UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
612 EAST LAMAR BLVD, SUITE 400
ARLINGTON, TEXAS 76011-4125

February 2, 2010

Matthew W. Sunseri, President and
Chief Executive Officer
Wolf Creek Nuclear Operating Corporation
P. O. Box 411
Burlington, KS 66839

Subject: WOLF CREEK GENERATING STATION - NRC SPECIAL INSPECTION REPORT 05000482/2009007

Dear Mr. Sunseri:

On December 4, 2009, the U.S. Nuclear Regulatory Commission (NRC) completed a special inspection at your Wolf Creek Generating Station. This inspection examined activities associated with the station's performance during a loss of offsite power on August 19, 2009. The NRC's initial evaluation of this issue, using the criteria in NRC Management Directive 8.3, "NRC Incident Investigation Program," determined that the estimated Incremental Conditional Core Damage Probability was 6.1×10^{-6}. This guided the NRC to charter and conduct a special inspection.

The enclosed report documents the inspection results, which were discussed at the exit meeting on December 22, 2009, with you and other members of your staff. The inspection examined activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. The inspection team reviewed selected procedures and records, observed activities, and interviewed personnel.

This report documents seven NRC-identified and self-revealing findings of very low safety significance (Green). Six of these findings were determined to involve violations of NRC requirements. Additionally, one licensee-identified violation, which was determined to be of very low safety significance, is listed in this report. However, because of their very low safety significance and because they are entered into your corrective action program, the NRC is treating these findings as noncited violations, consistent with Section VI.A.1 of the NRC Enforcement Policy. If you contest the noncited violations in this report, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, D.C. 20555-0001, with copies to the Regional Administrator, U.S. Nuclear Regulatory Commission, Region IV, 612 E. Lamar Blvd, Suite 400, Arlington, Texas, 76011-4125; the Director, Office of Enforcement, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001; and the NRC Resident Inspector at the Wolf Creek Generating Station. In addition, if you disagree with the characterization of any finding in this report, you should provide a response within 30 days of the date of this inspection report, with the basis for your disagreement, to the Regional Administrator, Region IV, and the NRC Resident Inspector

at the Wolf Creek Generating Station. The information you provide will be considered in accordance with Inspection Manual Chapter 0305.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, and its enclosure, will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

Sincerely,

/RA/ A. Vegel for

Dwight D. Chamberlain, Director
Division of Reactor Projects

Docket: 50-482
Licenses: NPF-42
Enclosure: NRC Inspection Report 05000482/2009007
w/Attachments: Supplemental Information
Charter
NRC Technical Review of the August 19, 2009, Self-Revealing Flaw in Essential Service Water System Piping

cc w/Enclosure:

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File located: R:_REACTORS_WC\2009\WC 2009007RWD.doc ML#100330574

ADAMS: □ No ☒ Yes	SUNSI Review Complete	Reviewer Initials: RWD
	☒ Publicly Available	☒ Non-Sensitive
Category A.	□ Non-Publicly Available	□ Sensitive
KEYWORD:		

C:DRP/B	SPE:DRP/B	SRI:DRP/B	RI:DRP:/B
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U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Docket:	50-482
License:	NPF-42
Report:	05000482/2009007
Licensee:	Wolf Creek Nuclear Operating Corporation
Facility:	Wolf Creek Generating Station
Location:	1550 Oxen Lane SE Burlington, Kansas
Dates:	September 21 through December 4, 2009
Inspectors:	R. Deese, Senior Project Engineer D. Dumbacher, Senior Resident Inspector, Callaway Plant G. Tutak, Reactor Inspector J. Medoff, Senior Mechanical Engineer M. Runyan, Senior Reactor Analyst C. Long, Senior Resident Inspector, Wolf Creek Generating Station C. Peabody, Resident Inspector, Wolf Creek Generating Station
Approved By:	G. Miller, Chief, Project Branch B, Division of Reactor Projects

SUMMARY OF FINDINGS

IR 05000482/2009007; 09/21/09 through 12/4/09; Wolf Creek Generating Station, Special Inspection in response to the loss of offsite power and essential service water leak on August 19, 2009.

This report covered a 5-day period (September 21-25, 2009) of onsite inspection, with in office review through December 4, 2009. This special inspection was conducted by a senior project engineer, a senior resident inspector, a reactor inspector, a headquarters specialist, and a senior reactor analyst assisted by a senior resident inspector and a resident inspector. Six Green noncited violations and one Green finding of significance were identified. The significance of most findings is indicated by their color (Green, White, Yellow, or Red) using NRC Inspection Manual Chapter 0609, "Significance Determination Process." Findings for which the significance determination process does not apply may be Green or be assigned a severity level after NRC management review. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 4, dated December 2006.

A. NRC-Identified Findings and Self-Revealing Findings

Cornerstone: Initiating Events

- Green. The team identified a finding associated with the licensee's failure to recognize the adverse conditions related to their offsite power system as prescribed by Procedure AP 28A-100, "Condition Reports." Specifically, the licensee failed to enter pertinent switchyard operating experience and six occurrences of offsite power line losses as adverse conditions in their corrective action program as of August 2009. The licensee entered these deficiencies in their corrective action program as Wolf Creek Condition Reports 00022242 and 00022241.

  This finding is greater than minor because, if left uncorrected, the failure to fully utilize the corrective action program could become a more significant safety concern. The inspectors determined that this finding impacted the Initiating Events Cornerstone equipment maintenance attribute and affected the cornerstone objective to limit the likelihood of those events that upset plant stability and challenge critical safety functions during shutdown as well as power operations. Using Manual Chapter 0609.04, "Phase 1 – Initial Screening and Characterization of Findings," the issue screened as having very low safety significance because it did not contribute to both the likelihood of a reactor trip and the likelihood that mitigation equipment or functions would not be available (Section 1R2).

- Green. The team reviewed a self-revealing noncited violation of Technical Specification 5.4.1.a, "Procedures," after operators' failure to monitor and maintain steam generator water levels resulted in an unanticipated turbine trip signal and feedwater isolation. On August 21, 2009, while in Mode 3, Wolf Creek operators, using an intermittent method of feeding steam generators over shift turnover, lost control of the level in steam generator A. This resulted in increased levels above the P-14 feedwater isolation actuation setpoint. Contributing to the loss of level control was the disabling of a previously established operator

selectable alarm for the steam generator level. The licensee entered this deficiency in their corrective action program as Wolf Creek Condition Report 00019295.

This finding is greater than minor because it impacted the Initiating Events Cornerstone human performance attribute and affected the cornerstone objective to limit the likelihood of those events that upset plant stability and challenge critical safety functions during shutdown as well as power operations. Using Manual Chapter 0609.04, "Phase 1 – Initial Screening and Characterization of Findings," the issue screened as having very low safety significance because it did not contribute to both the likelihood of a reactor trip and the likelihood that mitigation equipment or functions would not be available and it did not increase the likelihood of a fire or internal/external flooding. This finding has a crosscutting aspect in the area of human performance associated with the decision making component because licensee personnel failed to make safety-significant or risk-significant decisions using a systematic process especially when faced with uncertain or unexpected plant conditions to ensure that safety is maintained [H.1(a)] (Section 1R7).

Cornerstone: Mitigating Systems

- Green. The team identified a noncited violation of 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings," regarding the licensee's failure to follow the requirements of Procedure AP 26C-004, "Technical Specification Operability." Specifically, licensee personnel failed to perform an operability evaluation for the impact of the 2009 pressure transient and internal corrosion on the essential service water system. The Wolf Creek essential service water system was degraded by a system pressure transient on August 19, 2009. Also in 2009, widespread internal corrosion resulted in at least three through wall leaks. Discovery of these conditions had been documented in the corrective action program but had not resulted in performance of an operability evaluation of the current and potentially future impact on the system as a whole. The licensee entered this deficiency in their corrective action program as Wolf Creek Condition Report 00022240.

  This finding is greater than minor because it is associated with the Mitigating Systems Cornerstone attribute of equipment performance and adversely affected the objective to ensure equipment availability and reliability. Using Manual Chapter 0609.04, "Phase 1 – Initial Screening and Characterization of Findings," the issue screened as having very low safety significance because it was not a design or qualification deficiency that resulted in a loss of operability or functionality, did not create a loss of system safety function of a single train for greater than the technical specification allowed outage times, and did not affect seismic, flooding, or severe weather initiating events. This finding has a crosscutting aspect in the area of problem identification and resolution associated with the corrective action program because licensee personnel failed to thoroughly evaluate problems such that the resolutions address causes and extent of conditions [P.1(c)] (Section 1R2).

- Green. The team identified a noncited violation of 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings," regarding the licensee's

failure to follow the requirements of Procedure AI 28A-010, "Screening Condition Reports." Specifically, licensee personnel failed to properly screen condition reports for the essential service water system adverse conditions of internal corrosion and loss of offsite power induced system pressure transient since April 2008. The adverse conditions met the procedure's definitions to require a root cause analysis prior to September 2009, but none was performed. The licensee entered this deficiency in their corrective action program as Wolf Creek Condition Report 00022239.

This finding is greater than minor because, if left uncorrected, the failure to fully utilize the corrective action program could become a more significant safety concern. The inspectors determined that this finding impacted the Mitigating Systems Cornerstone. Using Manual Chapter 0609.04, "Phase 1 – Initial Screening and Characterization of Findings," the issue screened as having very low safety significance because it was not a design or qualification deficiency that resulted in a loss of operability or functionality, did not create a loss of system safety function of a single train for greater than the technical specification allowed outage times, and did not affect seismic, flooding, or severe weather initiating events. This finding has a crosscutting aspect in the area of problem identification and resolution associated with the corrective action program because licensee personnel failed to thoroughly evaluate problems such that the resolutions address causes and extent of conditions [P.1(c)] (Section 1R2).

- Green. The team identified a noncited violation of 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings," regarding the licensee's failure to provide adequate guidance to identify and address pitting, corrosion, and surface indications in the essential service water system. A 2007 licensee self-assessment on lake water corrosion issues recommended improvements in lake water chemistry control procedures to establish a pit monitoring program. In September 2009 NRC inspectors noted that the lake water monitoring and chemistry control procedures did not contain quality standards or acceptance criteria for newly discovered flaws or abnormal gross degradation due to erosion, pitting, or corrosion. This resulted in delaying repairs until such degradations (pitting) had become through-wall leaks. Several instances of internally identified corrosion were not entered into the corrective action program until essential service water piping had thinned to below the minimum ASME code allowed wall thickness. The licensee entered this deficiency in their corrective action program as Wolf Creek Condition Report 00022243.

  This finding is greater than minor because it is associated with the Mitigating Systems Cornerstone attribute of procedure quality and adversely affected the objective to ensure equipment availability and reliability. Using Manual Chapter 0609.04, "Phase 1 – Initial Screening and Characterization of Findings," the issue screened as having very low safety significance because it was not a design or qualification deficiency that resulted in a loss of operability or functionality, did not create a loss of system safety function of a single train for greater than the technical specification allowed outage times, and did not affect seismic, flooding, or severe weather initiating events. This finding has a crosscutting aspect in the area of problem identification and resolution associated with the corrective action program because licensee personnel failed

to take appropriate corrective actions to address safety issues and adverse trends in a timely manner [P.1(d)] (Section 1R4).

- Green. The team identified a noncited violation of 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings," regarding the licensee's failure to provide adequate guidance to address the impact of a loss of offsite power event on the essential service water system. On August 19, 2009, seven hours following a loss of offsite power, the NRC senior resident identified leakage from the piping on the 1988' elevation of the auxiliary building. Wolf Creek Procedure STN PE-040G, "Transient Event Walkdown," required that systems subject to expected transient dynamic forces following a reactor trip to have a post-trip walkdown to identify any structural damage. This procedure did not include the essential service water system as a vulnerable system. The procedure only specifically identified portions of systems inside containment. As a result, no walkdown was performed for the essential service water system on August 19, 2009. The licensee entered this deficiency in their corrective action program as Wolf Creek Condition Report 00022265.

  This finding is greater than minor because it is associated with the Mitigating Systems Cornerstone attribute of procedure quality and adversely affected the objective to ensure equipment availability and reliability. Using Manual Chapter 0609.04, "Phase 1 – Initial Screening and Characterization of Findings," the issue screened as having very low safety significance because it was not a design or qualification deficiency that resulted in a loss of operability or functionality, did not create a loss of system safety function of a single train for greater than the technical specification allowed outage times, and did not affect seismic, flooding, or severe weather initiating events. This finding has a crosscutting aspect in the area of problem identification and resolution associated with the operating experience component because the licensee failed to institutionalize lessons learned through changes to station walkdown procedures [P.2(b)] (Section 1R5).

- Green. The team identified a noncited violation of License Condition 2.C.(5), "Fire Protection," for the failure to establish a compensatory fire watch in a timely manner per the station fire protection program. On August 19, 2009, a complete loss of offsite power resulted in fire protection trouble alarms on fire protection panel KC-008. The control room supervisor acknowledged the alarms. Procedure ALR KC-888, "Fire Protection Panel KC-008 Alarm Response," required an impairment and compensatory measures for the affected smoke detectors. The following day, NRC inspectors noted that impairments and fire watches for the 13 affected fire zones on KC-008 had not been initiated. The licensee entered this deficiency in their corrective action program as Wolf Creek Condition Report 00019320.

  This finding was more than minor since it was associated with the protection against external factors attribute of the Mitigating Systems Cornerstone and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. Using Manual Chapter 0609, Appendix F, "Fire Protection Significance Determination Process," the inspectors determined that the finding had an adverse affect on the fixed fire protection systems element of fixed fire

detection systems. This finding was determined by a senior reactor analyst to be of very low safety significance because of a low exposure time of the uncompensated deficiency. This finding has a crosscutting aspect in the area of human performance associated with the work practices component because the licensee failed to ensure supervisory oversight of work activities such that nuclear safety is supported [H.4(c)] (Section 1R5).

