UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
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ARLINGTON, TEXAS 76011-4005

January 28, 2005

Jeffrey S. Forbes
Vice President Operations
Arkansas Nuclear One
Entergy Operations, Inc.
1448 S.R. 333
Russellville, AR 72801-0967

SUBJECT: ARKANSAS NUCLEAR ONE, UNITS 1 and 2 - NRC TRIENNIAL FIRE PROTECTION INSPECTION REPORT 05000313/2004010; 05000368/2004010

Dear Mr. Forbes:

On September 27, 2004 through October 29, 2004, the NRC conducted a triennial fire protection inspection at Arkansas Nuclear One, Units 1 and 2. Additional inspection activities continued through December 14, 2004. The enclosed report documents the inspection findings which were discussed on December 14, 2004, with Mr. Clifford Eubanks, General Manager, Plant Operations and other members of your staff.

During this triennial fire protection inspection, the inspection team examined activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and the conditions of your license. The inspection team visually inspected selected fire zones, interviewed operators and fire protection staff, reviewed selected procedures and records, and stepped-through operator actions prescribed in selected fire protection procedures.

Based on the results of this inspection, no findings of significance were identified.

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 (PARS) 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//

Linda Joy Smith, Branch Chief
Plant Engineering Branch
Division of Reactor Safety

Dockets: 50-313
50-368
Licenses: DPR-51
NPF-6

Enclosures:
Inspection Report 05000313/2004010; 05000368/2004010
w/Attachments:
1. Supplemental Information
2. ANO Position on the Requirements of 10 CFR Part 50, Appendix R, Section III.L
3. Summary of Integrated Calculation Process Used at ANO for App. R
4. Integrated Analysis Discussion
5. Evaluation of Pressurizer Level

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ENCLOSURE 1

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Docket(s):	50-313; 50-368
License(s):	DPR-51; NPF-6
Report No.:	05000313/2004010; 05000368/2004010
Licensee:	Entergy Operations, Inc.
Facility:	Arkansas Nuclear One, Units 1 and 2
Location:	Junction of Hwy. 64W and Hwy. 333 South Russellville, Arkansas
Dates:	September 27, 2004 through October 29, 2004
Team Leader	R. L. Nease, Senior Reactor Inspector Plant Engineering Branch
Inspectors:	G. Replogle, Senior Reactor Inspector Plant Engineering Branch Paula Goldberg, Reactor Inspector Plant Engineering Branch Tim McConnell, Reactor Inspector Plant Engineering Branch
Accompanying Personnel	Dean Overland, Reactor Inspector Plant Engineering Branch Tony Brown, Technical Support Staff
Contractor	Kenneth Sullivan, Project Engineer Brookhaven National Laboratory
Approved By:	Linda Joy Smith, Chief Plant Engineering Branch

SUMMARY OF FINDINGS

IR 05000313/2004-010; 05000368/2004-010; September 27, 2004 through October 29, 2004; Arkansas Nuclear One, Units 1 and 2: Arkansas Nuclear One, Units 1 and 2; Triennial Fire Protection Inspection

This report covered an announced inspection by four region-based inspectors, two accompanying personnel from NRC Region IV, and one contractor. One unresolved item (URI) was identified. The significance of most findings is indicated by its color (Green, White, Yellow, Red) using 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 3, dated July 2000.

A. NRC-Identified Finding

None

B. Licensee-Identified Findings

None

REPORT DETAILS

1 REACTOR SAFETY

1R05 Fire Protection

The purpose of this inspection was to review the Arkansas Nuclear One (ANO) facility fire protection program for selected risk-significant fire areas. Emphasis was placed on verification of the licensee's post-fire safe shutdown capability. The inspection team performed this inspection using the guidance in Inspection Procedure 71111.05, "Fire Protection," which requires selecting three to five fire areas for review. The inspection was performed in accordance with the NRC regulatory oversight process using a risk-informed approach for selecting the fire areas and attributes to be inspected. The team used licensee Calculation 85-E-0053-47, "Individual Plant Examination of External Event/Fire," to choose several risk-significant areas for detailed inspection and review. The following three fire zones were chosen for review during this inspection:

- Fire Zone 2109U (Corridor); located in Fire Area JJ, Unit 2
- Fire Zone 2097X (East DC Equipment Room); located in Fire Area SS, Unit 2
- Fire Zone 2091BB (Electrical Equipment Area); located in Fire Area B, Unit 2

For each of these fire areas, the inspection focused on fire protection features, systems and equipment necessary to achieve and maintain safe shutdown conditions, and licensing basis commitments.

