WOLF CREEK
NUCLEAR OPERATING CORPORATION

March 15, 1996

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Chairman, President and
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WM 96-0038

U. S. Nuclear Regulatory Commission
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Washington, D. C. 20555

Reference: Letter dated March 7, 1996, from J. L. Callan NRC, to N. S. Carns WCNOC

Subject: Docket No. 50-482: Wolf Creek Generating Station Icing Event Restart Issues

Gentlemen:

Attached is Wolf Creek Nuclear Operating Corporation's (WCNOC's) response to the restart issues identified in Enclosure 1 of the reference.

WCNOC has reviewed the restart issues contained in Enclosure 1 of the reference and has provided a detailed response to each of these issues in the attachment to this letter. Each response contains a causal statement, a corrective action discussion, and a projected corrective action completion date.

WCNOC understands the significance of the events that occurred during the January 30, 1996, icing event and the need to implement timely root cause evaluations and corrective actions to prevent recurrence. Based on the results of the evaluations, WCNOC has developed and implemented comprehensive corrective action plans to prevent recurrence. Some of these corrective actions in addition to being discussed in the attachment to this letter were discussed in WCNOC Licensee Event Reports (LER) 96-001-00 and 96-002-00. Refinements to the corrective actions discussed in the attachment will be made, as appropriate, based upon technical reviews or discovery of new information.

If you should have any questions regarding this response, please contact me at (316) 364-8831, extension 4100, or Mr. William M. Lindsay at extension 8760.

Very truly yours,

Neil S. Carns

NSC/jra

Attachment

cc: L. J. Callan (NRC), w/a
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Reply to Enclosure 1
Wolf Creek Restart Issues

Restart Issue No. 1: "Essential service water system; adequacy of design and operation for anticipated weather"

WCNOC Reply:

Root Cause and Contributing Factors:

Root Cause:

The root cause of this event is the inadequate design of the Essential Service Water (ESW) system to operate in a cold environment that leads to frazil ice formation. There was insufficient Warming Line flow for the Warming Line temperature to prevent the formation of frazil ice.

During the original design, the potential for frazil ice formation was recognized, but was thought to be addressed adequately by the design of the ESW Warming Line and the spacing of the trash rack bars. During April and May of 1976, the Architect Engineer (A/E) performed an evaluation on the potential for frazil ice formation at the Wolf Creek Generating Station (WCGS) ESW Pumphouse. As a result of this evaluation, the A/E changed the location of the Warming Lines to position them directly in front of the trash racks. A design calculation performed during this evaluation assumed an ESW Warming Line temperature of 35°F. With this assumption, the calculation determined a flow of 4000 gpm was required. Later, a design calculation determined that actual flow would be 4413 gpm with the additional assumption that the pipes would be full of water. The above assumptions were incorrect. The Warming Line temperature on the morning of January 30, 1996, was approximately 33°F. It was also discovered that the Warming Line and the ESW to Ultimate Heat Sink (UHS) return line piping diameters and elevations are such that portions of these lines operate with partial pipe flows. This condition was apparently not foreseen by the piping designer, and makes the calculation methodology used for sizing the Warming Line invalid with resulting non-conservative errors. Actual flows were not able to be accurately measured, but all estimates of flow indicated insufficient heat addition to prevent frazil ice.

Contributing Factors:

The incorrect ESW valve line-up for several hours during this event and the subsequent failure to verify and correct this misalignment in a timely manner were contributing causes to the ice build-up at the ESW trash racks. During the approximately six hour period preceding the first time "A" ESW pump had to be secured due to the ice blockage, ESW return to service water (SW) return cross tie isolation valves were open and the ESW return to the UHS valve was throttled. This caused some of the ESW return flow to be diverted from UHS through the normal SW discharge line.

<u>Short Term Corrective Actions:</u>

Personnel were dispatched to the ESW Pumphouse to determine the cause and implement actions to restore the pump suction bay level.

These subsequent actions included: the erection of a temporary shelter over the external bays to minimize conductive heat losses; the procurement and installation, on an interim basis, of portable space heaters and heater blowers to warm the air in the ESW Pumphouse and suction bays; the procurement and installation of portable air compressors, an air bubbler system, and portable water boilers. These items were used to inject air and warm water into the outside bays of the ESW Pump to aid in the agitating/breakup and removal of the frazil ice. After briefing and training a team of individuals, WCNOC established a 24 hour watch of the temporary equipment installed at the ESW Pumphouse and bays to assure continuous proper operation of the equipment and to inform the Control Room of any equipment degradation.

With the knowledge gained from the investigation, the incident investigation team (IIT) has recommended additional compensatory enhancements to ensure frazil ice blockage of the ESW intake trash racks does not occur until a permanent design solution can be implemented. Incorporation of these enhancements gives additional interim assurance for frazil ice mitigation into the ESW Pumphouse:

1. Verify proper valve and system lineup to maximize warming flow to the ESW bays whenever ESW Pump are running.
2. Install temporary heating equipment in the ESW screen bay area to reduce the likelihood of ice formation on the traveling screens.
3. Provide a means to clean the front of the ESW trash racks. This can be accomplished by installing temporary air sparging in each bay to "broom" the front of the trash rack and/or by use of a trash rack rake.
4. To provide early detection of active frazil ice formation while the ESW Pump are running, immerse a metal chain several feet into the trash rack bay water and monitor for ice accumulation.
5. Install tents over the grating of the bay to provide wind protection for personnel assigned to monitor ESW bay conditions and to help prevent surface ice formation. This is to assist in detection and cleaning of the trash racks should frazil ice begin to form.
6. Station a dedicated cognizant individual at the ESW Pumphouse while the ESW Pump are operating. This individual will: 1) Monitor the sparging air compressors, 2) Monitor the tents, and 3) Watch for formation of ice on the traveling screens, screen wash discharge, and trash racks. Notification of the Control Room will occur immediately

upon compressor failure, tent degradation or detection of ice formation.