B. Licensee-Identified Violations

One violation of very low safety significance, which was identified by the licensee, was reviewed by the inspectors. Corrective actions taken or planned by the licensee have been entered into the licensee's corrective action program. This violation and its condition report number are listed in Section 4OA7.

REPORT DETAILS

1. REACTOR SAFETY

Cornerstones: Initiating Events, Mitigating Systems, Barrier Integrity, and Emergency Preparedness

1R0 Introduction

On August 19, 2009, the NRC determined that a special inspection was warranted, in part, based on the potential safety significance of a complete loss of offsite power and because of potential generic issues associated with essential service water design and internal corrosion.

The inspection charter required the team to: (1) review the circumstances related to the discovery of the degraded conditions, (2) assess the licensee's determination of cause and effectiveness of actions taken to resolve and prevent recurrence of these problems, and (3) assess the effectiveness of licensee programs to maintain the physical condition of the offsite power systems and the essential service water system. The team evaluated the licensee actions to address these issues including extent of condition, extent of cause, and common cause questions. Specific focus was on licensee response to prior instances of loss of the offsite power lines and assessment of implementation of general design criteria requirements for independence of the offsite power lines. The inspectors reviewed the licensee's Generic Letter 89-13, "Service Water System Problems Affecting Safety-Related Equipment," program to ensure appropriate testing was being performed that would demonstrate essential service water system ability to function under design-basis conditions.

The team conducted their reviews in accordance with NRC Inspection Procedure 93812, "Special Inspection Procedure." The special inspection team reviewed procedures, corrective action documents, as well as design and maintenance records for the equipment of concern. The team interviewed key station personnel regarding the events, reviewed the root cause analysis, and assessed the adequacy of corrective actions. The team walked down and inspected the equipment in the field. A list of specific documents reviewed is provided as Attachment 1. The charter for the special inspection is provided as Attachment 2.

1R1 Sequence of Events Related to the Event

On August 19, 2009, Wolf Creek Generating Station experienced a complete loss of offsite power to the two essential 4 kV bus transformers, XNB01 and XNB02, for about 49 seconds. This condition resulted from a lightning strike causing a fault four miles to the east of the plant on the tie-line to La Cygne 345 kV substation. Wave trap and tuning circuitry damage caused carrier system signal failures which prevented the feeder breakers from two other substations, Rose Hill and Benton, from getting 'block' signals. Thus, these substation feeds were also rendered unavailable to Wolf Creek. The Wolf Creek main generator experienced a load change from approximately 1220 MW to 100 MW. This resulted in a turbine trip – reactor trip. All reactor coolant pump motors tripped on underfrequency. The main generator protection lockout relay 386-2G actuated, opening the main generator output breakers. At 49.6 seconds after the initiating event, the feeder breakers to 4 kV busses NB01 and NB02 were tripped open

by loss of voltage relays. At 55.2 seconds after the initiating event, the transmission system operator closed the Wolf Creek – Rose Hill transmission network line breaker 345-50. This restored one transmission line, supporting offsite power to Wolf Creek's essential 4 kV bus transformers. At 56.5 seconds, the emergency diesel generator output breakers NE001 and NE002 closed onto safety related 4 kV busses NB01 and NB02. At 12 minutes, the Wolf Creek – Benton 345 kV network line breaker 345-120 was closed by the transmission operator, restoring a second transmission line supporting offsite power. At 13 minutes and 6 seconds, the transmission system operator restored the third transmission line. One hour and 50 minutes after the event, offsite power was restored to safety related bus NB02. Two hours and 54 minutes after the event, offsite power was restored to safety related bus NB01.

This was the second loss of offsite power event at Wolf Creek in less than 18 months. The first occurred on April 7, 2008, during a refueling outage. For both of the loss of offsite power events, damage requiring repairs occurred within the essential service water system. In this event, a 3/8-inch hole developed in the licensee's service water system.

1R2 Review of Problem Identification and Resolution Aspects of the Event

.1 Review of Operating Experience

a. Licensee Review of Operating Experience

Responsibility for most of the switchyard work rested with Westar Energy. As a result, Wolf Creek typically did not enter switchyard-related maintenance and industry operating experience into the corrective action program. Wolf Creek only entered external operating experience evaluations into the corrective action program. Wolf Creek received external operating experience, but did not effectively communicate the grid and switchyard recommendations to Westar Energy.

Wolf Creek completed Self-Assessment 05-001, "Transformer and Switchyard Self-Assessment," in March 2005, to evaluate the interface of the nuclear power plant and the switchyard in terms of maintenance, operation, design, and performance monitoring relative to large power transformers and switchyard equipment. Wolf Creek also evaluated Westar's control of the grid as it affects the nuclear plant in terms of stability of offsite power. Wolf Creek also reviewed transmission line design and grid voltage control.

The licensee's incident investigation team reviewed over 30 condition reports that were generated from self-assessments and other industry operating experience. Based on their review, the licensee team concluded that the performance improvement programs, such as the Corrective Action Program, were not being used or implemented effectively. Improper screening of condition reports had not allowed Wolf Creek to adequately describe and evaluate problems.

b. Inspection Scope

The team reviewed internal operating experience by obtaining a list of plant corrective action documents related to the offsite power and essential service water system. The

team further examined the licensee's review of industry operating experience which included inspection of the licensee's operating experience program and specific review of related condition reports for the August 19, 2009, event.

For external operating experience, the NRC Operating Experience Branch provided the results of keyword searches related to offsite power and essential service water issues and findings associated with essential service water leaks. The NRC Operating Experience Branch also provided a list of licensee event reports, NRC Information Notices, NUREG documents, and other operating experience information. The team selected operating experience information that was applicable to this inspection and reviewed how the licensee had addressed the items in their root cause analyses related to these events or had processed the information through their operating experience program. As part of their review, the inspectors performed an essential service water system walkdown to determine if applicable industry operating experience had been incorporated into system design and maintenance practices.

c. Findings

No findings of significance were identified.

.2 Review of Root Cause Analysis

a. Licensee Review

Incident Investigation Team

On August 20, 2009, the licensee established an incident investigation team to perform a root cause analysis to investigate the facts and identify the causes of the loss of offsite power and subsequent plant trip on August 19, 2009. The licensee's final root cause analysis was completed on October 1, 2009. The team consisted of site personnel, Westar staff, and industry experts. The team conducted their review in accordance with Procedure AI 28A-001, "Level 1 CR Evaluation (IIT)." The incident investigation team's objectives were to:

- Determine the sequence of events
- Assess the risk and safety-significance of the event
- Identify and validate root and contributing causes
- Conduct an extent of condition review
- Determine extent of cause
- Develop corrective actions to limit likelihood of recurrence
- Evaluate existing procedures and processes
- Determine why prior corrective actions and applicable operating experience were not effective in preventing the event.

Licensee Root Cause Methodology

The licensee performed their analysis utilizing a structured root cause analysis method in accordance with Procedures AI 28A-001, "Level 1 CR Evaluation (IIT)," and AI 28A-016, "Cause Analysis Methods and Techniques." The licensee interviewed plant personnel and reviewed condition reports, procedures, and other important documents to perform the root cause analysis. The licensee created a detailed event and causal factors chart to establish the sequence of events and provide a complete view of the causes and contributors to the incident. The licensee used fault tree analysis, change analysis, common cause analysis, hardware failure analysis, and hazard-barrier-target analysis to supplement the investigation. The licensee also completed a management oversight and risk tree analysis and an event cause and effect diagram to complete the investigation.

Licensee Root Cause Analysis

The licensee determined that the root cause of the event was that Wolf Creek and the transmission and distribution organization have not sufficiently ensured a mutually desired level of reliable service for substation and transmission interfacing equipment with Wolf Creek.

The licensee determined that the following issues contributed to the event:

- Westar Energy's transmission line and substation design/maintenance had not always applied updated electric utility industry practices to ensure the desired level of reliable service for the applicable substations and transmission systems.

- A reliability-centered maintenance program was in progress for Wolf Creek Generating Station, but not fully implemented for the Wolf Creek Substation. Reliability-centered maintenance for the remote substation terminals and transmission preventive maintenance, inspection, and testing had not been effectively developed or implemented to the point equipment reliability meets expectations.

- Relevant operating experience for substation and transmission systems had not been effectively reviewed or utilized by Wolf Creek and shared with the transmission and distribution organization.

- A process did not exist between Wolf Creek and the transmission and distribution organization to effectively coordinate corrective action evaluations, action tracking, and priorities.

b. Inspection Scope

The team reviewed the licensee's root cause analysis prepared for the loss of offsite power event. The team membership, team charter, report methodology, root and contributing causes, recommended corrective actions, and supporting documentation were reviewed. The team interviewed personnel who participated in the root cause determination as well as personnel who were charged to implement corrective actions of the report.

c. Findings

No findings of significance were identified.

.3 Review of Licensee Corrective Actions

a. Licensee Review

Licensee Review of Extent of Condition

The licensee determined the extent of condition to be the area of owner-controlled equipment that was not previously fully considered to be within the scope of equipment needing life cycle management and maintenance strategies in response to prior industry operating experience. This equipment includes transformers or other communications equipment in the carrier system, including wave traps, lightning arrestors, cabling, relays and protection schemes, switches, disconnects, breakers, tuners, and surge arrestors. The entire 345 kV switchyard and transmission system were included in the extent of condition review. This equipment has the potential to adversely impact Wolf Creek and offsite power source operation and reliability. The licensee factored the extent of condition into all of the corrective actions planned in response to the loss of offsite power event.

Licensee Corrective Actions

The existing equipment vulnerability was resolved by actions taken to replace all three Rose Hill substation coupling capacitor voltage transformers, walk down the Rose Hill and Wolf Creek substations, and test the carrier system for the three transmission lines providing offsite power to Wolf Creek.

b. Inspection Scope

The team reviewed the licensee's root cause analysis to determine if it was conducted to a level of detail commensurate with the significance of the problem. As part of their review, the inspectors interviewed key station personnel from operations, design and system engineering, maintenance, and the corrective action program. Additionally, the team interviewed incident investigation team members and members of the licensee's Corrective Action Review Board.

The team reviewed the licensee's corrective actions to ensure they addressed the extent of condition and whether they were adequate to prevent recurrence. In particular, the team reviewed station procedures and processes to determine if any other issues exist within Wolf Creek's offsite power system or essential service water system.

c. Findings and Observations

Root Cause Analysis

The inspectors determined that the licensee's analysis accurately captured the root cause of the offsite power event. Since the event was determined to be caused by improper oversight of the switchyard between Wolf Creek and Westar, the inspectors noted that the licensee appropriately identified a need to implement several corrective actions related to improving the understanding of the importance of a reliable offsite

power system. The inspectors concluded the corrective actions were appropriate. The inspectors noted that there was not a similar corresponding analysis or effort by the licensee regarding leakage from the essential service water system following the loss of offsite power event.

1. Entry of Conditions into the Corrective Action Program

Introduction. The team identified a Green finding regarding the licensee's failure to follow the requirements of Procedure AP 28A-100, "Condition Reports," associated with failure to recognize adverse conditions with respect to the corrective action program.

Description. On August 19, 2009, a complete loss of offsite power resulted in a reactor trip. A fault was detected on the La Cygne 345 kV transmission line causing breakers in the Wolf Creek switchyard to open. However, the carrier communications equipment failed to block the trip signal on the Rose Hill 345 kV transmission line. The line deenergized, and the resulting grid instability caused the Benton 345 kV transmission line to trip, which resulted in a loss of offsite power to Wolf Creek. The carrier communications equipment did not function as required due to the failure of a coupling capacitor voltage transformer in the Rose Hill substation. The licensee had received industry operating experience related to switchyard equipment and its importance to maintaining a reliable grid, but failed to recognize the significance of switchyard reliability as evidenced by their failure to effectively screen relevant industry operating experience. In particular, Condition Report 00007499 was created from a third party recommendation to develop a monitoring program for coupling capacitor voltage transformers in the switchyard. This condition report, along with several other switchyard-related condition reports, were screened to Improvement and Learning Evaluation, which is the lowest level in the licensee's condition reporting system.

The licensee did not take action on several switchyard-related condition reports since due dates are not typically assigned for implementation of corrective actions for Improvement and Learning Evaluation condition reports. In Attachment B of Procedure AP 28A-100, the licensee defines adverse conditions, in part, as conditions that could negatively impact plant reliability and includes industry operating experience that is applicable or relevant to Wolf Creek as an example. The inspectors determined that the licensee had not properly recognized these conditions as adverse conditions.

Also, the team learned that the licensee's incident investigation team had determined that offsite power had numerous interruptions in the past. In their charter, the team was instructed to inspect previous line losses because regional inspectors noted that the station had experienced a high number of offsite power interruptions in the recent past. Based on this observation, the team requested information relating to previous line losses and learned that since 2004, there had been 31 instances of offsite power interruptions of at least one line. The team licensee staff had been done in these instances. The team learned that the cognizant engineer had kept a spreadsheet of all of these instances and what actions had been taken. The team noted that only 25 of these instances had been entered into the corrective action program.

Section 2.1 of Procedure AP 28A-100 states that this procedure applies to adverse conditions that affect equipment, procedures, or personnel and conditions deemed to be undesirable or questionable. From this, the team concluded that offsite power line interruptions affecting the availability of offsite power were an adverse condition that

affected plant equipment that was undesirable, or at least questionable, and within the scope of Procedure AP 28A-100.