In accordance with NRC Inspection Procedure 71111.05, dated March 6, 2003, the inspection did not include a comprehensive review of the potential impact of fire-induced failures in associated circuits of concern to post-fire safe shutdown. In response to a March 2001 voluntary industry initiative, the scope of NRC Inspection Procedure 71111.05 has been temporarily reduced pending the resolution of specific review criteria for fire-induced circuit failures of associated circuits.

Documents reviewed by the team are listed in the attachment to this inspection report.

.1 Systems Required to Achieve and Maintain Post-Fire Safe Shutdown

a. Inspection Scope

For the selected fire zones, the team reviewed the licensee's methodology for achieving and maintaining post fire safe shutdown described in Calculation 85-E-0086-01, "Safe Shutdown Capability Assessment Unit 1," and Calculation 85-E-0087-01, "Safe Shutdown Capability Assessment, Unit 2." This review was performed in order to ensure that at least one post-fire safe shutdown success path was available in the event of a fire in each of the selected areas. In addition the team verified that the licensee had properly identified the systems and component required to achieve and maintain safe shutdown conditions. The team focused on the below-listed functions that must be available to achieve and maintain post-fire safe shutdown conditions. In addition, the team verified that process monitoring capable of providing direct readings to perform and control these functions was available.

- Reactivity control capable of achieving and maintaining cold shutdown reactivity conditions,

- Reactor coolant makeup capable of maintaining the reactor coolant inventory,

- Reactor heat removal capable of achieving and maintaining decay heat removal, and

- Supporting systems capable of providing all other services necessary to permit extended operation of equipment necessary to achieve and maintain hot shutdown conditions.

To assure the licensee had properly identified the components and equipment necessary to achieve and maintain safe shutdown conditions in the event of a fire in the fire areas selected for review, the team reviewed piping and instrumentation diagrams for the systems required for performing above-listed functional requirements, and compared them to the list of equipment documented in the licensees post-fire safe shutdown analysis. In addition, plant drawings, operating procedures, operator lesson plans, and other relevant documents were reviewed to verify the flow paths and operational characteristics of those systems relied on to accomplish the 10 CFR Part 50, Appendix R post-fire safe shutdown functions listed above.

b. Findings

No findings of significance were identified.

.2 Fire Protection of Safe Shutdown Capability

a. Inspection Scope

For each of the selected fire areas, the team reviewed licensee documentation to verify that at least one train of equipment needed to achieve and maintain hot shutdown conditions was free of fire damage in the event of a fire in the selected fire areas. Specifically, the team examined (on a sampling basis) the separation of safe shutdown cables equipment and components within the same fire areas to verify that the licensee met the requirements of 10 CFR Part 50, Appendix R, Section III.G.2

The team reviewed the licensee's methodology for meeting the requirements of 10 CFR 50.48, 10 CFR Part 50, Appendix R, and the bases for the NRC's acceptance of this methodology as documented in NRC safety evaluation reports. In addition, the team reviewed license documentation, such as, the Arkansas Nuclear One, Units 1 and 2 Safety Evaluation Reports, submittals made to the NRC by the licensee in support of the NRC's review of their fire protection program, and exemptions from NRC regulations to verify that the licensee met license commitments.

b. Findings

Fire Zones 98J (Unit 1 diesel generator corridor) and 99M (Unit 1 north switchgear room) were the subject of a finding of low to moderate significance (white) and a Notice of Violation issued by letter dated April 7, 2004. This finding involved the failure to ensure that on train of required safe shutdown equipment (including cables) was free of fire damage in accordance with 10 CFR Part 50, Appendix R, Section III.G.2. During their extent of condition evaluation, the licensee identified that the team's selected fire zones, Fire Zones 2109U (Unit 2 corridor); 2097X (Unit 2 east DC equipment room); and 2091BB (Unit 2 electrical equipment area) were also subject to this finding.

For the fire zones selected for review, no additional findings of significance involving the separation and protection requirements of 10 CFR Part 50, Section III.G.2 were identified by the team during this inspection.