7. Install high intensity lights for observing and cleaning of trash racks and traveling screens.

Recommendations 1 through 7 were incorporated, with implementing details, into a "Contingency Plan For Ice Prevention Measures At The ESW Intake," dated February 24, 1996.

From the experience gained from the icing event, performance of these measures provides assurance that these temporary measures are adequate compensation until the design deficiency can be corrected.

Long Term Corrective Actions:

1. A Design Change Package (DCP 06349) will be developed to ensure adequate Warming Line flow. The hydraulics of the ESW discharge to the UHS and the Warming Line to the ESW Pumphouse will be changed to distribute the proper amount of flow to the ESW suction bay. Due to the low amount of heat (~3/4°F) available from the unloaded safety train, a higher flow rate than the original design 4,000 gpm will be required. The upper bound for this Warming Line flow will be dictated by the UHS cooling characteristics and the temperature range chosen for this mode of operation. To achieve the proper flow, back pressure on the ESW discharge to the UHS will be raised downstream of the Warming Line tee. The back pressure orifices, Flow Element 3 and 4 (FE-3/4), located upstream in the ESW discharge lines, will be re-sized, so that flow through the ESW System is not reduced to an unacceptable level. Back pressure in the Warming Line will also be raised to achieve full pipe flow without sending too much water through the Warming Line. A computer analysis of the ESW System out to the UHS and the Warming Line has been completed. Numerous variables are being fine tuned to determine the size of both the UHS orifice and the new FE-3/4 orifices as well as the expected throttle positions of key valves. The final sizing is expected to be complete before the end of March. The desired goal is to develop full pipe flow with approximately 5000 gpm through the Warming Line. DCP 06349 will establish the new design basis for these flow rates and related temperatures. The design is underway and will be implemented in both trains as soon as practical, but not later than October 1, 1996.
2. Lake water temperature indication is being incorporated into the WCNOC design basis by DCP 06447. This DCP will also include pump suction temperature and Warming Line flow temperatures. The potential for frazil ice is significant when bulk lake water temperature is at 33°F and decreasing. Very small changes in temperature when the water is in the 32°F range can trigger frazil ice production. It is WCNOC's intent to install the most accurate and precise indication reasonably attainable. This design is underway and will be implemented on or before October 1, 1996.

3. The Probabilistic Safety Assessment (PSA) model for ESW did not include the Warming Lines in the fault tree. The ESW/SW model will be revised to include the Warming Lines and a total loss of all service water (ESW & SW). This will be done by the end of June 1996.
4. Other issues are being evaluated at this time to determine the cost/safety benefit and feasibility of implementing them. The first is permanent flow monitoring of the Warming Line. The configuration is less than ideal and periodic use of a Controlatron or similar test instrument may be a better option. Another issue is the need for a permanent air bubbler design. It is WCNOC's intent to avoid the formation of frazil ice in its entirety. If this can be confidently achieved, air bubblers are not needed. Development of a cover for the trash racks is also being evaluated. This evaluation will also include any required area lighting, bay level indication or non-safety related general area supplemental heat. These evaluations are underway and will be implemented, as deemed appropriate, on or before October 1, 1996.

<u>Projected Completion Date:</u>

All activities related to this restart issue will be worked aggressively. On or before October 1, 1996, the ESW System will be modified to function properly in a cold weather environment conducive to frazil ice formation.

Restart Issue No. 2: "Essential service water system misalignment on January 30, 1996; corrective actions to address impromptu alignment, lack of self-checking, shift turnover and command and control weaknesses, teamwork weakness, incomplete operations shift communications (including relief crew communications), lack of questioning attitude by operators and supervisors"

WCNOC Reply:

Root Cause and Contributing Factors:

Background:

The starting of the ESW System was performed by reference to alarm response procedure ALR 00-008B, "Service Water Pressure HI LO." Prior to the event, this procedure directed that ESW be placed in service in accordance with system operating procedure SYS EF-200, "Operation of the ESW System." The Shift Supervisor determined that the delay which would be encountered by printing SYS EF-200 from the filenet computer would allow additional unnecessary degradation of plant conditions, and directed that ESW be placed in service immediately. This directive carried with it the Shift Supervisor's understanding that the SYS EF-200 would be used to verify system alignment at a later time. The ESW System was aligned improperly. The valve misalignment was discussed during turnover, and subsequently corrected by a different crew after shift turnover.

Root Cause:

The root cause of the misaligned system was a failure to follow-up using an approved procedure, after aligning the ESW System for operation.

Contributing Factors:

A failure to correct the misalignment during the turnover process.