Section 6.1 of Procedure AP 28A-100 details the licensee's guidance for recognizing an adverse condition. Within this section, Step 6.1.1 instructs Wolf Creek personnel to initiate a condition report document when they recognize an adverse condition. Substep 1 of Step 6.1.3 of Procedure AP 28A-100 gives examples of some adverse conditions. These include:

Step 1.b. A plant or system transient
Step 1.c. An unanticipated actuation or reposition of equipment

The team concluded that offsite power line interruptions comprised an offsite power system transient. They also concluded that offsite power line interruptions comprised unanticipated repositioning of equipment.

Based on these conclusions, the team determined that the licensee should have recognized these conditions as adverse conditions and as a result entered them into their corrective action program.

The team also observed that all line losses since August 2008 were entered into the corrective action program. From this, the team concluded that the failure to enter adverse conditions in the corrective action problem was being addressed by the licensee's ongoing problem identification and resolution improvement initiative and was not indicative of current performance.

Analysis. The performance deficiency associated with this finding involved the licensee's failure to follow the requirements of Wolf Creek Procedure AP 28A-100. Specifically, licensee personnel failed to recognize adverse conditions with respect to the corrective action program which affected the reliability of the offsite power system. This finding is greater than minor because if left uncorrected, the failure to fully utilize the corrective action program could become a more significant safety concern. This finding was more than minor because it impacted the equipment performance attribute of the Initiating Events Cornerstone objective to limit the likelihood of those events that upset plant stability and challenge critical safety functions during shutdown as well as power operations. Using Manual Chapter 0609.04, "Phase 1 – Initial Screening and Characterization of Findings," the inspectors determined that the finding was of very low safety significance (Green) because it did not contribute to both the likelihood of a reactor trip and the likelihood that mitigation equipment or functions would not be available. A crosscutting aspect was not identified for this finding because the inspectors concluded the deficiency in this area was not indicative of current performance.

Enforcement. The performance deficiency did not involve a violation of regulatory requirements because the offsite power sources feeding the Wolf Creek switchyard are not safety-related. The licensee entered this issue into their corrective action program as Condition Reports 00022241 and 00022242. Because this finding does not involve a violation of regulatory requirements and has very low safety significance, it is identified as FIN 05000482/2009007-01, "Failure to Enter Adverse Conditions into the Corrective Action Program."

2. Handling and Evaluation of Noted Conditions

Introduction. The team identified a Green noncited violation of 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings," regarding the licensee's failure to follow the requirements of Procedures AP 28-001, "Operability Evaluations," and AP 26C-004, "Technical Specification Operability," associated with deficiencies resulting from the loss of offsite power induced pressure transient on the essential service water system. The pressure transient resulted in significant leakage from the system and required immediate repair.

Description. When the essential service water pumps started following the loss of offsite power event on August 19, 2009, the resulting pressure surge (water hammer) created forces that contributed to a three-eighths inch diameter circular hole in essential service water piping on the 1988' elevation of the auxiliary building. No operability evaluation was performed immediately following the August 19, 2009, event. Additionally, the licensee discovered multiple examples of through-wall leakage and essential service water piping wall thinning attributed to internal corrosion in the summer of 2009. In April 2008, a loss of offsite power had created a water hammer on the essential service water system piping resulting in leakage from control room air conditioner and emergency diesel generator heat exchangers. The air conditioning unit heat exchanger experienced sufficient forces to stretch the heat exchanger end bell bolting. In Operability Evaluation GK-08-004, the licensee determined that the piping and heat exchanger repairs were sufficient to assure continued functionality of the essential service water system. Operability Evaluation GK-08-004 did not evaluate the essential service water system as a whole to provide a documented basis for continued functionality after the water hammer event.

Wolf Creek Procedure AP 26C-004 required that an operability determination be performed "immediately upon determination that a deficiency exists that could affect the operability of an SSC subject to Technical Specifications." In Step 4.1.1 the procedure defined deficiency as "an all-inclusive term used in reference to any condition or circumstance that reduces the confidence that a structure, system, or component (SSC) will perform satisfactorily in service." The August 19, 2009, water hammer was not discussed in any corrective action document until September 23, 2009, when the NRC questioned the basis for continued operability of the system. During this inspection on September 24, 2009, the licensee initiated Operability Evaluation EF 09-007. This evaluation noted that the essential service water system safety design basis as described in Updated Safety Analysis Report 9.2.1.2.1.1 defined, in part, the following system required functions:

- Safety Design Basis Three – *Safety functions can be performed assuming a single active component failure coincident with the loss of offsite power (GDC 44)*

- Safety Design Basis Eleven – *The essential service water system is protected from long term organic fouling and corrosion problems*

Operability Evaluation EF 09-007 indicated that most of the essential service water system piping and valves are carbon steel and susceptible to internal localized corrosion. Wolf Creek relies on internal inspection of the essential service water piping whenever components within the system are removed for work. As noted above, several recent piping failures have occurred indicating an increased trend in degradation

of the piping wall thickness. There was no operability evaluation for the internal corrosion until prompting by NRC team inspectors.

The September 24, 2009, operability evaluation concluded that any subsequent corrosion causing piping leakage would be limited to essential service water flow losses less than or equal to those that have already occurred, and thus be bounded by the maximum allowable essential service water leakage (140 gpm) from the ultimate heat sink system. To address the possible future essential service water system water hammer events, the licensee is pursuing an engineered solution from a contracted engineering firm. The licensee is planning increased nondestructive inspection using ultrasonic detection of degraded wall thickness to determine the extent of condition.

Analysis. The performance deficiency associated with this finding involved the licensee's failure to perform an adequate operability evaluation for the essential service water system identified nonconforming conditions related to repeated occurrences of system water hammer and localized internal corrosion. This finding is more than minor because it is associated with the Mitigating Systems Cornerstone attribute of equipment performance and adversely affects the objective to ensure equipment availability and reliability. Using Manual Chapter 0609.04, "Phase 1 – Initial Screening and Characterization of Findings," the issue screened as having very low safety significance because it was not a design or qualification deficiency that resulted in a loss of operability or functionality, did not create a loss of system safety function of a single train for greater than the technical specification allowed outage times, and did not affect seismic, flooding, or severe weather initiating events. This finding has a crosscutting aspect associated with the problem identification and resolution area component of the corrective action program because licensee personnel failed to thoroughly evaluate problems such that the resolutions address all causal factors and extent of conditions, as necessary [P.1(c)].

Enforcement. Title 10 of the Code of Federal Regulations, Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings," requires, in part, that activities affecting quality shall be prescribed by documented instructions or drawings of a type appropriate to the circumstances and shall be accomplished in accordance with these instructions or drawings. Contrary to the above, following a water hammer event and essential service water system pressure boundary leakage in 2009, the licensee failed to use the operability process immediately upon determination that a deficiency existed that could have affected the operability of the essential service water system as required by Step 6.1.4 of Procedure AP 26C-004, "Technical Specification Operability." Specifically, the licensee failed to perform Step 6.1.6 of Procedure AP 26C-004, which calls for performance of an immediate operability determination. Because of the very low safety significance and Wolf Creek's action to place this issue in their corrective action program as Condition Report 00022240, this violation is being treated as a noncited violation in accordance with Section VI.A.1 of the Enforcement Policy: NCV 05000482/2009007-02, "Failure to Perform an Operability Evaluation."

3. Screening of Conditions in the Corrective Action Program

Introduction. The team identified a Green noncited violation of 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings," regarding the licensee's failure to follow the requirements of Procedure AI 28A-010, "Screening

Condition Reports," Revision 3A, associated with the effects of a loss of offsite power induced water hammer of the essential service water system.

Description. On August 19, 2009, a complete loss of offsite power resulted in a water hammer of the essential service water system which created forces that contributed to a three-eighths inch diameter circular hole in essential service water piping on the 1988' elevation of the auxiliary building. In June and July of 2009, the licensee identified that internal corrosion had created through-wall leakage on the 1974' elevation essential service water piping. In April 2008 a similar loss of offsite power created a water hammer of the essential service water piping. This occurrence created leakage from control room air conditioner and emergency diesel generator heat exchangers. The air conditioning unit heat exchanger experienced sufficient forces to stretch the heat exchanger end bell bolting. These are four recent examples of system damage to one of the most risk significant systems at Wolf Creek Generating Station. Condition Report 2008-004983 describes four additional essential service water system water hammers in 1993, 1995, 1999, and 2004 that resulted in system damage.

Wolf Creek Procedure AI 28A-010, uses a qualitative risk matrix table to determine whether identified conditions adverse to quality require a root cause analysis. The matrix describes that risk vulnerability is a product of the probability of an occurrence and its potential consequence. A qualitative consequence is determined to be 'marginal' if system damage or a noncritical equipment failure occurs. A qualitative consequence is determined to be 'critical' if major system damage occurs, or if an event results in a loss of production or could have resulted in catastrophic consequences under different circumstances. The widespread corrosion effects on both trains of the essential service water system and the vulnerability to large leaks after loss of offsite power induced essential service water water hammer events could be considered 'critical' by these definitions. These adverse conditions definitely meet the 'marginal' definition. The matrix describes a qualitative consequence as 'probable' if the condition is likely to occur several times in the life of an individual system. This frequency was validated by the multiple examples described above that resulted in through-wall leaks and damage to the essential service water system supplied heat exchangers. Using the licensee matrix, the combination of 'critical' and 'probable' results in requirement to conduct a Level 1, high, root cause analysis. A combination of 'marginal' and 'probable' results in a requirement to conduct a Level 2, moderately high, root cause analysis. At the time of inspection, the licensee had initiated two condition reports addressing essential service water leakage from these adverse conditions. Condition Report 2008-001660 followed the April 2008 complete loss of offsite power event and water hammer which resulted in a Level 4, low risk, basic evaluation. The June, July, and August 2009 essential service water leakage events were rolled together into Condition Report 00018785 that was screened as a Level 3, moderately low risk, apparent cause evaluation.

The licensee has inspected only a small portion of the essential service water system piping to identify the magnitude and location of other likely localized corrosion under deposits. Possible inspection methods include internal inspections and ultrasonic measurements.

Analysis. The performance deficiency associated with this finding involved the licensee's failure to follow the requirements of Wolf Creek Procedure AI 28A-010. Specifically, licensee personnel did not effectively screen condition reports for the adverse conditions of internal corrosion and loss of offsite power induced water

hammers to require a root cause analysis. This finding is greater than minor because if left uncorrected, the failure to fully utilize the corrective action program could become a more significant safety concern. The inspectors determined that this finding impacted the Mitigating Systems Cornerstone. Using Manual Chapter 0609.04, "Phase 1 – Initial Screening and Characterization of Findings," the issue screened as having very low safety significance because it was not a design or qualification deficiency that resulted in a loss of operability or functionality, did not create a loss of system safety function of a single train for greater than the technical specification allowed outage times, and did not affect seismic, flooding, or severe weather initiating events. The cause of this finding is related to the problem identification and resolution crosscutting component of the corrective action program because licensee personnel failed to thoroughly evaluate problems such that the resolutions address causes and extent of conditions [P.1(c)].

Enforcement. Title 10 of the Code of Federal Regulations, Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings," requires, in part, that activities affecting quality shall be prescribed by documented instructions or drawings of a type appropriate to the circumstances and shall be accomplished in accordance with these instructions or drawings. Contrary to the above, prior to September 2009, the licensee failed to accomplish on activity affecting quality in accordance with documented instructions. Specifically, as required by Step A.1 of Attachment A to Wolf Creek Procedure AI 28A-010, "Screening Condition Reports," the licensee failed to correctly determine the appropriate probability associated with occurrences of water hammer damage and essential service water piping corrosion that resulted in system damage. Specifically, the licensee did not apply Step A.4.2, "Probable," in accordance with the definition in Step A.4.2, and therefore the licensee's application of Step A.6, "Qualitative Risk Matrix," was inappropriate. As a result of the incorrect screening, Condition Report 00018785 did not require performance of a root cause analysis and did not evaluate the additive effect of documented loss of offsite power induced water hammers and internal corrosion. Because of the very low safety significance of this finding and because the licensee has entered this issue into their corrective action program as Wolf Creek Condition Report 00022239, this violation is being treated as a noncited violation in accordance with Section VI.A.1 of the Enforcement Policy:
NCV 05000482/2009007-03, "Failure to Correctly Screen Essential Service Water Piping Leaks for Significance."

1R3 Review of the Licensee's Offsite Power System

a. Inspection Scope

The inspectors reviewed the licensee's actions for prior instances of loss of the offsite power lines and whether the licensee's actions were commensurate with the number of previous line failures. Additionally the inspectors assessed the licensee's ability to meet the General Design Criteria requirements for independence of the offsite power lines in light of conditions surrounding the event.

b. Findings

Unresolved Item: 345 kV Offsite Power System Compliance with General Design Criterion 17

The 345 kV switchyard currently provides both sources of offsite power to the plant. The original design of the offsite power system included a 345 kV source from the 345 kV switchyard and a separate 69 kV source from the 69 kV switchyard. In April 1982, the NRC concluded that the original design was acceptable because the circuits provided sufficient assurance that redundant and independent sources of offsite power were provided, as required by General Design Criterion 17. The NRC safety evaluation report was in two parts. The first described offsite power inside the Standardized Nuclear Unit Power Plant System design and the second described offsite power to the Wolf Creek specific Standardized Nuclear Unit Power Plant System (i.e., Wolf Creek). In 1983, Wolf Creek Generating Station reanalyzed the offsite power system and determined that changes needed to be made to the Updated Safety Analysis Report. Wolf Creek Generating Station submitted the revised Updated Safety Analysis Report pages to the NRC which described the changes to the switchyard and how General Design Criterion 17 would be met. The significant changes were removing one of the four proposed 345 kV transmission lines coming into the 345 kV switchyard and adding a 345/69 kV transformer to connect the 345 and 69 kV switchyards. Thus, both offsite power sources were routed through the common 345 kV switchyard versus from separate switchyards. In 1985 the NRC concluded that the design changes met the requirements of General Design Criterion 17 and were acceptable. The removal of this portion of the USAR was not described in Wolf Creek's submittal and the effective deletion of the NRC's 1983 safety evaluation report were not described in the NRC approval. Thus, this Updated Safety Analysis Report change also effectively removed the second portion of the NRC safety evaluation report from the licensing basis that described how the plant's 345 kV and 69 kV switchyards met the independence requirements of General Design Criterion 17.