.3 Post-fire Safe Shutdown Circuit Analysis

a. Inspection Scope

On a sample basis, the team verified that cables of equipment required to achieve and maintain hot shutdown conditions in the event of fire in selected fire zones had been properly identified and either adequately protected from the potentially adverse effects of fire damage or analyzed to show that fire-induced faults (e.g., hot shorts, open circuits, and shorts to ground) would not prevent safe shutdown. Cable routing data depicting the routing of power and control cables associated with each of the selected components was reviewed. The specific components selected for review are listed below.

Electrical distribution components:
- DC Panel 2D23
- DC Panel 2D24 2D24
- Inverter Y11
- Inverter Y22

Reactor coolant system inventory makeup components:
- 2CV-4873-1 (charging pump suction valve from volume control tank)
- 2CV-4950-2 (charging pump suction valve from reactor water storage tank)
- 2CV-4824-2 (auxiliary spray valve)
- 2P36A, 2P36B and 2P36C 2P36C (charging pumps)

Potential reactor coolant system leak path components:
- 2CV4698-1 and 2CV4740-2 (pressurizer vent valves)
- 2CV-4823-2, 2CV-4821-1and 2CV-4820-2 (letdown valves):

Decay heat removal components:
- 2CV-1001, 2CV-1002, 2CV-1051 and 2CV-1052 (atmospheric dump valves)
- 2P7A and 2P7B (emergency feedwater pumps)

In addition, on a sampling basis, the team reviewed the adequacy of selected electrical protective devices (e.g., circuit breakers, fuses, relays), breaker coordination, and the adequacy of electrical protection provided for nonessential cables, which share a common enclosure (e.g., raceway, junction box, conduit, etc) with cables of equipment required to achieve and maintain safe shutdown conditions.

For the selected fire areas, the team also reviewed the location and installation of diagnostic instrumentation that is necessary for achieving and maintaining safe shutdown conditions to ensure that in the event of a fire, this instrumentation would remain functional.

b. Findings

No findings of significance were identified.

.4 Alternative Safe Shutdown Capability

a. Inspection Scope

The team reviewed the licensee's alternative shutdown methodology to determine if the licensee properly identified the components and systems necessary to achieve and maintain safe shutdown conditions from alternative shutdown locations in the event of a fire in the control room, requiring control room evacuation. The team focused on the adequacy of the systems selected for reactivity control, reactor coolant makeup, reactor heat removal, process monitoring and support system functions. The team verified that the licensee's methodology included an evaluation that hot and cold shutdown from outside the control room can be achieved and maintained with off-site power available or not available. The team verified that the transfer of control from the control room to the alternative locations was not affected by fire-induced circuit faults by reviewing the provision of separate fuses for alternative shutdown control circuits. The team also reviewed plant technical specifications and applicable surveillance procedures to verify incorporation of operability testing of alternative shutdown instrumentation and transfer of control functions.

b. Findings

Introduction: The team identified an unresolved item (URI) concerning an inadequate alternate shutdown analysis. The alternate shutdown analysis was inadequate because: (1) it was based on acceptance criteria, which was inconsistent with 10 CFR 50, Appendix R requirements; and (2) did not accurately model the simultaneous operation of emergency feedwater restoration, letdown isolation and makeup restoration.

Description: The licensee developed Calculation 85-E-0086-02, "Manual Action Feasibility Methodology and Common Results," Revision 0, to demonstrate alternative shutdown capability for ANO, Units 1 and 2. This calculation did not directly address alternate shutdown, but was instead, a compilation of other calculations. The team identified that (1) these analyses were based on acceptance criteria that differed from that in 10 CFR Appendix R, Section III.L; and (2) the licensee had not performed an integrated analysis which considered the results of more than one set of analyzed conditions occurring simultaneously. Each of these issues is discussed below.

Inadequate Alternative Shutdown Acceptance Criteria: Title 10 of the Federal Code of Regulations, Part 50, Appendix R, Section III.L. 1 specifies, in part, that during alternative post-fire shutdown, the reactor coolant system process variables (reactor temperature, pressure, and level) shall be maintained within those predicted for a loss of normal AC power. The licensee did not have predictive calculations for a loss of normal AC power, but utilized other existing calculations to predict plant response to this event. The team reviewed the following calculations, and noted that these calculations predicted that reactor coolant level would remain well within the level indication in the pressurizer.