A failure to provide the necessary actions in the ALR, instead of referencing the SYS Procedure.

Weak teamwork skills, incomplete communications, lack of self-checking, inconsistent questioning attitude, incomplete shift turnover and command and control weaknesses.

Short Term Corrective Actions:

Administrative Procedure (AP) 15C-002, "Procedure Use and Adherence," has been revised to strengthen Management's expectations regarding follow-up activities by specifying the Shift Supervisor or Supervising

Operator may direct operating personnel to take expedient actions which minimize the possibility for personal injury or damage to equipment. If these actions are performed without referencing an approved procedure, the Shift Supervisor shall ensure that the following actions are implemented:

1. Engineering evaluations of the effects of any abnormal equipment/system operation, as soon as practical.
2. Return equipment/system to an approved lineup or initiate appropriate procedure changes, as soon as practical.
3. Magnetic lamacoid "follow-up buttons" have been provided in the Control Room for use by the operating crews in identifying items for which a follow-up review is required.

Operations Management will re-enforce the procedure use expectations with the operating crews. This briefing will discuss the following expectations from AP 15C-002, "Procedure Use and Adherence," and AP 21-001, "Operations Watchstanding Practices:"

1. Continuous use versus reference use requirements (AP 15C-002; paragraphs 6.1, 6.2)
2. General requirements for procedure use (AP 15C-002, paragraph 6.3)
3. Use of "not applicable," (N/A) (AP 15C-002, paragraph 6.6)
4. Shift relief and turnover (AP 21-001, paragraph 6.1)
5. Conduct of operations personnel (AP 21-001, paragraph 6.4)
6. Communications (AP 21-001, paragraph 6.4.2)
7. Main control board walkdowns (AP 21-001, paragraph 6.4.5)
8. Control Room board awareness (AP 21-001, paragraph 6.4.6)
9. Supervisory monitoring and coaching (AP 21-001, paragraph 6.4.8)
10. WCNOC's self checking program [Stop Think Act Review (STAR)] (AP 21-001, paragraph 6.4.9)

This briefing will also address the issues of communications and teamwork, with augmented crews. In addition, Management will re-enforce the use of operations' divisional standards (STAR, safety, communications, questioning attitude, attention to detail, and housekeeping). A seventh operations division standard, follow-up, has been added.

Long Term Corrective Actions:

An upgrade of Control Room ALRs has been initiated. The goal of this review is to identify all ALRs which refer to other procedures for specific instructions on how to align systems. ALRs which require short term operator actions important to aligning the system promptly, will be revised to include the specific actions or steps required. This will replace the reference to a SYS Procedure. Each ALR which fits this criteria will be evaluated to determine the acceptability of continued reference to other procedures. To date, fifteen ALRs which include those important to mitigating events that could occur during eighth refuel outage, have been revised. This number also includes all ALRs which address ESW, CW, or SW.

To further strengthen communications, a "codeword" is being developed for use by any operator. When implemented, an operator who states the codeword, will immediately become the focus of attention for the Control Room. At that time, the operator will state the concern. An evaluation of that concern will be made by shift supervision, and appropriate follow-up actions put in place. The "follow-up buttons" previously mentioned will be utilized to identify items which cannot be immediately addressed. The use of the "codeword" concept will be reviewed after six months to determine its effectiveness.

Training will be provided to re-enforce current Management expectations (operations watchstation practices, procedure use and adherence, and divisional standards), and to re-enforce the use of the "follow-up button" and "codeword" concepts. A pilot program will develop a protocol of behavior that recognizes and appropriately responds to the unexpected. This will involve the interjection of some pre-planned inappropriate action or verbal response by a crew member. The intent is to establish recognition of the inappropriate action or response, and subsequently gain control of the situation with the correct verbal and procedural response. This pilot program will complement the "training for success" concept of our systematic approach to training, with a "training for failures" theme which will also help assure that proper actions are taken.

Specifically, simulator scenarios will be developed which involve complex, multiple casualties which will require different crew members to concentrate on different issues. At a predetermined time, the scenario will be stopped. The purpose of stopping the scenario is to evaluate the effectiveness of the crew communication, after each crew member has had an opportunity to focus on individual issues. These scenarios will begin with some event in progress (not steady state). Simulator training in this manner is expected to allow the operations personnel to practice communication skills within the crew (making sure that each crew member is kept apprised of the others' activities and priorities), practice use of the codeword, utilize the follow-up tool and stress the value of complete, precise turnover. The use of these techniques will be reviewed after 6 months to determine their effectiveness.

Projected Completion Date:

Short Term Actions: Prior to Mode 2
Long Term Actions: October 1, 1996

Restart Issue No. 3: "Improper positioning of a manual isolation valve (EFV0263) in the Train B essential service water warming line in November 1995; corrective actions to prevent recurrence"

WCNOC Reply:

Root Cause And Contributing Factors:

Background:

The valve shaft of EFV0263 became locked due to silt build-up and corrosion at the bottom bearing in April 1991. A contributing factor to this condition is that this Warming Line Valve (one of four in this family of Warming Line Valves) is infrequently operated, typically only two times per year. In addition, the valve shaft orientation was vertical, contributing to corrosion product accumulation at the bottom bearing.