After the NRC approved the offsite power design changes in 1985, Wolf Creek Generating Station installed an additional 345/13.8 kV transformer. The new configuration bypassed the 69 kV switchyard and went directly to the onsite XNB01 safety related transformer. In the 10 CFR 50.59 evaluation, Wolf Creek Generating Station determined that this would be a more reliable source of offsite power than the previously approved source, which was routed through the 69 kV switchyard. Wolf Creek Generating Station determined that the new design met General Design Criterion 17. The inspectors were not able to determine if these design changes were submitted to the NRC for approval and if the changes, including those in 1983, would have been accepted as conforming to General Design Criterion 17. Therefore, this issue is unresolved pending more NRC inspection of the General Design Criterion 17 acceptance criteria applied by Wolf Creek Generating Station and basis and verification of the removal of the 69 kV system from the offsite power analysis: Unresolved Item 05000482/2009007-04, "345 kV Offsite Power System Compliance with General Design Criterion 17."

1R4 Review of the Licensee's Essential Service Water System

.1 Review of Generic Letter 89-13 and Periodic Verification Program

a. Inspection Scope

The team reviewed the licensee's Generic Letter 89-13, "Service Water System Problems Affecting Safety-Related Equipment," program for the essential service water system including the licensee's periodic verification program. As part of their review, the inspectors examined the licensee's response to Generic Letter 96-06, "Assurance of Equipment Operability and Containment Integrity during Design-Basis Accident Conditions," dated September 30, 1996. Additionally, the inspectors reviewed the licensee's engineering analysis of the system and testing results to ensure the essential service water system is adequately designed and has the ability to function under design-basis conditions.

b. Findings and Observations

The team determined that while the licensee had appropriately followed their Generic Letter 89-13 program for the essential service water system, their implementing procedures did not result in identifying and correcting pipe wall wastage mechanisms prior to localized pitting becoming through-wall leaks.

Introduction. The team identified a Green noncited violation of 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings," regarding the licensee's failure to provide adequate guidance to identify and address pitting, corrosion, and surface-breaking flaw indications in the essential service water system. Previous licensee self-assessment efforts and associated corrective actions recognized the need for increased monitoring of piping system pitting and wall thinning but had not translated the need into the implementing procedures such that the service water monitoring program could address extent of condition.

Description. From 2005 to 2009, at least five examples of through-wall leakage from the essential service water piping were documented in the Wolf Creek service water monitoring and corrective action programs. The cause and extent of condition of essential service water system leaks were not fully addressed by the licensee due to procedural inadequacies. This was evident because the licensee monitoring efforts were unable to ensure the continuous system degradation did not reduce essential service water pipe wall thickness below the minimum allowed ASME code specifications.

The essential service water system is a critical system for the plant because it is tied to the ultimate heat sink for the facility and because the system is relied upon to provide appropriate cooling to the heat exchangers and coolers in safety-related systems needed for accident mitigation or safe-shutdown of the facility. As documented in the addendum to Wolf Creek Condition Report 00018785, the Wolf Creek essential service water system has had a history of corrosion and leakage. The licensee only assessed, and if necessary corrected, degradation in the essential service water system on a case-by-case basis, and only after determining that the degradation had progressed to an unacceptable state; that is, only after actual wall thickness for a component was below the minimum wall thickness requirement or after the component had leaked.

NRC Generic Letter 89-13, applies to all holders of operating licenses for nuclear power generation facilities, and requested that licensees implement augmented activities for those service water systems that are tied to the ultimate heat sink and that are used to provide cooling for safety-related systems and components during operational transients and postulated design basis accidents. These augmented inspection, surveillance, and maintenance programs were designed to:

- Significantly reduce the incidence of flow blockage problems as a result of biofouling

- Ensure that corrosion, erosion, protective coating failure, silting, and biofouling cannot degrade the performance of the safety-related systems supplied by service water

- Confirm that these type of emergency or essential service water systems will perform their intended function in accordance with the licensing basis for the plant

- Confirm that maintenance practices, operating and emergency procedures, and training that involves these types of service water systems are adequate to ensure that safety-related equipment cooled by the systems will function as intended

Wolf Creek implements its Generic Letter 89-13 program in accordance with administrative Procedures ADM-01-100, "Lake Water Systems Inspection, Monitoring and Maintenance Program," and AP-23L-001 "Lake Water Systems Corrosion and Fouling Program," dated March 21, 2005. These procedures refer to augmented inspection Procedures QCP-20-518, "Visual Examinations of Heat Exchangers and Piping Components," and WCRE-13, "Lake Water Systems Structural Integrity Program." The purpose of these lake water procedures is to detect degradation in the essential service water system prior to a leakage event. The inspection procedure for implementing augmented visual examinations of the essential service water system is Procedure QCP-20-518.

Procedure WCRE-13 is the augmented volumetric inspection procedure. Procedure WCRE-13 did not consider essential service water piping with intermediate flow velocities to be susceptible to wall thinning mechanisms. Intermediate flow velocity sections of pipe are in WCRE-13, but they were not inspected. It also does not identify silting deposits (under deposits) as possible sources of microbiologically influenced corrosion in the essential service water system. This is inconsistent with the definition for "tubercles" in visual inspection Procedure QCP-20-518 which does identify that silting tubercles (under deposits) can be a source of microbiologically influenced corrosion. The August 19, 2009, leak was through intermediate level velocity piping and was partially caused by pitting and wall-thinning. The inspection team determined that each of these procedures have inadequacies that have prevented detection, adequate expansion of extent of condition testing for microbiologically influenced corrosion, and thus corrective action for pitting related degradation in the essential service water system. Thus, significant portions of piping would not have received inspection until after they suffered through wall leaks.

These procedure inadequacies were recognized in 2007 Licensee Self-assessment Number 76, “Lake Water Corrosion, Fouling and Chemistry,” which identified:

- A need to establish a pit monitoring program for the essential service water system

- A need to revise Wolf Creek’s volumetric inspection Procedure WCRE-13, to be consistent with the augmented inspection guidelines in EPRI Service Water Piping Guideline [EPRI Report TR-1010059]

Corrective action procedures also contributed to the inadequate verification of the essential service water system material condition. Section 6.1.3 of Procedure AP 28A-100, “Condition Reports,” did not identify detection of degradation or corrosion as an adverse condition for generating condition reports at the facility. As a result, documentation of corrosion on the inside surfaces of the essential service water system was not normally translated into appropriate condition reports until either a leak had occurred or essential service water pipe wall thickness had thinned to below the minimum ASME Code, Section III, wall thickness requirements. Additionally documentation of corrosion occurring on the outside surfaces of essential service water system piping did not occur prior to August 2009.

Analysis. The performance deficiency associated with this finding was a failure to include appropriate essential service water system quality standards and acceptance criteria in Procedures QCP-20-518, WCRE-13, and AP 28A-100 to address:

- depth sizing relevant surface-breaking flaw indications and abnormal gross degradation (such as corrosion, erosion, or wear)

- extent of degradation

- blockage as a result of microbiologically influenced corrosion, macrofouling, silting or corrosion deposits

As a result of the inadequate procedures, appropriate corrective actions could not occur when essential service water internal surfaces indicated the presence of corrosion. This finding is greater than minor because if left uncorrected, the failure to fully utilize the lake water and corrective action programs could become a more significant safety concern. The inspectors determined that this finding impacted the Mitigating Systems Cornerstone. Using Manual Chapter 0609.04, “Phase 1 – Initial Screening and Characterization of Findings,” the issue screened as having very low safety significance because it was not a design or qualification deficiency that resulted in a loss of operability or functionality, did not create a loss of system safety function of a single train for greater than the technical specification allowed outage times, and did not affect seismic, flooding, or severe weather initiating events. This finding has a crosscutting aspect in the area of problem identification and resolution associated with the corrective action program because licensee personnel failed to take appropriate corrective actions to address safety issues and adverse trends in a timely manner [P.1(d)].

Enforcement. Title 10 of the Code of Federal Regulations, Part 50, Appendix B, Criterion V, “Instructions, Procedures, and Drawings,” requires, in part, that activities affecting quality shall be prescribed by documented instructions or drawings of a type

appropriate to the circumstances and shall be accomplished in accordance with these instructions or drawings. Contrary to the above, prior to September 2009, Procedures QCP-20-518, "Visual Examinations of Heat Exchangers and Piping Components," and AP 28A-100, "Condition Reports," were not appropriate to the circumstances because the licensee failed to include appropriate quality standards and acceptance criteria for corrosion in the essential service water system. As a result of these procedural deficiencies, the licensee did not evaluate the affect of documented internal corrosion. Because of the very low safety significance of this finding and because the licensee has entered this issue into their corrective action program as Condition Report 00022243 this violation is being treated as a noncited violation in accordance with Section VI.A.1 of the Enforcement Policy: NCV 05000482/2009007-05, "Failure to Ensure Adequate Acceptance Criteria and Extent of Condition Guidance in Lake Water and Corrective Action Program Procedures."

.2 Review of the Bases for Insulating Essential Service Water Piping

a. Inspection Scope

The team evaluated the licensee's bases for insulating the essential service water system piping in the auxiliary building. The licensee's design drawings and design basis documentation were reviewed. Also, key personnel from design and system engineering were interviewed.

b. Findings

No findings of significance were identified.

.3 Review of the Evaluation for Piping Structural Integrity

a. Inspection Scope

The team evaluated the licensee's evaluation of the structural integrity of the essential service water system piping with the 3/8-inch hole which had developed during the event. In their evaluation, the licensee applied Code Case N-513-2 to the ASME Piping Code. This code case required the licensee to perform additional monitoring of the essential service water system piping. The team reviewed acceptability of the chosen monitoring the licensee adopted. Key personnel from operations, design and system engineering, maintenance, and the corrective action program were interviewed. The NRC Office of Nuclear Reactor Regulation also provided technical assistance to the inspection team during the review of this area (Attachment 3).

b. Findings

No findings of significance were identified.

.4 Review of Essential Service Water System Piping Repairs

a. Inspection Scope

The team evaluated the licensee's repairs to the 3/8-inch hole in the essential service water system piping that occurred during the event. The licensee also discovered

another area that was below the minimum wall thickness prescribed by the American Society of Mechanical Engineering Code after the event. This condition and its repair was also reviewed by the team. Key personnel from operations, design and system engineering, maintenance, and the corrective action program were interviewed.

b. Findings

No findings of significance were identified.

1R5 Review of Plant Systems during the Event

.1 Observed Pressure Oscillations in the Auxiliary Feedwater System

a. Inspection Scope

During the event, the senior resident inspector noted there was indication that the pressure in the auxiliary feedwater system at the suction of the pumps was oscillating. The team reviewed the acceptability of the observed pressure oscillations observed on the suction of the auxiliary feedwater pumps and their impact on system operability and technical specifications. Applicable system piping and instrumentation diagrams along with system isometrics drawings were reviewed. Also, the team walked down the auxiliary feedwater system suction piping to verify the drawings and assumptions the licensee made relative to the indications and their impact on the system. Finally, key personnel from operations, design and system engineering, maintenance, and the corrective action program were interviewed.

b. Findings

No findings of significance were identified.

.2 Water Hammer on the Essential Service Water System

a. Inspection Scope

The team verified that a water hammer occurred on the essential service water system on August 19, 2009. The team noted multiple previous examples of water hammer occurrences were documented in the licensee's corrective action system as mentioned and detailed in Condition Report 2008-004983.

The team evaluated the licensee's procedures for water hammer response and corrective actions to previous water hammer events. The licensee's response to Generic Letter 96-06, "Assurance of Equipment Operability and Containment Integrity During Design-basis Accident Conditions," was reviewed. Key personnel from operations, design and system engineering, maintenance, and the corrective action program were interviewed.

b. Findings

Introduction. The team identified a Green noncited violation of 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings," regarding the licensee's failure to provide adequate guidance to address the impact of a loss of offsite power event on the essential service water system.

Description. On August 19, 2009, a leak of approximately 20 gpm from the essential service water system piping occurred on the 1988' elevation level of the auxiliary building concurrent with a loss of offsite power event. This plant area was not frequently entered by plant personnel. The plant's emergency diesel generators started per design and sequenced on safety loads including two trains of essential service water pumps. The design of the load sequencing subjects the plant essential service water piping to a water column separation from the piping high point. Wolf Creek Procedure STN PE-040G, "Transient Event Walkdown," required that several plant systems subject to expected transient dynamic forces following a reactor trip to have a post-trip walkdown to identify any structural damage from the off-normal forces. The walkdown procedure did not identify the essential service water system as vulnerable to such dynamic forces. However, the procedure's Appendix H did allow for operations shift management to designate additional systems to walk down following reactor trip events. This procedure was used in a very similar loss of offsite power induced water hammer on April 7, 2008. That event recognized an essential service water piping walkdown was needed after leakage from several locations had been identified.

With the current essential service water system design, every loss of offsite power event at Wolf Creek will result in a water column separation and subsequent re-pressurization by the loss of normal service water pumps and the sequencing on of the essential service water pumps. This phenomenon was not specifically described in the licensee's Updated Safety Analysis Report; however, it had been clearly identified in previous Wolf Creek condition reports (00012990, 00009688, 2008-005075, 2008-004983, and 2008-001660). This was also evident by Wolf Creek's response to NRC Generic Letter 96-06, "Assurance of Equipment Operability and Containment Integrity During Design-Basis Accident Conditions," September 30, 1996. Despite the abundant internal operating experience, Procedure STN PE-040G did not identify essential service water as a required walkdown system. The post-trip walkdown procedure only required walkdowns inside the containment building unless specified by operating department shift supervisors. From the recent implementation of the procedure, outside containment piping system damage must be self-evident to result in usage of STN PE-040G, Appendix H. The August 19, 2009, leak was discovered approximately seven hours after the reactor trip by the NRC resident inspectors and not by the licensee. The resident inspectors had noted one to three inches of water buildup on the floor one level below the elevation where the leak had occurred seven hours earlier.