- (Unit 1) Calculation BWNP-20007, Number 86-1118045-00 (steam generator tube rupture and loss of normal ac power)
- (Unit 1) Framatome Technologies Calculation 32-1266115-00 (ANO-1 turbine trip analysis)
- (Unit 2) Calculation ANO-2 95-E-0080-05 (ANO-2 loss of condenser vacuum)

Title 10 of the Federal Code of Regulations, Part 50, Appendix R, Section III.L.2 specifies in part, that the reactor coolant makeup function shall be capable of maintaining the reactor coolant level within the level indication in the pressurizer. The team reviewed a sampling (listed below) of the calculations that comprised Calculation 85-E-0086-02, "Manual Action Feasibility Methodology and Common Results," which the licensee used to demonstrate alternative shutdown capability. The team identified that the acceptance criteria were not consistent with maintaining the reactor coolant level within the level indication in the pressurizer (III.L.2) nor were they consistent with maintaining reactor coolant level within that predicted for a loss of normal AC power (III.L.1). Furthermore, the acceptance criteria among the various calculations were not consistent with each other

- Unit 1, Calculation 89-E-0047-20, “Time to Restore Emergency Feedwater,” Revision 1 (calculated the time to reach to top of the fuel)
- Unit 1, Calculation 85-E-0072-03, “Time to Establish Positive Control of RCS Inventory,” (estimated the amount of time for level to reach the pressurizer surge line)
- Unit 1, Calculation 1CNAA039401, “Time to Isolate Main Feedwater,” (found the loss of indicated pressurizer level during the event to be acceptable).
- Unit 2, Calculation 85-E-0072-04, “Normal/Excess Letdown Inventory Loss” (determined the time to empty the pressurizer surge line)
- Unit 2, Calculation 87-E-0003-01, “Time to Isolate Main Feedwater” (determined the time necessary to experience RCS loop voiding).

The inspectors did not perform an exhaustive search of all possible supporting calculations that could be affected. The licensee acknowledged that, in general, these calculations did not use acceptance criteria consistent with those in 10 CFR Part 50, Appendix R, Section III.L. However, the licensee disagreed that maintaining level within the pressurizer indicating range was a requirement of 10 CFR Part 50, Appendix R, Section III.L.2. The licensee also disagreed that maintaining level within that predicted by a normal loss of AC power was a requirement of 10 CFR Part 50, Appendix R, Section III.L.1. This licensee submitted an analysis, entitled "ANO Position on the Requirements of 10 CFR Part 50, Appendix R, Section III.L" describing their position, which is Attachment 2 to this report.

Failure to Integrate Analyses: The team identified that the licensee had not performed an integrated analysis, which considered the results of more than one set of analyzed conditions occurring simultaneously. For example, the “Time to Restore Emergency Feedwater,” analysis was developed independently of the “Time to Establish Positive Control of RCS Inventory,” analysis. For alternate shutdown purposes, both events could occur simultaneously and the results of one analysis could impact the results of the other in a nonconservative direction. The licensee acknowledged that they did not have an integrated alternative shutdown analysis, merely a compilation of existing calculations performed for other events. They posted a fire impairment for the control rooms and initiated Condition Reports CR-ANO-C-2004-0755 and CR-ANO-C-2004-1758 to address the lack of a comprehensive alternative shutdown analysis, and to develop an analysis specific to fire safe shutdown. The licensee provided a paper summarizing their integrated calculation process entitled, "Summary of the Integrated Calculation Process Used at ANO for App. R," (Attachment 3 to this report) to demonstrate that their alternative shutdown methodology was adequate. The licensee also submitted a discussion paper on their integrated calculation process entitled, "Integrated Analysis Discussion," (Attachment 4 to this report). In this paper the licensee concluded that their approach is conservative and suitable for use until an analysis specific to 10 CFR Part 50, Appendix R can be developed.

The use of inappropriate and inconsistent acceptance criteria and the failure to perform an integrated analysis was a concern, because the licensee based the times that operators needed to perform actions required to achieving and maintaining safe shutdown on the time limits generated by these calculations. As stated above, the licensee posted a fire impairment and entered this issue into their corrective action program Condition Reports CR-ANO-C-2004-0755 and CR-ANO-C-2004-1758.

<u>Analysis</u>: This issue is unresolved pending further NRC review of its compliance aspects. It's significance will be determined upon resolution of the URI.