As part of a Service Water Self Assessment, it was identified that the valves' infrequent operation may be contributing to their failures. Part of the corrective action recommended was to exercise the valves more frequently. It was decided not to exercise them until they were repaired due to the potential of creating operability concerns if the valves locked in the closed position.

Historical correspondence records indicate that the use of power operated actuators on the Warming Line Valves was considered during their original design. At some point though, this concept was terminated and the existing design resulted. In addition, no information could be found with respect to the reasoning behind designing two valves in series when only one valve would have been required for isolation purposes.

In the Spring of 1995, System Engineering performed a formal work request history search on principal systems to identify past significant component problems and reoccurring failures. The principal systems are those that are important to operational safety, reliability or power production. The review encompassed thousands of work requests statused as open, closed, or vaulted. Numerous issues and problems were identified from the review and a multitude of PIRs were generated for evaluation and corrective action. Warming Line Valve EFV0263 was identified as being locked in a throttled position. However, this valve had already been scheduled to be worked in the eighth refueling outage (RFVIII) because the time necessary for the refurbishment was considered to be longer than that limited by a 72 hour Technical Specification Limiting Condition For Operation (LCO).

Root Cause:

Engineering did not believe that the condition of the valve was an operability concern based on engineering judgment that the reduction in flow at this disk position would have been minimal due to the throttling characteristics of this butterfly valve at design flow. There was no indication or reason to believe that the Warming Line flow was not per design. The decision made at that time has been reviewed and verified to have been an accurate judgment of this condition.

Contributing Factor:

A spare valve or parts to correct the problem were not available in a short duration.

Short Term Corrective Actions:

All of the Warming Line Valves were removed from the system and refurbished or replaced during RFVIII. This included reinstalling them, so the shafts are installed horizontal, instead of vertical (CCP 05843). Warming Line isolation valves EFV0263 and 0265 were scheduled, in advance, to be reworked in RFVIII. Warming Line isolation valves EFV0262 and 0264 were scheduled for the ninth refueling outage (RFIX). However, due to the recent icing concerns, EFV0262 was refurbished and EFV0264 was replaced in RFVIII. Rotating the valves such that the stem was in the horizontal position to increase their reliability was also accomplished, as part of the long term corrective action.

In order to validate current System Engineering practices for action request reviews, as discussed below, Engineering is currently performing another review of open action requests to identify any components or equipment which have not had appropriate timely corrective action based on the significance of the component's or equipment's importance to plant safety and reliability.

Long Term Corrective Actions:

System Engineering will closely monitor these Warming Line Valves for additional problems in the future and pursue the appropriate corrective action. This is an on-going activity within the System Engineering group.

To ensure outstanding corrective maintenance action requests are appropriately being evaluated in a timely manner, a process will be established to review those requests for safety-related systems that are older than six months. This review will be performed by the Plant Safety Review Committee (PSRC) and will ensure that adequate periodic reviews are being performed on open issues that could impact those components considered to be important to operational safety, reliability or power production. This process will be implemented by June 1, 1996.

Further actions may be required for the Warming Line Valves as part of the long term corrective actions as discussed in Restart Issue No. 1.

<u>Projected Completion Date:</u>

Short Term Actions: Prior to restart from RFVIII
Long Term Actions: June 1, 1996

<u>On-going Actions By System Engineering To Prevent Similar Corrective Action Problems On A Generic Basis:</u>

The implementation of the corrective action program at WCNOC has changed since 1991. Expectations for this program have drastically increased since that time and there is a heightened awareness in System Engineering with respect to reoccurring failures and the appropriate corrective action. The work request history review, as discussed above, is one proactive example of where re-enforcement of this expectation has been successfully pursued by System Engineering.

Review of action requests on a daily basis is performed by System Engineering in accordance with procedure AI 23-005, "Action Request Review," to identify operability concerns and reoccurring failures. The purpose of this procedure is to provide guidance for an independent, timely review of recently initiated action requests. In addition, the formulation of maintenance rule activities and processes will be utilized in reviewing and monitoring system health and performance.

System Engineers also perform a review and prioritize open work on their systems in order to ensure high priority jobs are being worked commensurate with their importance to plant safety and reliability. This process provides an on-going assessment of outstanding work activities and system health.

In addition, System Engineers are challenged to look ahead for long term enhancements to their systems and to establish long term corrective action which will prevent actual component failures in the future and enhance system performance.

Restart Issue No. 4: "Turbine-driven auxiliary feedwater pump packing failure; corrective actions to prevent recurrence and completion of surveillance testing"

WCNOC Reply:

Root Cause and Contributing Factors:

Root Cause:

Inadequate and inconsistent work planning resulting in poor packing installation and adjustment practices.

Contributing factors include:

1. Failure to incorporate revised vendor manual technical information (CCP 05767) , into work package instructions.
2. Work instructions were followed incorrectly.
3. Failure to adequately address corrective action issues on previous PIRs.
4. Failure to accurately address the contents of the CCP 05767 change to technical manual M-021-0061 in maintenance continuing training.
5. Lack of a questioning attitude at the work location.