Analysis. The performance deficiencies of this finding are the inadequate walkdown procedure for post loss of offsite power reactor trips and the failure of the operations crew to recognize the need to require a walkdown of the essential service water system in its entirety following the loss of offsite power and reactor trip. This finding is more than minor because it is associated with the Mitigating Systems Cornerstone attribute of procedure quality and adversely affects the objective to ensure equipment availability and reliability. This finding is of very low safety significance because it was not a design deficiency or qualification deficiency, did not represent a loss of system safety function, did not represent an actual loss of safety function of one or more non-technical specification trains of equipment designated as risk-significant, and was not potentially risk significant due to a seismic, flooding, or a severe weather initiating event. This finding is related to the area of problem identification and resolution and is associated with the operating experience crosscutting component because the licensee failed to use information, including vendor recommendations, and internally generated lessons

learned, to support plant safety. Specifically, the licensee failed to implement and institutionalize operating experience through changes to station walkdown procedures [P.2(b)].

Enforcement. Title 10 of the Code of Federal Regulations, Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings," requires, in part, that activities affecting quality shall be prescribed by documented instructions or drawings, of a type appropriate to the circumstances and shall be accomplished in accordance with these instructions or drawings. Contrary to the above, Procedure STN PE-040G, "Transient Event Walkdown," was not appropriate to the circumstances in that it was not adequate to detect essential service water system damage on August 21, 2009. Because of the very low safety significance and Wolf Creek's action to place this issue in their corrective action program as Condition Report 00022265, this violation is being treated as a noncited violation in accordance with Section VI.A.1 of the Enforcement Policy: NCV 05000482/2009007-06, "Inadequate Procedure Resulted in Failure to Discover Essential Service Water System Leakage Following a Water Hammer Event."

.3 Impact on Internal Flood Control Mitigation Capability

a. Inspection Scope

The team noted that water from the essential service water system was entering the auxiliary building and that the plant's room drain pump were powered from non-emergency sources. In light of this, the team reviewed the design and operation of the internal flood control features in the plant and their ability to mitigate a leak during a sustained loss of offsite power event. Pertinent plant drawings were reviewed. Also, key personnel from operations and engineering were interviewed.

b. Findings

No findings of significance were identified.

.4 Effects of Loss of Power to Plant Radiation Monitors

a. Inspection Scope

During the event, numerous radiation monitors lost power. Due to their design, some required resetting and other actions to place them back in to operation. The team reviewed monitors that were unavailable at any time during or after the event and determine if any of the radiation monitor failures experienced in the event would have hampered further actions (e.g., implementing the emergency plan). The team reviewed plant logs, plant computer system data, and the licensee's emergency action level procedures to evaluate the effects. Also, key personnel from radiation protection, emergency planning, and maintenance were interviewed.

b. Findings

No findings of significance were identified.

.5 Partial Loss of Fire Detection System Capability

a. Inspection Scope

The team reviewed the actions taken for the loss of fire detection capability in the auxiliary building during the event. In their review, the team sought to establish if this loss of detection capability was anticipated in plant design.

b. Findings

1. Operations Department Actions to Compensate for the Loss of Detection

Introduction. The team identified a Green noncited violation of License Condition 2.C.(5), "Fire Protection," for the failure to establish a compensatory fire watch in a timely manner per the station fire protection program.

Description. On August 19, 2009, a complete loss of offsite power resulted in a reactor trip. Immediately after the trip, fire protection trouble alarms came in on fire protection panel KC-008. The control room supervisor acknowledged the alarms and verified that every smoke detector in window 109 of the panel was in a trouble alarm state. The control room supervisor dispatched personnel to verify a fire existed in accordance with Procedure OFN KC-016, "Fire Response." Licensee personnel reported that a fire did not exist in the location of the alarming smoke detectors. Since there was not an actual fire, the procedure directed the control room supervisor to exit Procedure OFN KC-016 and enter alarm Procedure ALR KC-888, "Fire Protection Panel KC-008 Alarm Response." Step 4.3.1 required, in part, the operator to take appropriate compensatory measures per administrative Procedure AP 10-103, "Fire Protection Impairment Control," for the smoke detectors that were in a trouble alarm state.

The control room supervisor was preoccupied with actions related to the reactor trip and did not perform the required action to initiate a fire protection impairment. The control room supervisor assigned the action to the nightshift control room supervisor during the shift turnover. The nightshift control room supervisor subsequently assigned the action to the nightshift shift engineer. The nightshift shift engineer failed to initiate the appropriate compensatory measures for the alarming smoke detectors. The next morning, the NRC senior resident inspector questioned why no impairment had been established for the alarms on KC-008. The dayshift shift engineer subsequently discovered the detectors were inoperable and issued the impairment for the 13 affected fire zones.

The team determined that a significant contributor to the finding was that the licensee did not follow their procedures as required. Both the dayshift and nightshift control room supervisors delegated the responsibility of initiating the impairment and failed to verify that the task was completed. Not having proper compensatory measures in place added unnecessary risk to the plant.

Analysis. The licensee's failure to initiate fire protection impairment and establish an hourly fire watch for the areas impacted by the inoperable fire detectors was a performance deficiency. The finding was more than minor since it was associated with the protection against the external factors attribute of the Mitigating Systems Cornerstone, and adversely affected the cornerstone objective to ensure the availability,

reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. Using Manual Chapter 0609, Appendix F, "Fire Protection Significance Determination Process," the inspectors determined that this finding had an adverse affect on the fixed fire protection systems element of fixed fire detection systems. The inspectors assigned a high degradation rating due to the fact that all the smoke detectors in the fire zones were inoperable. Because the system was degraded without compensatory actions for approximately 15 hours and licensee personnel were walking through the auxiliary building performing post-trip actions, senior reactor analysts determined this finding to be of very low safety significance. This finding had a crosscutting aspect in the area of human performance associated with the work practices component because the licensee failed to ensure supervisory oversight of work activities such that nuclear safety is supported [H.4(c)].

Enforcement. License Condition 2.C.(5) states, in part, that the licensee shall maintain in effect all provisions of the approved fire protection program as described in the Standardized Nuclear Unit Power Plant System (SNUPPS) Final Safety Analysis Report for the facility through Revision 17, the Wolf Creek Site Addendum through Revision 15, and as approved in the Safety Evaluation Report through Supplement 5. The Wolf Creek Updated Safety Analysis Report combined the SNUPPS Final Safety Analysis Report, Revision 17, and the Wolf Creek Site Addendum, Revision 15, into one document. Updated Safety Analysis Report, Appendix 9.5A, Section B, "Administrative Procedures, Controls and Fire Brigade," states that work control procedures, which include identification of the need for special action such as a fire watch, are utilized.

Contrary to the above, the licensee failed to utilize work control procedures to identify the need for a special action (fire watch). Specifically, the licensee did not issue a fire protection impairment and implement an hourly fire watch within one hour as required by administrative Procedure AP 10-103, "Fire Protection Impairment Control." This issue and the corrective actions are being tracked by the licensee in Condition Report 00019320. Because the finding is of very low safety significance and has been entered into the corrective action program, this violation is being treated as a noncited violation, consistent with Section VI.A.1 of the NRC Enforcement Policy: NCV 05000482/2009007-07, "Failure to Initiate Timely Fire Protection Impairment Control Permit and Implement Compensatory Measures."

2. Uncontrolled and Unanalyzed Room Environment Following a Loss of Offsite Power

The Wolf Creek Station Blackout Coping Assessment, Section 4.5, evaluated the "Effects of Loss of Ventilation," associated with the loss of offsite power. Specifically, the assessment evaluated the loss of auxiliary building ventilation effects on the environment surrounding the turbine-driven auxiliary feedwater pump room. The evaluation states: "It is shown that the turbine-driven auxiliary feedwater pump room air temperature will stay below 150 degrees Fahrenheit turbine-pump design specifications provided actions are taken to open doorways to enhance air circulation." The final steady state temperature of the room is determined by a NUMARC methodology. This methodology assumed an "open door formula"; that is, a need to open the four other doors adjacent to the corridor outside the turbine-driven auxiliary feedwater pump room. This action was not performed during the August 19, 2009, loss of offsite power/loss of auxiliary building ventilation event. Due to this, temperatures in the corridor were recorded above the assumed maximum of 113 degrees Fahrenheit using the open door formula. With the doors remaining closed, the calculation determined that the turbine-driven auxiliary

feedwater pump room temperatures would rise to 170 degrees Fahrenheit, which is above that allowable to maintain the room's equipment operable.

The turbine-driven auxiliary feedwater pump steam drain traps in room 1206/1207 below the corridor exhausted to the floor drains. During steady-state conditions, the ventilation system keeps the steam from accumulating in the room. However, during a loss of offsite power event, the ventilation system no longer functions and the steam heats up the room. This additional heat source to the corridor was not accounted for in the station blackout analysis and created conditions not previously analyzed associated with room 1206/1207. The licensee did not provide an adequate evaluation or adequate procedural guidance to address the impact of a loss of offsite power on the auxiliary feedwater system.

The concerns associated with the steam environment in room 1206/1207 below the auxiliary feedwater pump rooms were:

- The safety related transmitters for condensate storage tank swap-over could be challenged
- The seismic supports for essential service water piping in the room could be affected by the increased local temperature
- Manual operator actions to manipulate an essential service water motor operated valve could be challenged due to visibility and local temperatures

This issue is unresolved pending further NRC inspection of the evaluation by Wolf Creek Generating Station associated with steam exhausting into rooms 1206/1207 and the corridor outside the auxiliary feedwater pump rooms following a loss of offsite power: Unresolved Item 05000482/2009007-08, "Uncontrolled and Unanalyzed Room Environment Following a Complete Loss of Offsite Power."

1R6 Review of the Post-Trip Report

a. Inspection Scope

The team reviewed the licensee's post-trip report prepared for analyzing the event. The report was initially reviewed prior to plant restart and again during the onsite portion of the special inspection. The team interviewed key personnel from operations and engineering to discuss the findings of the report.

b. Findings

No findings of significance were identified.

1R7 Review of High Level in Steam Generator Following the Event

a. Inspection Scope

On August 21, 2009, the licensee reported to the NRC a condition in which the level in Steam Generator A exceeded the 78 percent level. The team reviewed the licensee's report, control room logs, plant computer data, and pertinent plant operating procedures. Also, key personnel from the operations department were interviewed.

b. Findings

Introduction. A self-revealing Green noncited violation of Technical Specification 5.4.1.a, "Procedures," was reviewed involving a failure to monitor and maintain steam generator water levels resulted in an unanticipated turbine trip signal and feedwater isolation.

Description. On August 21, 2009, while in Mode 3, Wolf Creek control room received annunciator 112A, "S/G LEVEL HIGH TURB TRIP." This was caused by operator inattention during shift turnover. Steam generator A level had increased to the 78 percent, P-14 feedwater isolation actuation setpoint. This was above the 40 percent to 60 percent operating band designated in Procedure GEN-OO-005, "Minimum Load to Hot Standby," and created the P-14 feedwater isolation, an engineered safeguards actuation signal. Control room operators responded to the feedwater isolation by restoring steam generator water levels to the program band.

The licensee had been having difficulties maintaining steam generator water levels since the reactor trip from full power on August 19, 2009. These difficulties were due to staying in Mode 3, steaming the steam generators with no automatic feedwater control, and atmospheric relief valves periodically releasing steam. The practice established had been to secure auxiliary feedwater flow as soon as an established operator selectable alarm indicated that Steam generator A was at 65 percent. This allowed for an anticipated additional 5 percent level increase due to swell of the introduced colder auxiliary feedwater and another 5 percent level increase caused by opening of the atmospheric relief valve.

The licensee determined that the oncoming shift operators had disabled an operator selectable alarm due to the constant alarms being a distraction. The trip signal and actuation occurred while the operators were walking down the control boards for shift turnover. Thus there were no additional operators monitoring the steam generator A level. Disabling the operator selectable alarm, not having a dedicated operator monitoring steam generator water levels when in manual control, and intentionally allowing levels to go above the control band were all contrary to licensee Procedure AI 21-100, "Operations Guidance and Expectations."

Analysis. The performance deficiency associated with this finding involved the failure to control and maintain steam generator water levels as required in Procedure GEN-OO-005. This finding was determined to be greater than minor because it impacted the Initiating Events Cornerstone attribute of human performance and affected the cornerstone objective to limit the likelihood of those events that upset plant stability and challenge critical safety functions during shutdown as well as power operations. Using Manual Chapter 0609.04, "Phase 1 - Initial Screening and Characterization of Findings," this finding was determined to be of very low safety significance since it did not affect the technical specification limit for reactor coolant system leakage or mitigation systems safety function, did not contribute to both the likelihood of a reactor trip and mitigation equipment or functions not being available, and did not increase the likelihood of a fire or internal/external flooding. The finding has a crosscutting aspect in the area of human performance associated with the decision making component because the licensee failed to make safety-significant or risk-significant decisions using a systematic process, especially when faced with uncertain or unexpected plant conditions [H.1 (a)].

