOP was the actuation of protective relaying resulting from a short between two taps on the high side current transformers. During the previous year, the licensee had contracted with a vendor to replace electrical seal assemblies in the start-up transformer that experienced oil leakage. This vendor performed the majority of the work in accordance with established instructions and practices, but failed to install insulating sleeves on 2 of the 37 wiring connections. These sleeves are required to prevent terminal-to-terminal contact. The investigation that followed determined that the licensee failed to satisfy the requirements of written procedures to ensure that (1) field activities were adequately monitored, and (2) periodic verification of contracted work was conducted to verify that it was performed in accordance with applicable work orders. After the event, the licensee installed the missing insulation sleeves, and updated station procedures regarding the oversight of contractors performing work on risk-significant components.

This IN provides no new information on this event. The condition described was summarized from previously-released reports prepared by an NRC Augmented Inspection Team (AIT) chartered shortly after the event in 2012 to review the facts surrounding the LOOP, and the complications that resulted. Additional information can be found in Licensee Event Report 05000482/2012-001, "Failure of 345 kV Switchyard Breaker due to Internal Fault Resulting in Reactor Trip and Coincident Loss of Offsite Power," dated April 9, 2012, in "Wolf Creek Nuclear Operating Corporation–NRC Augmented Inspection Team Report 05000482/2012008," dated April 4, 2012, and in the "NRC Augmented Inspection Team Follow-Up Report 05000482/2012009," dated August 6, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML12109A049, ML12095A414, and ML12227A919, respectively).

Arkansas Nuclear One, Unit 1 and Unit 2

On March 31, 2013, at Arkansas Nuclear One (ANO) during its Unit 1 outage, an inadequately designed temporary lifting rig failed while moving the Unit 1 main generator stator out of the turbine building. The 525-ton stator fell onto the turbine deck and then continued falling approximately 30 feet into a train bay that is shared between Units 1 and 2. The collapse of the lifting rig resulted in one fatality and injured eight others. The impact of the dropped stator on the turbine deck damaged the Unit 1 non-vital electrical switchgear connecting plant vital busses to off-site power, causing a LOOP to Unit 1 for six days.

At the time of the event, Unit 2 was operating at 100 percent power. Vibrations from the stator drop and temporary lift rig collapse caused a Unit 2 reactor coolant pump breaker to trip, resulting in an automatic reactor trip of Unit 2. Water spray from a ruptured fire water pipe

migrated into the ANO-2 non-vital switchgear area located just off the train bay causing an electrical fault inside the non-vital Unit 2 electrical switchgear approximately 90 minutes after the stator drop. This fault caused a lockout of start-up transformer 3 and a partial LOOP for Unit 2. Loss of power to all four reactor coolant pumps necessitated a natural circulation plant cooldown, which was complicated by additional equipment unavailability due to the partial LOOP.

The temporary lifting rig collapse resulted from errors in contractor design calculations. The basic lifting rig design had been used by the contractor for stator lifts at other nuclear power plants; however, the design of the rig had been modified for use at ANO. The licensee failed to perform an adequate review of the contractor's modified design calculations, and failed to require the contractor to perform a load test in accordance with site procedures and applicable regulations. These failures were the result of inadequate oversight by the licensee. The licensee repaired the damage to the plant and updated procedures to provide guidance on review of calculations, quality requirements, and standards associated with third party reviews.

The NRC chartered and dispatched an AIT to review the facts of the event. Additional information can be found in Licensee Event Report 05000313/2013-001, "Collapse of a Main Generator Stator Temporary Lift Assembly Results in a Fatality, Multiple Injuries, a Plant Scram, a Notification of Unusual Event, and Dual Unit Structural Damage," dated August 22, 2013 (ADAMS Accession No. ML12109A049).

Comanche Peak Nuclear Power Plant, Unit 1 and Unit 2

On December 4, 2013, Comanche Peak Nuclear Power Plant (Comanche Peak) experienced a LOOP to safety-related busses when an energized cable feeding the in-service start-up transformer was mistakenly cut while the other start-up transformer was out of service for modifications. Both units remained at full power as nonsafety-related loads (including reactor coolant pumps) continued to receive power from the main generator through the unit auxiliary transformer. All four emergency diesel generators started automatically and re-energized the safety-related busses.