Short Term Corrective Actions:

1. Inboard packing immediately replaced under WP109087.
2. Auxiliary Feedwater Pump work instructions revised to include updated packing instructions and post maintenance testing.
3. The appropriate operability surveillances will be performed.
4. On March 11, 1996, the Manager Maintenance directed the inboard packing on PAL02 to be removed and repacked using the revised packing instructions. This work is presently scheduled to be done by March 21, 1996.
5. PIRs 96-0269 and 96-0217 written from IIT 96-001 have been issued to Maintenance Planners as required reading to promote uniform awareness of the planning concerns associated with this issue.
6. A critique training session will be conducted with all planners concerning the lessons learned from PIRs 96-0269 and 96-0217. This training will also review the revised packing and maintenance run-in work instructions, and will be conducted the week of March 18, 1996.
7. An individual providing oversight, whose sole duty is to ensure correctness of work being done, will be assigned to oversee TDAFWP work (see long term corrective action).
8. A new PM task to inspect the PAL02, PAL01A, and PAL01B gland nuts and to tighten them, if necessary, is being developed.
9. Outstanding corrective maintenance backlog on PAL02 will be reviewed by the System Engineer.

Long Term Corrective Actions:

1. The Manager Maintenance issued letter MD 96-0012, dated March 11, 1996, placing into effect a requirement that a separate and knowledgeable individual responsible for oversight be assigned for unplanned corrective maintenance activities on the TDAFWP and the Emergency Diesel Generators (EDG). This has been directed for the purpose of providing extra vigilance to assure the correctness of maintenance activities, and equipment reliability. The efficacy of this oversight will be evaluated in 6 months. This action also provides added oversight on adherence to work instructions, use of STAR at the work location, and the use of questioning attitudes.
2. Additional pump packing training will be provided to planners and mechanics. This training will also be offered to System Engineers.
3. PIRs 96-0269 and 96-0217 and corrected technical manual information will be placed into maintenance continuing training.
4. The appropriate post maintenance testing methodology relative to maintenance activities will be developed.

Projected Completion Dates:

Short Term: Prior to restart
Long Term: September 1, 1996

Additional Auxiliary Feedwater System Actions Being Taken During The Eighth Refueling Outage:

PAL02 (TDAFWP):

1. Perform PM to check shaft sleeve-nut and retighten, WP 109544.
2. Coupling lubrication PM, WP 106811.
3. Lube oil change PM, WP 109290.
4. Inspect bearing covers and drain plugs for Leakage, WP 103705.
5. Inboard / outboard pump bearing oil sample, WP 108651.

KFC02 (Terry turbine):

1. Trip tappet inspection PM, WP 106758.
2. Coupling lubrication and maintenance, WP 106811.
3. Mark site glass, WP 106536.
4. Replace EG-R actuator, WP 109170.
5. Rework oil leak in treaded pipe connection, WP 105414.
6. Rework lube oil site glass leak, WP 104442.

PAL01A (Motor-Driven Auxiliary Feedwater Pump):

1. Inboard/outboard bearings oil change, WP 109289.
2. PM to check shaft sleeve nut & tighten, WP 109556.

PAL01B (Motor-Driven Auxiliary Feedwater Pump):

1. Replacement of rotating assembly, WP 107850.

FCHV0312 (Auxiliary Feedwater Pump Turbine Mechanical Trip Throttle Valve):

1. Disassemble, clean and lubricate, (change to Mobilgrease #28) WP 102223.
2. Motor drive gear speed/rewire bypass modification, CCP 6279, WP 107958.
3. Lubricate linkages and check governor valve travel PM, WP 108673.

FCFV0313 (Turbine Speed Governing Valve):

1. Replace governor valve stem and spacers, WP 108158.
2. Lubricate linkages and check governor valve travel PM, WP 108673.

ABHV0006 (Main steam loop "C" to TDAFWP):

1. Repair seat leakage WP 107182.

Restart Issue No. 5: "Missing procedures in control room copies of Emergency Management Guidelines; corrective actions to prevent recurrence and verification of current status"

WCNOC Reply:

Root Cause and Contributing Factors:

The root cause of the missing procedure was inattention to detail in that procedure EMG E2, "Faulted Steam Generator Isolation," was inserted in the place of ES 02, "Reactor Trip Response." A contributing cause of the missing procedure was inadequate training of the Shift Clerks.

Short Term Corrective Actions:

An audit has been conducted of all Control Room procedures by Document Services Personnel. This audit has assured that the Control Room documents are complete and reflect the proper revision status. The procedures that were audited included:

1. Emergency Management Guidelines (EMGs)
2. Off Normal Procedures (OFNs)
3. Alarm Response Procedures (ALRs)
4. Emergency Plan Procedures (EPPs)
5. General Operating Procedures (GENs)
6. System Operating Procedures (SYSs)
7. Technical Specification Surveillance Procedures (STSs)
8. Non-Technical Specification Surveillance Procedures (STNs)

Training will be provided to all Shift Clerks to emphasize attention to detail in dealing with document transmittals. Training will also be provided to all Shift Clerks to ensure that the correct procedures are processed in accordance with the document transmittal. Specifically, not all Shift Clerks were aware that each document transmittal form was unique to a specific procedure set (location) in the Control Room. This training will assure that documents are filed in the proper procedure set, in the Control Room.

Long Term Corrective Actions:

The Shift Clerk qualification card will be revised so that future Shift Clerks will be properly trained.