Enforcement. Technical Specification 5.4.1.a, "Procedures," required that written procedures be established and implemented covering activities specified in Appendix A, "Typical Procedures for Pressurized Water Reactors," of Regulatory Guide 1.33, "Quality Assurance Program Requirements (Operation)," February 1978. Regulatory Guide 1.33, Appendix A, Section 2.i, requires procedures for plant shutdown to hot standby. Contrary to the above, on August 21, 2009, operators failed to implement Procedure GEN-OO-005, "Minimum Load to Hot Standby." Specifically the operators failed to control and maintain steam generator water levels between 40-60 percent as required in Step 7.4 of Section 7.0, "Final Conditions." Because of the very low safety significance and Wolf Creek's action to place this issue in their corrective action program as Condition Report 00019295, this violation is being treated as a noncited violation in accordance with Section VI.A.1 of the Enforcement Policy: NCV 05000482/2009007-09, "Failure to Adequately Control Steam Generator Water Levels."

1R8 Verification of Meeting Reporting Requirements

a. Inspection Scope

The team reviewed the conditions which occurred due to the event and the reports the licensee made to the NRC per 10 CFR Part 50.72, "Immediate Notification Requirements for Operating Nuclear Power Plants," and 10 CFR Part 50.73, "Licensee Event Report System." The team also interviewed key personnel from the operations, licensing, and emergency planning departments to discuss the content of and bases for their reports.

b. Findings and Observations

No findings of significance were identified. The review of Licensee Event Report 05000482/2009-002-00 issued for the event are discussed in Section 4OA3 of this report.

1R9 Review of Compliance with Technical Specifications

a. Inspection Scope

The team reviewed the conditions which occurred during and after the event relative to the actions taken by the licensee to review the licensee's compliance to their technical specifications. The team also interviewed key personnel from the operations and licensing departments.

b. Findings and Observations

One finding of significance is documented in Section 4OA7 of this report.

1R10 Review of Licensee's Decision to Maintain the Plant in Mode 3 After the Event

a. Inspection Scope

The team reviewed the conditions which occurred after the event, specifically relative to the licensee's decision to keep the plant in a hot standby condition rather than opting to

shut down and cool down the plant. The team reviewed plant procedures and interviewed key personnel from the operations and licensing departments in this effort.

b. Findings and Observations

No findings of significance were identified.

1R11 Review of Application of Emergency Action Level Scheme

a. Inspection Scope

The team reviewed the plant conditions which occurred after the event, specifically relative to whether the conditions met any entry conditions which would have required the licensee to declare a Notice of Unusual Event. The team reviewed plant procedures and interviewed key personnel from the emergency planning, operations, and licensing departments in this effort.

b. Findings and Observations

NRC inspectors reviewed licensee Procedure APF 06-002-01, "Emergency Action Levels (EAL)." The inspectors noted that the offsite power feeds to the 4 kV essential NB system busses were not restored until 1 hour and 50 minutes following the event, and the licensee did not report a Notice of Unusual Event. The team concluded this was in accordance with the licensee's EAL procedures because those procedures described that power interruptions to the NB transformers for less than 15 minutes would be considered momentary power losses and would not be required to be declared as a Notice of Unusual Event.

The team observed that any interruption of power to the 4 kV essential busses (as described in their EAL basis document) would have been difficult to recover from in less than 15 minutes. Because Wolf Creek training documents and the implementing emergency action level procedure specified restoring power to the NB transformers (and not the 4 kV busses) and did not emphasize when the 15 minutes to restore power to the 4 kV NB essential bus should start, the inspectors determined that no findings of significance had occurred.

Because they observed a disparity between the licensee's EAL procedure and bases, the team reviewed the potential scenario of having 15 minutes to restore power to the 4 kV busses alluded to in the EAL bases. The team reasoned that much of the 15 minutes could be used by the shift manager/emergency coordinator to verify that the crew is correctly performing its emergency response immediate actions, obtaining emergency action level procedural guidance, assessing the plant to determine which emergency action levels may be applicable, diagnosing the plant event effect on the switchyard and the 4 kV NB essential bus support components and determining what available personnel can be diverted from the emergency procedures and fire brigade response duties. The shift manager may also be involved in communications with the transmission grid operator to understand the grid status during this time. The team concluded that the time needed to perform these actions coupled with the time to perform bus power restoration Procedure OFN-NB-030, "Loss of AC Bus NB01 (NB02)," could consume much, if not all, of the prescribed 15 minutes to restore power to the NB busses had the procedure specified that the 15 minutes would start at the initiation of

the loss of all offsite power. From this, the inspectors determined that performing the associated emergency procedures would severely challenge a crew's resources making it questionable whether the crew's actual event response would ever be to able restore offsite power to the 4 kV NB essential busses within 15 minutes, requiring the licensee would have had to declare a Notice of Unusual Event.

The team also noted other factors specific to the August 19, 2009, loss of offsite power event which would prolong the time to restore power. During this event, operators took 27 minutes to complete the procedural steps which directed them to transition to bus restoration Procedure OFN-NB-030. Also, reports from licensee personnel of smoke near the NB system transformers during the event that day, the presence of actuated fire alarms in the nearby turbine building and auxiliary building during the event that day, and the presence of a 'trouble' alarm for each of the NB system transformers were factors which could have influenced the emergency coordinator's decision that power could be restored to the 4 kV NB essential busses within 15 minutes.

The team shared their observations with the licensee. The licensee entered this apparent procedural disparity condition into their corrective action program. .

4. OTHER ACTIVITIES

4OA3 Event Follow-up (71153)

(Closed) Licensee Event Report 05000482/2009-002-00: Loss of Offsite Power due to Lightning

Licensee Event Report 05000482/2009-002-00 was issued on October 17, 2009, after the onsite portion of the inspection. The events and facts detailed in this Licensee Event Report were covered and reviewed as part of this special inspection. The licensee has initiated appropriate corrective actions. No findings of significance were noted. This Licensee Event Report is closed.

(Closed) Licensee Event Report 05000482/2009-004-00: Feedwater Isolation on High Water Level in A Steam Generator

Licensee Event Report 05000482/2009-004-00 was issued on October 18, 2009, after the onsite portion of the inspection. The events and facts detailed in this Licensee Event Report were covered and reviewed as part of this special inspection. The licensee has initiated appropriate corrective actions. One finding of significance was noted and is contained in Section 1R7 of this report. This licensee event report is closed.

4OA6 Meetings, Including Exit

On September 25, 2009, the team presented the preliminary results of this inspection at the end of the onsite week to Mr. Rick A. Muench, President and Chief Executive Officer, and other members of his staff who acknowledged the findings. The team verified that no proprietary information was retained.

On December 22, 2009, the team leader presented the final results of the inspection to Mr. Matt Sunseri, Vice President Operations and Plant Manager, and other members of the licensee staff who acknowledged the findings. The team verified that no proprietary information was retained.

4OA7 Licensee-Identified Violations

The following violation of very low safety significance (Green) was identified by the licensee and is a violation of NRC requirements which meets the criteria of Section VI of the NRC Enforcement Policy, NUREG-1600, for being dispositioned as a noncited violation.

Technical Specification 5.4.1, "Procedures," required that written procedures be established and implemented covering activities specified in Appendix A, "Typical Procedures for Pressurized Water Reactors," of Regulatory Guide 1.33, "Quality Assurance Program Requirements (Operation)," February 1978. Regulatory Guide 1.33, Appendix A, Section 6.c, required procedures for combating emergencies and other significant events. Contrary to the above, from November 2, 2007, to August 19, 2009, Procedure EMG ES-02, "Reactor Trip Response," was inadequate for restoration of essential service water cooling to instrument air compressors. Specifically, Step 5a, "response not obtained," incorrectly directed operators to locally open valves EFHV0043 and EFHV0044. This action takes the valves out of their normal position and prevents their automatic isolation on a high flow condition. The unavailability of this automatic feature makes each train of essential service water inoperable. This finding is greater than minor because it was associated with the Mitigating Systems Cornerstone attribute of procedural quality and it affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. Using Manual Chapter 0609.04, "Phase 1 – Initial Screening and Characterization of Findings," the issue screened as very low safety significance because it was not a design or qualification deficiency that resulted in a loss of operability or functionality, did not create a loss of system safety function of a single train for greater than the technical specification allowed outage time and did not affect seismic, flooding, or severe weather initiating events. This finding was entered in the licensee's corrective action program as Condition Report 00019660

ATTACHMENT 1

SUPPLEMENTAL INFORMATION

KEY POINTS OF CONTACT

Licensee Personnel

T. Birzer, Lake Water Engineering
B. Blecha, Supervisor, Maintenance
W. Camp, Control Room Supervisor
A. Critchly, Corrective Action Technical Specifications
T. Damashek, Superintendent, Operations Support
D. Dees, Superintendent, Operations
B. Dorathy, Supervisor, Systems Engineering
T. Dougan, Quality
D. Erbe, Manager, Security
R. Flannigan, Manager, Regulatory Affairs
M. Free, Senior Nuclear Safety Officer
C. Garcia, Supervisor, Systems Engineering
R. Gardner, Manager Quality, Performance Improvement and Assessment
T. Garrett, Vice President, Engineering
D. Gholson, Reactor Operator
S. Good, Security
S. Hedges, Vice President, Oversight
D. Helm, Supervisor, Supervisor, Systems Engineering
S. Henry, Manager, Operations
R. Hubbard, Shift Manager, Operations
W. Kennamore, Manager Nuclear Engineering
B. Ketchum, Probabilistic Safety Analysis, Nuclear Engineer
M. Kewley, Senior Nuclear Safety Officer
G. Kinn, Supervisor, Nuclear Engineering
S. Koenig, Manager, Corrective Action
B. Masters, Supervisor, Design Engineering
D. McClure, Senior Reactor Operator
R. Muench, President and Chief Executive Officer
B. Muilenburg, Licensing
J. Myers, Reactor Operator
G. Neisis, Manager Design
W. Norton, Manager IPS/Scheduling
G. Pendergrass, Manager Systems Engineering
C. Peterson, Senior Nuclear Safety Officer
D. Phelps, Owners Representative
L. Ratzlaff, Manager Support Engineering
E. Ray, Manager, Chemistry/Health Physics
L. Rockers, Licensing
L. Solorio, Design Engineer
M. Sunseri, Vice President Operations and Plant Manager
B. Vickery, Supply Chain Manager
M. Westman, Manager, Training
S. Yunk, Senior Reactor Operator/Shift Technical Advisor

LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

Opened and Closed

05000482/2009007-01	FIN	Failure to Enter Adverse Conditions into the Corrective Action Program (Section 1R2)
05000482/2009007-02	NCV	Failure to Perform an Operability Evaluation (Section 1R2)
05000482/2009007-03	NCV	Failure to Correctly Screen Essential Service Water Piping Leaks for Significance (Section 1R2)
05000482/2009007-05	NCV	Failure to Ensure Adequate Acceptance Criteria and Extent of Condition Guidance in Lake Water and Corrective Action Program Procedures (Section 1R4)
05000482/2009007-06	NCV	Inadequate Procedure Resulted in Failure to Discover Essential Service Water System Leakage Following a Water Hammer Event (Section 1R5)
05000482/2009007-07	NCV	Failure to Initiate Timely Fire Protection Impairment Control Permit and Implement Compensatory Measures (Section 1R5)
05000482/2009007-09	NCV	Failure to Adequately Control Steam Generator Water Levels (Section 1R7)

Opened

05000482/2009007-04	URI	345 kV Offsite Power System Compliance with General Design Criterion 17 (Section 1R3)
05000482/2009007-08	URI	Uncontrolled and Unanalyzed Room Environment Following a Complete Loss of Offsite Power (Section 1R5)

Closed

05000482/2009-002-00	LER	Loss of Offsite Power due to Lightning (Section 4OA3)
05000482/2009-004-00	LER	Feedwater Isolation on High Water Lever in A Steam Generator (Section 4OA3)

DOCUMENTS REVIEWED

PROCEDURES

NUMBER	TITLE	REVISION / DATE
0400	Westar Energy, Inc. Transmission Operations Procedure	July 28, 2008
0414	Westar Energy, Inc. Transmission Operations Procedure	May 1, 2009

PROCEDURES

NUMBER	TITLE	REVISION / DATE
ADM 01-100	Lake Water Systems Inspection, Monitoring and Maintenance	March 21, 2005
AFP 06-002-01	Emergency Action Levels	12
AI 21-100	Operations Guidance and Expectations	15
AI 26A-003	Regulatory Evaluations (Other Than 10 CFR 50.59)	10
AI 28A-001	Level 1 CR Evaluation (IIT)	10
AI 28A-006	Level 3 Condition Report Evaluation	7
AI 28A-007	Level 2 CR Evaluation	2
AI 28A-008	Level 4 CR Evaluation	2
AI 28A-010	Screening Condition Reports	3A
ALR KC-888	Fire Protection Panel KC-008 Alarm Response	16
ALR 831	ESF Transformer XNB01	3
ALR832	EXF Transformer XNB02	3
ALR 00-019D	XNB01 Transformer Trouble	9
ALR 00-022D	XNB02 Transformer Trouble	9
ALR 00-127D	Condensate Storage Tank Level LoLo 2	7
ALR 00-127E	Condensate Storage Tank Level LoLo 1	10A
AP 10-10	Fire Protection Impairment Control.	23
AP 10-100	Fire Protection Program	14
AP 10-103	Fire Protection Impairment Control	11 and 21
AP 10-104	Breach Authorization	22
AP 10-106	Fire Preplans	8
AP 21-001	Conduct of Operations	43
AP 23I-001	Fatigue Management	1
AP 23L-001	Lake Water Supply Corrosion and Fouling Programs	March 21, 2005