Comanche Peak was in the process of implementing a modification to start-up transformer XST-1. In preparation for the work, contract personnel had walked down the cables for XST-1 to ensure the correct cables were identified. However, an incorrect assumption about the layout of the cable bus enclosure routing, combined with a failure to use design drawings to facilitate the walkdown, contributed to the contractors misidentifying a feeder cable for the other start-up transformer, XST-2, rather than the cable for XST-1. The licensee did not validate the resulting work plan provided by the contractors. The contract electricians performing the work raised questions about the accuracy of the cable identification, but failed to pursue the issue, contrary to station procedures. The licensee repaired the cut cable to restore off-site power, and improved procedures regarding the design change development, review, and oversight processes.

Additional information can be found in Licensee Event Report 05000445/2013-003, "Auto Start of Both Units' Auxiliary Feedwater Pumps and Emergency Diesel Generators Due to a Loss of Both Units' Safeguards Electrical Power," dated January 30, 2014 and in "Comanche Peak

Nuclear Power Plant–NRC Integrated Inspection Report 05000445/2014003 and Notice of Violation," dated August 6, 2014 (ADAMS Accession Nos. ML14043A089 and ML14218A072, respectively).

Joseph M. Farley Nuclear Plant, Unit 2

On October 14, 2014, a lightning strike on a 500kV line caused a partial LOOP to Joseph M. Farley Nuclear Plant (Farley), Unit 2. A power circuit breaker opened to clear the fault, and experienced an internal fault on the bus side of the main contacts. The high-fault current exposed a loose connection, creating a high resistance and differential current signal that led to isolation of the 2B start-up auxiliary transformer (SAT), and a LOOP to its associated "B" train power bus. The 2B emergency diesel generator was out of service at the time for scheduled maintenance, and was unable to assume the "B" train safety-related loads. One of these loads was the "B" train of component cooling water, which was supplying cooling water to reactor coolant pump oil coolers and seal coolers at the time of the event. In accordance with the abnormal operating procedure for loss of component cooling water, operators inserted a manual reactor trip.

The loose connection that caused the isolation of the 2B SAT resulted from improper wiring that was introduced during installation of a power circuit breaker 18 months earlier. The breaker installation was part of a design change package for the high-voltage switchyard implemented by the grid operator to replace and upgrade several power circuit breakers and their control relay packages. Testing during the implementation verified the correct installation of the current transformers and associated wiring. However, inadequate verification practices failed to identify a missing nut on one of the terminals during the installation. This led to a loose connection that was adequate for normal testing and operational purposes, but not for the conditions experienced during a ground fault isolation. A contributing cause of this event was the licensee's failure to fully understand the extent of differences in verification practices performed by an outside organization.

The missing nut on the power circuit breaker current transformer was installed, and the transformer primary and secondary protective relaying functions were tested satisfactorily. In addition, the licensee worked to strengthen the application of verification procedures used by the utility performing the switchyard maintenance.

Additional information can be found in Licensee Event Report 05000364/2014-002, "Manual Reactor Trip due to Loss of 2B [Start-up] Auxiliary Transformer and Loss of Offsite Power," dated December 12, 2014 (ADAMS Accession No. ML14346A391).

DISCUSSION

Licensees often rely on contractors and supplemental personnel to perform work. This is especially the case during scheduled outages. This work includes specialized, low-frequency tasks involving one-time modifications or the overhaul of major equipment. The NRC has previously issued several other IN's regarding contractor oversight issues, such as IN 97-74, "Inadequate Oversight of Contractors During Sealant Injection Activities", and IN 00-11, "Licensee Responsibility for Quality Assurance Oversight of Contractor Activities Regarding Fabrication and Use of Spent Fuel Storage Cask Systems."

Although the performance of particular tasks, including the development and execution of work instructions and procedures, may be delegated to outside organizations, the licensee retains

overall responsibility for ensuring that the procedures and their execution meet the quality assurance expectations of plant process controls and, for safety-related equipment, the requirements of the plant's NRC-approved quality assurance program. While the work activities discussed in this IN were associated with non-safety related equipment, each event placed the plant in a LOOP condition and challenged the operability and reliability of safety-related equipment.

Industry operating experience has shown the importance of licensee programs designed to ensure effective station oversight of contractor activities. Establishing clear lines of accountability within the licensee organization that maintains sufficient knowledge and technical expertise to exercise an appropriate level of oversight of the design, maintenance, modification, or refurbishment activities performed by contracted personnel is essential. This includes verification that procedures and work instructions contain sufficient detail, and that supplemental personnel are familiar with site work control processes and expectations for procedure adherence.

CONTACT

This IN requires no specific action or written response. Please direct any questions about this matter to the technical contacts listed below, or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

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