A checklist is also being developed for use by the Shift Clerks. This check list will require that actions taken regarding document transmittals from the previous shift be independently verified by the oncoming Shift Clerk. The Control Room procedures will be periodically audited by document services. The frequency of this audit will be quarterly for the remainder of 1996. The frequency of audits beyond 1996 will be revised as appropriate.

<u>Projected Completion Date:</u>

Short Term Actions: Prior to Mode 2
Long Term Actions: June 1, 1996

Restart Issue No. 6: "Circulating water and service water systems; adequacy of design and operation for cold weather operation"

WCNOC Reply:

Root Cause And Contributing Factors:

The root cause of the event was that the design of the CW intake structure and associated traveling screens did not account for the harsh environmental conditions imposed on them during the events of January 30, 1996.

A contributing factor to the event was the spraying of near freezing water onto the screens exposed to atmospheric conditions. This spray water caused an initial ice build-up on the screens, which grew when exposed to the water from the lake.

Short Term Corrective Actions:

Actions taken immediately after the problem was identified included the erection of a temporary shelter over the traveling screen area to minimize the cold weather effects. In addition, heaters were utilized to warm the traveling screens within this temporary shelter. Portable air compressors were used to provide air sparging upstream of the trash racks to aid in the agitation and breakup of the surface ice.

Revisions to procedures SYS SW-121, "Circulating Water Screen Wash System," and STN GP-001, "Plant Winterization," were made to limit the operation of the screens during cold weather conditions. These revisions (by the issuance of on-the-spot-changes (OTSCs) 96-0058 and 96-0059) removed the requirement to operate the screens continuously in cold weather.

Long Term Corrective Actions:

To further increase the margin against recurrence of this event, the traveling screens will be enclosed in a permanent, heated structure.

Projected Completion Date:

Short term Actions: Completed
Long Term Actions: August 1, 1996

Restart Issue No. 7: "Emergency Plan Implementing Procedures; training, guidance and philosophy of using the administrative emergency action level chart"

WCNOC Reply:

Root Cause and Contributing Factors:

As noted in the Nuclear Regulatory Commission (NRC) Augmented Inspection Team Report 50-482/96-05, WCNOC had a history in 1992 and 1993 of not being able to demonstrate consistent classification of emergency events. WCNOC submitted a new set of emergency action levels (EAL'S) based on the Nuclear Management And Resources Council (NUMARC) guidance in December 1993, and received NRC approval for implementation in August 1994. In an effort to ensure there were no further problems with inconsistent classification, WCNOC Management discouraged the use of the Administrative EAL Chart if there was any other EAL Chart that covered the event. This was an attempt to ensure everyone's professional judgment and assessment of an event would result in consistent classifications of the event.

The NUMARC/NESP-007, Revision 2, or NRC Regulatory Guide (NUREG)-0654/FEMA-REP-1 documents do not specifically address icing conditions or loss on equipment to maintain cold shut down in modes one through four. WCNOC's EAL's also did not specifically address these items.

Short Term Corrective Actions:

WCNOC will take the following actions to correct these weaknesses.

The Administrative EAL Chart in EPP 01-2.1, "Emergency Classification," will be revised to reflect the NUMARC/NESP-007 definitions of Notification Of Unusual Event (NUE), Alert, Site Area Emergency (SAE), and General Emergency (GE) classifications. The bases for the administrative EAL will be changed to reflect the guidance in NUMARC/NESP-007.

The system malfunction EAL Chart will be revised to provide better guidance for a loss of equipment needed to maintain the plant in cold shut down conditions when in modes one through four. Specifically, the new EAL block asks the question if there has been a "Complete loss of function of both trains of Residual Heat Removal (RHR) or Component Cooling Water (CCW) or ESW." If there has been a complete loss of function of both trains, the block directs an alert classification. The basis for this new block states, "The complete loss of function means that the system can not pump water or remove heat. This does not apply if the system is inoperable, but can still pump water and remove heat. The inability of RHR, CCW, or ESW to provide cooling for any reason which prevents the pumping of water or removal of heat in both trains of any of the three systems should cause an alert classification. Steam generators are still available to remove heat and UHS is still available as a source of water using alternate methods of supplying the water."

The natural phenomena chart will be revised to cover ice, as well other natural occurrences which could have an impact on plant safety systems.

Training will be completed by March 26,1996, by all Shift Supervisors, Shift Engineers, Duty Emergency Directors (DED), Duty Emergency Managers (DEM), Operations Emergency Coordinators (OEC) and Emergency Offsite Facility (EOF) Technical Advisors. This training will include:

1) Management Philosophy And Expectations: In assessing an event, all EAL Charts are to be considered. Professional judgment must be used for classifying all events including those events which can be matched to more than one EAL Chart.
2) Revised Wording And Bases OF Administrative EAL Chart: Three considerations listed in NUMARC/NESP-007 for helping determine thresholds between emergency classifications will be included in the discussion of the bases. These are:
   I. The potential impact on radiological safety, either as now known or as can be reasonably projected.
   II. How far the plant is beyond its pre-defined design, safety, and operating envelopes.
   III. Whether or not conditions that threaten health are expected to be confined within the site boundary.

In addition, discussion will take place on the significance of increased monitoring of plant systems, the need for additional staffing, the development of contingency planning, and the distinguishing differences between a NUE and Alert. Training will also be provided on the changes to the system malfunction and natural phenomena charts.