PROCEDURES

NUMBER	TITLE	REVISION / DATE
AP 26C-004	Technical Specification Operability	20
AP 28-001	Operability Evaluations	17
AP 28A-100	Condition Reports	10
AP-21C-001	WCGS/Westar Substation	9
APF 06-002-01	Emergency Action Levels	12
BD-EMG C-0	Loss of All AC Power	11
EMG-E-0	Reactor Trip or Safety Injection	24
EMG ES-02	Reactor Trip Response	18
EPP 06-001	Control Room Operations	13
GEN-OO-005	Minimum Load to Hot Standby	62
OFN AF-025	Unit Limitations	27
OFN KC-016	Fire Response	22
OFN-NB-030	Loss of AC Emergency Bus NB01(NB02)	22
STN PE-040G	Transient Event Walkdown	1
STS NB-005	Breaker Alignment	4A
STS RE-004	Shutdown Margin Determination	25
SYS NB-201	Transferring NB01 Power Sources	42
SYS NB-202	Transferring NB02 Power Sources	37
QCP 20-518	Visual Examinations of Heat Exchangers and Piping Components	5A
WCRE-13	Lake Water Systems Structural Integrity Program	5A

DRAWINGS

NUMBER	TITLE	REVISION
M-12 AL01	Auxiliary Feedwater System Drawing	
M-12 AN01	Piping and Instrumentation Diagram Demineralized Water	8

DRAWINGS

NUMBER	TITLE	REVISION
	Storage and Transfer System	
M-12 AP01	Condensate Storage and Transfer System	8
M-12 FC02	Auxiliary Turbines System Drawing	
M-13 AL01	Piping Isometric Auxiliary Feedwater Pumps Suction Piping	10
10466-J-110-0357-W06	Instrument Loop Diagram for Auxiliary Feedwater Supply Pressure from Condensate Storage Tank	0
TI 2AC-175	Foxboro Spec 200 Dynamic Compensator	0
Gould Pumps Inc. 765502	Floor Drain Tank Pumps	3

CONDITION REPORTS

00003599	00006780	00007499	00007502	00007508
00007509	00007510	00007511	00009519	00009688
00011704	00012990	00013805	00014261	00014930
00015520	00015521	00015574	00015634	00016358
00016901	00016905	00017900	00018217	00018646
00018785	00018817	00019079	00019219	00019248
00019284	00019295	00019308	00019320	00019660
00019716	00019724	00019806	00019918	00019951
00019955	00019960	00020022	00020050	00020068
00020097	00020099	00022247	2007-001531	2007-001780
2007-001993	2007-002009	2007-002162	2007-002656	2007-003350
2007-003378	2007-004125	2007-004126	2007-004127	2007-004128
2007-004129	2007-004130	2007-004131	2007-004132	2008-000116
2008-001448	2008-001450	2008-001456	2008-001457	2008-001458
2008-001459	2008-001479	2008-001481	2008-001485	2008-001494
2008-001511	2008-001642	2008-001660	2008-001797	2008-001819
2008-001932	2008-002280	2008-002785	2008-003745	2008-004536
2008-004592	2008-004983	2008-005075	2009-000250	

PERFORMANCE IMPROVEMENT REQUESTS

1994-08237	1995-0558	1997-03965	2002-083	2000-2122
2003-2178	2004-2435	2004-2441	2004-2683	2005-2167
2005-2619	2007-003378	2008-005913		

CALCULATIONS

NUMBER	TITLE	REVISION / DATE
01030-C-001	Reanalysis of Pipe Stress Calculation P-093A for Containment Cooler Return Line	
01030-C-002	Incorporate Dynamic Loads due to Water Hammer on Containment Coolers	May 17, 2001
FL-01	Flooding of the Auxiliary Building	1
FL-03	Flooding of Individual Aux Bldg Rooms	0
M-FL-04	Summary of Flood Levels in all Auxiliary Building Rooms due to Pipe Break or Crack	1
XX-E-013	Post Fire Safe Shutdown (PFSSD) Analysis including change notices	1
XX-E-009	System NB,NG,PG Undervoltage/Degraded Voltage Relay Setpoints, including attachments	1
XX-E-006	AC System Analysis including attachments and change notices	5
	Engineering Change Package 05818 for Containment Cooler Support Installations	

CORRESPONDENCE

NRC Generic Letter 96-06, Assurance of Equipment Operability and Containment Integrity during Design-Basis Accident Conditions, September 30, 1996

NRC Generic Letter 2006-02, Grid Reliability and the Impact on Plant Risk and the Operability of Offsite Power, February 1, 2006

ET 07-0003, Wolf Creek Nuclear Operating Corporation Response to NRC Additional Request for Additional Information RE: NRC Generic Letter 2006-02, Grid Reliability and the Impact on Plant Risk and the Operability of Offsite Power, January 1, 2007

WM 06-0011, Wolf Creek Nuclear Operating Corporation Response to NRC Generic Letter 2006-02, Grid Reliability and the Impact on Plant Risk and the Operability of Offsite Power, March 31, 2006

Wolf Creek response to Generic Letter 96-06, January 29, 1997

Letter from Mel Gray, Subject: Request for Additional Information – Generic Letter 96-06, Assurance of Equipment Operability and Containment Integrity during Design-Basis Accident Conditions, June 18, 1999

NRC letter: Request for Additional Information Regarding Resolution of Generic Letter 2006-02, Grid Reliability and the Impact on Plant Risk and the Operability of Offsite Power, December 3, 2006

CORRESPONDENCE

NRC letter: Revised Response Date for Request for Additional Information Regarding Resolution of Generic Letter 2006-02, Grid Reliability and the Impact on Plant Risk and the Operability of Offsite Power, December 13, 2006

NRC letter: Wolf Creek Generating Station – Closeout Letter for Generic Letter 2006-02, Grid Reliability and the Impact on Plant Risk and the Operability of Offsite Power, May 10, 2007

NRC Information Notice 2007-01: Recent Operating Experience Concerning Hydrostatic Barriers

NRC Information Notice 2009-16: Spurious Relay Actuations Result in Loss of Power to Safeguards Buses. (blue added 10-15-09)

NRC Regulatory Guide 1.101, Emergency Planning and Preparedness for Nuclear Power Reactors, Revision 3

NEI 99-01, Methodology for Development of Emergency Action Levels, Revision 5

NRC Generic Letter 1989-13, Service Water System Problems Affecting Safety-Related Equipment, January 29, 1990

LICENSEE EVENT REPORTS

NUMBER	TITLE	DATE
1995-006-00	Loss of Emergency Bus NB02 Due to Degraded Gasket on Motor Operator Cabinet	December 7, 1995
1995-006-01	Loss of Emergency Bus NB02 Due to Degraded Gasket on Motor Operator Cabinet	February 1, 1996
1999-005-00	Engineered Safety Features Actuation Because of Loss of Number 7 Transformer	June 11, 1999
2004-003-00	Automatic Start of B Emergency Diesel Generator Due To Start-Up Transformer Cable Ground Fault	May 5, 2004
2007-001-00	Emergency Diesel Out of Service Longer than Technical Specification Allowed Outage Time	September 6, 2007
2008-004-00	Loss of Offsite Power Event when the Reactor was Defueled	

ACTION PLAN DETAIL REPORTS

NUMBER	TITLE	DATE
1047	Actions for Switchyard Restoration Issues	August 24, 2007
1100	SOER and Non-SOER Evaluation Guidance and SOER Effectiveness Reviews	January 30, 2008
1273	PIR 2007-003378 Action Plan – SOER Effectiveness Review	February 20, 2008

ACTION PLAN DETAIL REPORTS

NUMBER	TITLE	DATE
1703	CR 2007-004128 Corrective Actions	May 13, 2009
1806	Critical Component Review of the Switchyard	March 17, 2009
1890	EDG Alarm Acknowledge	November 22, 2008
1909	CAP for CR 2008-001797	June 27, 2008
2032	CR 2008-001457 Action Plan	February 27, 2009
2186	Revise AP 12-001	December 17, 2008

OPERABILITY EVALUATIONS

NUMBER	TITLE	REVISION
EF 09-007	Post ESFAS Water Hammer Evaluation	0
GK-08-004	Control Room AC Unit SGK04B and SGK05B Heat Exchangers	0

OPERATING EXPERIENCE DETAIL REPORTS

NUMBER	TITLE	DATE
323	Information Notice 2007-14, Loss of Offsite Power and Dual-Unit Trip at Catawba Nuclear Generating Station	9/20/2007
71	Information Notice 2006-06, Loss of Offsite Power and Station Blackout are More Probably During Summer Period	

WORK ORDERS

07-294733-000	08-302566-000	08-305239-000	08-305240-000	08-305244-000
08-305281-000	08-305289-000	08-305312-000	08-305312-001	08-305313-000
09-305434-001	09-305838-00	09—316569-000	09-319476-000	09-320505-000
09-320505-001				

HISTORY OF ESSENTIAL SERVICE WATER LEAKS

TIME	DESCRIPTION	FLOW VELOCITY, FPS	POSITION OF LEAK
2002	CCW HX drain leak, galvanic and under deposit pitting	0	Side of vertical pipe

HISTORY OF ESSENTIAL SERVICE WATER LEAKS

TIME	DESCRIPTION	FLOW VELOCITY, FPS	POSITION OF LEAK
2005	SW discharge bypass line leak, under deposit corrosion EA129HBC-16	0, Stagnant	Bottom segment of pipe
2005	ESW – AFW leak, under deposit corrosion EF054HBC-8	0, Stagnant	Bottom segment of pipe
2007	SGN01D containment air cooler 6” return header, under deposit pitting	~ 6.0	Side of vertical pipe
2009	ESW B 30” return line, through-wall pit EF138HBC-30	1.6	Bottom segment of pipe
2009	ESW B 18” supply leak at weld EF150HBC-18	5.9	Weld area, side of pipe
2009	ESW A 8” room cooler return line leak EF049HBC-8	0.9/1.6	Bottom segment of pipe

MISCELLANEOUS DOCUMENTS

NUMBER	TITLE	REVISION / DATE
	Posttrip Review Data Package	August 19, 2009
	Technical Specifications and Bases	
	Operating License	
	Control Room Logs	August 19-26, 2009
	Outage Center Logs	August 19-26, 2009
Table 2-2	Offsite Dose Calculation Manual	6
Table 3-2	Offsite Dose Calculation Manual	6
WCAP-12231	Station Blackout Coping Assessment for Wolf Creek Generating Station	April 15, 1989
	Safety Evaluation and Request for Additional Information Concurring Station Blackout Analysis for the Wolf Creek Generating Station	January 16, 1992
	Wolf Creek Generating Station – Supplemental Safety Evaluation Regarding the Stat ion Blackout Rule	June 16, 1992
DCP 07687	GE Magne-Blast Circuit Breaker Replacement	5

MISCELLANEOUS DOCUMENTS

NUMBER	TITLE	REVISION / DATE
	Simplified Switchyard Drawing	
	Zone 117 Device List	
	Westinghouse Instructions for Metering Accuracy Capacitor Voltage Transformer Type PCA-9	June 1982
	Wolf Creek Generating Station License Renewal Application	22
	ACE Documents for CR 18785	September 21, 2009
2938	Information on ITIP: Response to NRC Information Notice 95-04	September 22, 2009
2507	Information on ITIP: Response to NRC Information Notice 93-83	September 22, 2009
2275	Information on ITIP: Response to NRC Information Notice 93-17	September 22, 2009
946	Information on ITIP: Response to NRC Information Notice 88-75	September 22, 2009
	Switchyard SPV Evaluation	
	Switchyard SPVs and Mitigating Strategies	
	Switchyard Component IDs	
	Notes regarding CR 2008-001457	
SER 4-06	INPO Significant Event Re port: Dual-Unit Loss of Off-Site Power	September 25, 2006
2898	CDE Detail Report: Extension Request for CR 2008-005913	May 13, 2009
	DOBLE Test Assistant – Autotransfer without Tertiary	
	Bushing Analysis Test Data	
12708	Engineering Disposition: Evaluation of ESW Water Hammer Event Due to Loss of Offsite Power	1
	Licensing Evaluation/Reportability Evaluation Request 2008-023/PIR 2008-001797	
93	Operability/Reportability Detail Report	November 21, 2008
	Line loss spreadsheet	March 6, 2004 through

MISCELLANEOUS DOCUMENTS

NUMBER	TITLE	REVISION / DATE
		August 19, 2009
	Westar Energy Root Cause Analysis Report: Root Cause Analysis Performed at Management Discretion	March 30, 2009
	Incident Investigation Report 09-002 for CR 00019245	October 1, 2009
	NRC Question 1, Request 12821	
	NRC Question 2, Request 12831	
	NRC Question 3, Request 12841	
	NRC Question 4, Request 12851	
Modification Package 05818	Pipe Support Mod on GN Sys for Water Hammer	2
STN PE-040G	Completed Surveillance of Transient Event Walkdown	April 7, 2008
LR1007001	Emergency Action Levels and Protective Action Recommendations Training Material	
	Updated Safety Analysis Report Section 3.9(N), Table 3.9 (N) – 13 Component Cyclic or Transient Limits	
	Table 4: Cycle Summary – Current Analysis Period – 11/1/07 through 8/18/08	
	WCAP 12231, Station Blackout Coping Assessment for Wolf Creek Generating Station	April 15, 1989
	Computer Point Trend for Points ALF0002 and AEL0517	August 21, 2009
Change # 12798	Engineering Disposition Evaluation of Essential Service Water Water Hammer Event due to Loss of Offsite Power	1
	Simulator Training Performance Evaluation Summary for Crew – D	October 15, 2008
IIT 09-002	For Condition Report 00019245, Loss of Offsite Power and Plant Trip	September 22, 2009
	Post Trip Review Data Package for October 7, 2004	
	Purchase Order 745187/0 for Engineering Services to Address Water Hammer Issues	March 18, 2009

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
612 EAST LAMAR BLVD, SUITE 400
ARLINGTON, TEXAS 76011-4125

MEMORANDUM TO: Richard Deese, Senior Project Engineer, Team Leader
Projects Branch B
Division of Reactor Projects

David Dumbacher, Senior Resident Inspector
Projects Branch B
Division of Reactor Projects

Jim Medoff, Senior Mechanical Engineer
Division of License Renewal
Office Nuclear Reactor Regulation

FROM: Dwight Chamberlain, Director
Division of Reactor Projects

SUBJECT: CHARTER FOR SPECIAL INSPECTION INVOLVING THE LOSS OF OFFSITE POWER AND REACTOR TRIP AT WOLF CREEK GENERATING STATION

In response to the loss of offsite power and subsequent reactor trip which occurred at Wolf Creek Generating Station on August 19, 2009, a special inspection will be performed. You are hereby designated as the special inspection team leader.

A. Basis

On August 19, 2009, during stormy weather in the area, Wolf Creek Generating Station experienced a loss of all 345 kV power to its switchyard. All reactor coolant pumps, condensate pumps and remaining secondary cooling equipment lost power resulting in the inability to reject heat to the condenser. The main turbine tripped followed by a reactor trip. With the condenser unavailable, cooling was supplied by the auxiliary feedwater system and discharged through the atmospheric relief valves.

With offsite power unavailable, the emergency diesel generators started and powered emergency loads as required.

Offsite power was noted to have numerous interruptions in the last year, with momentary line outage occurring relatively frequently. The Rose Hill offsite power line experienced brief or momentary line outages at least 7 times within the last year. Faulty equipment on the Rose Hill line which failed to block the effects of the La Cygne line lighting strike is believed to have led this loss of single offsite power line event into a complete loss of offsite power.

Also the essential service water system experienced a through-wall leak concurrent with the event. A 3/8-inch hole was revealed in the header leading to the emergency core cooling system room coolers as water was discovered streaming from the essential service water piping after the event. Further evaluation of the area around the hole uncovered another adjacent area that was below minimum wall. These and previously identified leaks lead to questioning the reliability of the essential service water system.

A regional Senior Reactor Analyst (SRA) preliminarily estimated the Incremental Conditional Core Damage Probability for this issue to be 6.1×10^{-6}, which falls in the region which recommends a special inspection. A special inspection will be performed since there are questions with the reliability of offsite power.

B. Scope

1. Develop a complete sequence of events related to the event.

2. To support review of the problem identification and resolution aspects of the event:

   a. Review operating experience involving prior opportunities to identify and evaluate action implemented at Wolf Creek from industry Operating Experience.

   b. Review the licensee's root cause analysis for the event initiator and determine if it was conducted to a level of detail commensurate with the significance of the problem.

   c. Determine if the licensee's corrective actions have addressed the extent of condition and assess whether these actions are adequate to prevent recurrence.

3. Perform the following to review the licensee's offsite power system:

   a. Review the licensee's actions for prior instances of loss of the offsite power lines and whether the licensee's actions were commensurate with safety for the number of previous line failures.

   b. Assess the licensee's ability to meet the General Design Criteria requirements for independence of the offsite power lines in light of conditions surrounding the event.

4. Perform the following to review the licensee's essential service water system:

   a. In light of the leak in the essential service water system that developed, review the scope and depth of the licensee's actions for the monitoring and prevention of degradation of the essential service water system piping [extent of condition check]. In this review, verify the licensee's commitments to Generic Letter 89-13, if applicable.

   b. Review the licensee's bases for insulating the essential service water piping in the auxiliary building.

   c. Review the application of ASME Code Case N-513-2, especially with regard to choice and acceptability of the additional (extent of condition required by ASME

Code Case and others) ultrasonic testing samples performed for the identified areas.

d. Evaluate the adequacy of the repairs to the 3/8-inch hole in the essential service water pipe that occurred during the event and the subsequent below minimum wall thickness area.

5. Perform the following to review the performance of plant systems during the event:

a. Review the acceptability of the observed pressure oscillations observed on the suction of the auxiliary feedwater pumps and their impact on system operability and technical specifications.

b. Determine if reasonable evidence existed for deduction that a water hammer event occurred in the essential service water system and whether licensee actions following the event were sufficient for such an evaluation.

c. Review the design and operation of the internal flood control features in the plant, in light of being able to handle a slightly larger leak during a sustained loss of offsite power.

d. Determine if any of the radiation monitor failures experienced in the event would have hampered further actions (i.e., implementing the emergency plan).

e. Review the actions taken for the loss of fire detection capability in the auxiliary building during the event. Establish if this loss was anticipated in plant design.

6. Review the post-trip report for adequacy and whether the conclusions the licensee drew are supported by the report.

7. Review the causes of the high level in Steam Generator A that occurred the day after the event.

8. Verify the licensee met the proper reporting requirements of 10 CFR 50.72 and 10 CFR 50.73. Determine if the licensee has plans to issue a Licensee Event Report to document this issue.

9. Review the licensee's compliance with the Technical Specifications.

10. Review the licensee's decision to maintain the plant in Mode 3 (feeding from the condensate storage tank with auxiliary feedwater and dumping steam with the atmospheric relief valves) for an extended period of time.

11. Determine if the licensee correctly applied the Emergency Action Levels and if the Emergency Action Levels are appropriate.

12. Support assessment of risk significance by performing the following:

a. Collect facts to support an accurate portrayal of exposure time for the LOOP.

b. Collect facts to support proper crediting of the licensee's ability to recover offsite power sources within 1 hour as assumed in the risk assessment. Ensure to

include in the assessment the “trouble” annunciators that existed on the safety transformers during the event.

c. Collect facts to support/refute crediting the licensee’s ability to recover offsite power within 15 minutes in support of establishing low pressure recirculation for a reactor coolant pump seal LOCA.

d. Collect facts to verify/refute classification as a grid-centered loss of offsite power for risk assessment purposes.

e. Verify the risk assessment assumption that no test or maintenance were in progress at the time of the event.

f. Collect facts to support the senior risk analysts in making a realistic assumption of the unreliability of the essential service water system.

g. Determine if the difficulties experienced with the startup and main feed pumps on the prior startup and the startup from this event represented a loss of mitigation equipment.

h. Verify the function of the main steam isolation valve rupture discs was per design and did not preclude use of any mitigation equipment when they ruptured.

C. Guidance

Inspection Procedure 93812, “Special Inspection,” will be used during this inspection. The inspection should emphasize fact-finding in its review of the circumstance surrounding this event. It is not the responsibility of the team to examine the regulatory process. Safety concerns identified that are not directly to the event should be reported to the Region IV office for appropriate action.

The team will report to the site and begin inspection no later than September 21, 2009. While onsite, you will provide daily status briefings to Region IV management, who will coordinate with the Office of Nuclear Reactor Regulation, to ensure that all other parties are kept informed. Depending on the outcome of the inspection, inspection results will be documented in Special Inspection Report 05000482/2009007. This report will be issued within 45 days of the completion of the inspection.

This guidance may be modified should you develop significant new information that warrants review. Should you require support for the final determination of the risk significance of any issue, contact Michael Runyan at (817) 860-8142. Should you have any questions concerning this guidance, contact Vince Gaddy at (817) 860-8141.

ATTACHMENT 3

NRC Technical Review of the August 19, 2009, Self-Revealing Flaw in Essential Service Water System Piping

General Summary

The Wolf Creek's flaw evaluation is acceptable. The licensee used Code Case N-513-2, the ASME Code Section XI, Appendix H, and ASME Code, Section III, ND-3600 to perform the flaw evaluations. The licensee did not use information outside of the ASME Code (other than the wear rate. (See questions # 4 and discussion below).
In accordance with N-513-2, the licensee will monitor the leakage each shift, perform UT of the pinhole every 30 days, and perform UT at a minimum 10 locations. The licensee performed a temporary repair (encapsulation) at the pinhole location and will perform a code repair in the next refueling outage.

Suggested Questions to Ask the Licensee—

1. On page 3 of 5 of the licensee's engineering disposition paper, the licensee stated that "Engineering shall be notified of any changes in the leakage or flaw growth." This is an open ended statement (not useful in terms of NRC regulatory/enforcement actions) because there is no commitment in the licensee's part as to what are the acceptance criteria for the leakage or flaw growth or the corrective actions that they will do. It is not clear what the licensee would do if there is a change in the leakage or if there is a flaw growth that extends outside the encapsulation. It is not clear at what leak rate or flaw growth the licensee will take corrective action. The licensee needs to clarify the specific acceptance criteria on leak rate and flaw growth and discuss corresponding actions.

2. The licensee needs to clarify why they used the ASME Code, Section XI, Appendix H to evaluate the flaw(s) instead of the ASME Code, Section XI, Appendix C, which is required by Code Case N-513-2. [see the basis of this question below]

3. The licensee stated that it will perform augmented UT on 10 locations (on page 3 of 5 of the Engineering report). However, it is not clear whether these 10 locations are in the same degraded pipe or in sister pipes (or pipes in the same system). At a minimum, the licensee needs to check the wall thickness of the degraded pipe to ensure that there are no other locations in the pipe that have the corrosion problems. The licensee also needs to UT sister pipes in the affected piping system. The licensee needs to clarify where are the 10 locations that will be examined to satisfy the requirements of Code Case N-513-2, paragraph 5.0 [see discussion below].

4. Appendix 2 of the licensee's flaw evaluation calculates the wear rate of the pinhole. The wear rate was calculated by dividing the difference between the nominal wall thickness (0.322") and the final wall thickness (which is zero because of the pinhole) by the operating years. This wear rate method assumes that general corrosion at the pinhole is directly proportional to the operating time (i.e., a linear relationship) and that corrosion initiated from day one of the commercial operation. The licensee needs to justify the linear relationship for the wear rate. [See discussion below]

Discussions

Appendix 1 of the licensee's flaw evaluation---

In Appendix 1 of the licensee's flaw evaluation, the licensee back-calculated the allowable pipe thickness based on the stress equations in ASME Code, Section III, ND-3600 with various load combinations and associated allowable stresses. Using this approach, the licensee calculated the minimum pipe wall thickness.

The summary page of Appendix 1 shows the minimum thickness for each piping load combination. The allowable thickness ranges from 0.0035 inches to 0.0595 inches, depending on the load combinations. The nominal wall thickness is 0.322 inches. The licensee selected the allowable thickness of 0.1 inches. This is conservative because it is more than the calculated wall thickness (> 0.0595"). If the pipe wall thickness falls below 0.1 inches, the pipe does not meet the Section III code allowable, does not meet the design conditions, and is, therefore, inoperable.

The wall thickness at the pinhole location is zero and is below the allowable thickness of 0.1 inches. However, the licensee has used Code case N-513-2 to accept the structural integrity of the pipe considering the pinhole location (i.e., operable but degraded).

I do not know if the licensee has performed wall thickness measurement on various locations of the leaking pipe to confirm that the rest of the leaking pipe satisfies the allowable thickness of 0.1 inches. Question # 3 above should confirm this issue.

Appendix 2 of the licensee's flaw evaluation—

Appendix 2 calculates the wear rate of the pinhole. The wear rate was calculated by dividing the difference between the nominal wall thickness (0.322") and the final wall thickness (which is zero because of the pinhole) by the operating years (20 years). This method assumes that general corrosion at the pinhole is directly proportional to the operating time (i.e., a linear relationship) and that corrosion initiated from day one of the commercial operation. I do not know if this linear relationship for the wear rate is correct. In addition, if the inside of the pipe is coated with epoxy or some protective coating then the corrosion will not initiate until some years later. If the pipe is not coated inside, it will still take a few years before corrosion initiates. If the corrosion initiates not from day one but started several years later, the denominator in the above wear rate equation will be less than 20 year. This will make the wear rate higher and more conservative. The licensee's wear rate may not be conservative because it assumes the corrosion starts on day one of the commercial operation. The licensee needs to justify its method of wear rate calculation. [note that N-513-2 does not specify the flaw growth rate for general corrosion. The flaw growth rate in N-513-2 is for planar flaws which is not applicable to general corrosion in service water line at wolf creek. Therefore, there is no requirement for the licensee to use certain wear rate method. All we can do is to ask why they think their method is acceptable]

Appendices 3 and 4 of the licensee's flaw evaluation--

Appendices 3 and 4 analyze the general corrosion/pinhole (which is a nonplanar flaw) as two planar flaws to show that the pipe with the 2 planar flaws has sufficient fracture toughness to resist catastrophic failure. Code Case N-513-2, paragraph 3.0(f) allows evaluating a through wall penetration as two independent planar flaws—axial flaw and circumferential flaw. Appendix

3 of the licensee's flaw evaluation evaluates the axial flaw. Appendix 4 of the licensee's flaw evaluation evaluates the circumferential flaw.

Appendices 3 and 4 use information in Section XI, Appendix H instead of Section XI, Appendix C, which is required by Code Case N-513-2. Code Case N-513-2, paragraph 3.0(c) requires that for planar flaws in ferritic piping the evaluation procedure of ASME Section XI Appendix C be used and N-513-2 cites several Appendix C subparagraphs. However, the cited Appendix C paragraphs do not appear in the 1998 Section through 2000 addenda of the ASME Code, Section XI, which I suppose is the code of record for Wolf Creek for the current ISI inspection interval. Therefore, I believe that the licensee used Appendix H of the Section XI to perform the flaw evaluation because Appendix C in the 1998 edition of the ASME Code, section XI, does not contain flaw evaluation information that is required by N-513-2.

I have no problem with the licensee using the ASME Code, Section XI, Appendix H for its flaw evaluation.

Appendix 3 demonstrates that the leaking pipe will not fail catastrophically because the calculated stress intensity factor (Kmax) of the axial flaw (pinhole) is less than the stress intensity factor of the pipe material (Kicallowable).

Appendix 4 demonstrates that the leaking pipe will not fail catastrophically because the calculated stress intensity factor (Kmax) of the circumferential flaw (pinhole) is less than the stress intensity factor of the pipe material (Kicallowable).