Long Term Corrective Actions:

The requalification lesson plans for the appropriate emergency response personnel will be revised to reflect these changes before the next requalification cycle covering emergency classification begins.

Projected Completion Date:

Short Term Actions: March 26, 1996
Long Term Actions: May 31, 1996

Restart Issue No. 8: "Failure of 5 rod cluster assemblies (control rods) to fully insert on January 30; actions taken to ensure control rods will fully insert and are operable"

WCNOC Reply:

Root Cause and Contributing Factors:

An inspection program was undertaken by WCNOC and the NSSS Vendor to address the incomplete Rod Cluster Control Assembly (RCCA) insertions that occurred at WCGS at the End-Of-Cycle (EOC) 8. These activities included the preparation, review and implementation of a test plan and the formation of a root cause team.

Below is a description of the inspections and root cause analysis results.

1.0 Results of Inspections

The rod drop test showed an interference occurring in the upper portion of the fuel assembly. The drag test in the reactor and in the spent fuel pool confirmed the source of the interference to be in the fuel assembly and not in the reactor internals or with the control rods. A summary of the inspections performed is provided below.

1.1 Trip at EOC 8

There were five RCCA's which failed to fully insert. The location of these assemblies is indicated in Figure 1-1 (see page 23). The following fuel assemblies were involved.

Core Position	Fuel Assembly
H02	H16
F06	H50
K06	H53
K10	H59
H08	H38

NOTES: All involved fuel assemblies are three times burned. Burn up ranges from approximately 49100 to 51500 MWD/MTU.

1.2 Cold drop tests:

Rod drop tests were performed on all RCCA's at full flow conditions and an RCS temperature of 195 degrees Fahrenheit. In addition to the five assemblies above, the following three assemblies failed to fully insert.

Core Position	Fuel Assembly
H14	H11
P08	H03
B08	H32

1.3 Drag Tests With Upper Internals In Place

A total of 27 RCCA's were tested with the upper internals in place, including 4 of the assemblies that failed to fully insert during the cold drop tests. Four affected fuel assemblies were not tested to preserve as found conditions.

Core Position Tested	Fuel Assembly Tested
H06	J35
K08	J29
B10	J56
P06	J63
F14	J50
P10	J64
B08	H32
H14	H11
F06	H50
F10	H45
D12	J32
D04	J08
H08	H38
D02	K06
B12	K46
D14	K22
M02	K15
C09	J28
N07	J30
C07	J03
J03	J25
L13	J37
N05	J52
N11	J39
L03	J45
H04	H69
H12	H54

1.4 Drag Test In Spent Fuel Pool

1.4.1 RCCA's In Fuel Assembly

A total of 16 assemblies were selected for this test. This included: all eight that failed to fully insert during cold drops; Two additional "H" assemblies that showed high drag during the test in 1.3 above, Four "J" assemblies with various burnups; and Two "K" assemblies (control).

FUEL ASSEMBLIES TESTED

Fuel Assembly	RCCA
H16	R27
H53	RS31
H32	RS42
H50	RS19
H11	RS21
H59	RS13
H03	RS11
H38	RS29
J37	RS28
J03	RS23
K46	RS40
J52	RS30
J50	RS09
K06	RS01
H45	RS22
H54	RS18

1.4.2 Drag Test with Short RCCA

A drag test was performed using a mock RCCA with 13 inch long rodlets. The tested fuel assemblies were J03, H53, H50, H38, H16 H81 and K06.

1.5 Drag Test of RCCA's In Reference Fuel Assembly

The 16 RCCA's tested in 1.4.1 above were drag tested in a new fuel assembly.

1.6 Fuel Assembly Length Measurements

Length measurements were conducted on the fuel assemblies listed in Section 1.4 and assembly H81(removed from core last cycle due to high drag). Additional length measurements were taken on the following fuel assemblies: G46, G35, G18, H43, H62, H07, J61, J29 and J46.

1.7 Fuel Assembly Bow Measurements

Bow measurements were taken on the first 17 fuel assemblies on which length measurements were taken in 1.6 above.

1.8 Boroscope Inspection

The following assemblies were selected for boroscope inspection; H38, H16, H81, J03, K06.

1.9 Single Tube Probes

The following fuel assemblies were selected for probing the single guide thimble tubes with the single tube probes: K06, H16, H38, H53, H81, H50, and J03.

GO/NO GO tests were completed on the above assemblies. Also drag measurements were made on selected assemblies using probe 5 (small probe for upper guide thimble) and the 0.381 diameter full length probe (simulation of RCCA rodlet).

2.0 Root Cause Evaluation

2.1 Background

A root cause team was organized to determine the root cause of the incomplete RCCA insertion issue. The team included representatives from WCNOC, Houston Lighting & Power Co., and several NSSS Vendor divisions.

The team evaluated three established root cause analysis tools, shown below, to select a method which would be the most effective in evaluating the data which was available at the time.

- Root Cause Analysis (Causal Factor)
- Change Analysis
- Kepner-Tregoe Problem Analysis

The Kepner-Tregoe Problem Analysis technique was selected by the team since the specific cause of the incomplete RCCA insertion was not known at the time the team was convened.

The Kepner-Tregoe Problem Analysis approach consists of the four main phases shown below.

- Describe Problem
- Identify Probable Causes
- Evaluate Probable Causes
- Confirm True Cause

2.2 Summary of Evaluation

The tests and inspections performed indicate that an interference between the control rods and the fuel assembly, which manifested itself in incomplete rod insertion, originated in the fuel assembly. The fuel assemblies affected were thrice burned assemblies with exposures exceeding 49,000 MWD/MTU.

2.3 Description of Problem

The statement of the problem for the Kepner-Tregoe evaluation was:

"RCCAs Do Not Fully Insert Into Fuel Assemblies During Rod Drop"

Following the Kepner-Tregoe methods, the information on what, where, extent and when the problem occurs in WCNOC data were listed. These results show that:

- All RCCAs entered the dashpot prior to stopping during the scram.
- The RCCAs stopped after entry into the dashpot (32 steps) on
- All assemblies during cold drop except H16 which had Hafnium in the RCCA rodlets.
- All of the assemblies that had incomplete insertion after trip had incomplete insertion during cold rod drop testing and three additional assemblies that inserted fully during the trip did not fully insert during the cold rod drop testing. Factors that differ between hot and cold reactor conditions include:
  - Thermal differential growth between the fuel assemblies and core cavity, resulting in a somewhat higher assembly hold down spring force at cold conditions.
  - Primary coolant viscosity, resulting in higher hydraulic friction forces acting on the RCCA and driveline surfaces at cold conditions.
  - The assemblies with incomplete insertion had burnups between 49,100 MWD/MTU and 51,500 MWD/MTU.

The Kepner-Tregoe technique next calls for identification of what, where, extent and when the problem did not occur. This list is the remainder of the fuel assemblies in rodded positions during cycle 8 at WCGS (5 additional "H", 32 "J", and 8 "K" assemblies) and their burnup at the time of the rod drop tests. It is noted that:

- The burnup of the assemblies was less than or equal to 44,700 MWD/MTU with the exception of assembly H45 which had 51,300 MWD/MTU.
- RCCA insertion velocity traces indicated that some resistance also occurred in assembly H45 during the drop test (as evidenced by no recoil of the RCCA at the end of insertion).

In preparation for listing possible root causes, the distinctions believed to be notable between assemblies for which incomplete insertion occurred and other assemblies were listed.

2.4 Possible Root Causes and Evaluation of Causes

Possible root causes were developed by the root cause team prior to implementation of the inspection plan. These possible causes were reviewed as the inspections progressed. Key WCNOC inspections as summarized in Section 1.0 through 1.9, successful rod drops at the beginning of cycle 8, as well as judgment and experience were used by the root cause team to support or eliminate some possible causes.

Short Term Corrective Actions:

The Cycle 9 loading pattern and associated reload design were developed with direct intent to mitigate each of the root causes under consideration. The loading pattern was redesigned with the express intent of lowering the burnup of all assemblies beneath control rods. This is displayed in the table below:

Burnups versus number of rodded locations

Burnup (GWD/MTU)	BOC9(#RCCAs)	EOC9(#RCCAs)	EOC8 (#RCCAs)
0	36	Zero	Zero
<18	17	Zero	8
18-30	Zero	44	Zero
30-34	Zero	1	Zero
35-40	Zero	Zero	8
40-41	Zero	8	Zero
41-42	Zero	Zero	8
43-45	Zero	Zero	20
48-50	Zero	Zero	5
50-52	Zero	Zero	4

Notes:

- The new core contains two types of fuel. 168 assemblies of V5H with IFM's. 25 assemblies of standard fuel without IFMs.
- One rodded location contains standard fuel. (H-08 the center location)
- 52 rodded locations have V5H fuel with IFMs.
- No three burn assemblies in core.
- The "H" assemblies completed a third cycle of operation in cycle 8 and were scheduled for discharge. There are no "H" assemblies in the Cycle 9 reload design.
- The maximum residency time for any fuel assembly in Cycle 9, including the reinsertion of the region 1 assemblies, is less than three years (i.e., two cycles).

While the root cause evaluation of the EOC-8 event is not yet complete, the correlation between extended assembly burnup and susceptibility to the issue seems to be reasonably sound. The redesigned Cycle 9 loading pattern will, based on current information, eliminate the possibility of a recurrence of this event at the end of Cycle 9.

Long Term Corrective Actions:

Long term corrective actions involve the following:

- If WCGS experiences any failure of rods to fully insert during Cycle 9, WCGS will perform appropriate rod drop testing prior to restart.

WCGS will continue to monitor developments as the NSSS Vendor and the Westinghouse Owners Group (WOG)continue to gather data at other sites.

Projected Completion Date:

WCNOC will continue to work with the WOG and the NSSS Vendor. Information will be made available as it is developed. A definitive completion date is not available at this time.

Figure 1-1 - Locations of Rodded Core Locations at WCGS

	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R
15															
14				SA		B		C		B		SA			
13					SD		SB		SB		SC				
12		SA		D				SE				D		SA	
11			SC										SD		
10		B				C		A		C				B	
9			SB										SB		
8		C		SE		A		D		A		SE		C	
7			SB										SB		
6		B				C		A		C				B	
5			SD										SC		
4		SA		D				SE				D		SA	
3					SC		SB		SB		SD				
2				SA		B		C		B		SA			
1															