<u>Enforcement</u>: Title 10 of the Federal Code of Regulations, Part 50, Appendix R, Section III.L. 1 specifies, in part, that during alternative post-fire shutdown, the reactor coolant system process variables (reactor temperature, pressure, and level) shall be maintained within those predicted for a loss of normal AC power. Title 10 of the Federal Code of Regulations, Part 50, Appendix R, Section III.L.2 specifies in part, that the reactor coolant makeup function shall be capable of maintaining the reactor coolant level within the level indication in the pressurizer. The licensee failed to demonstrate by

analysis that they had implemented an alternative shutdown methodology that (1) maintained reactor coolant process variables (e.g., reactor level) within those predicted for a normal loss of AC power (Appendix R, Section III.L.1); and (2) maintained reactor coolant level within the level indication in the pressurizer (Appendix R, Section III.L.2). The licensee submitted a paper (attached) contesting the team's position regarding the requirements of 10 CFR Part 50, Appendix R, Sections III.L.1 and III.L.2. This issue is unresolved pending further NRC review of the compliance aspects (URI 05000313; 368/2004010-01, Failure to Maintain Reactor Inventory Within the Pressurizer Indicating Range and Inadequate Alternate Shutdown Procedure).

.5 Operational Implementation of Alternative Safe Shutdown

a. Inspection Scope

The team reviewed the systems required to achieve alternative safe shutdown to determine if the licensee had properly identified the components and systems necessary to achieve and maintain safe shutdown conditions from the remote shutdown panel. The team focused on the adequacy of the systems to perform reactor pressure control, reactor makeup, decay heat removal, process monitoring, and support system functions. The team reviewed Procedures 1203.002, "Alternate Shutdown," (Unit 1) and 2203.014, "Alternate Shutdown," (Unit 2), which would be used by operators to shut down the reactor in the event of a fire requiring evacuation control room evacuation. The team also walked through the procedures with licensed operators to determine its adequacy to direct actions necessary to achieve and maintain safe shutdown conditions in accordance with their safe shutdown analysis.

b. Findings

Introduction. The team identified an issue involving the failure to implement a fire protection procedure. Specifically, in walking through Procedure 1203.002, "Alternate Shutdown," the team noted that licensed operators would not have been able to complete certain portions of the procedure within the times assumed in Calculation 85-E-0086-02, "Manual Action Feasibility Methodology and Common Results," possibly resulting in reactor level falling below pressurizer indication. The failure to perform a rigorous validation of the procedure contributed to this issue. As discussed above (in Section 1R05.4 of this report) the team considered that in implementing a methodology based on reactor level falling below pressurizer indication the licensee is not meeting 10 CFR Part 50, Sections III.L.1 and III.L.2. This issue is unresolved pending further NRC review of the compliance aspects.

Discussion. The team performed a walkdown of Procedure 1203.002, “Alternate Shutdown,” (Unit 1), with plant operators to verify that operator actions could be completed within times specified in their post fire safe shutdown analyses. As stated in above, Calculation 85-E-0086-02, "Manual Action Feasibility Methodology and Common Results," is a compilation of several existing calculations performed for other events. (Note: the adequacy of this calculation is discussed above in Section 1R05.4 of this report). The team found that the operators could not perform some of the required actions within the times specified in the calculations. For example, Calculation 85-0072-03, “Time To Loss of Subcooling or Loss of Pressurizer Liquid Inventory From Plant Trip with no Makeup Available Under Various Leak Path Scenarios,” specified, in part, that the time before normal makeup flow must be established to maintain level within the pressurizer (actually empty the surge line) is:

> With AC power - letdown isolated in 2.9 minutes, makeup initiated in 30 minutes
>
> With RCPs - Letdown isolated in 5 minutes, makeup initiated in 5 minutes
>
> No AC power - Letdown isolated in 6.9 minutes, makeup initiated in 30 minutes
>
> Letdown isolated in 8 minutes, makeup initiated in 8 minutes
>
> Restore makeup in 55 minutes, based on letdown isolation in about 2 minutes for a realistic letdown flow rate.

During the walkdown of Procedure 1203.002, the team noted that operators would have isolated letdown in approximately 5 minutes and initiated makeup in approximately 55 minutes with RCP secured and no AC power available. These operator action times do not meet any of the above calculated times to secure letdown and establish make-up.

The team identified that a lack of rigorous procedure validation contributed to this issue. Procedure writers had informally estimated the times necessary to perform procedural steps, rather than time the actions in the plant. The inspectors identified the following problems with this informal validation effort:

- The time estimates were sometimes not credible. For example some steps were estimated to be completed in 2 seconds or less, including reading the step(s), transit time, identifying components, turning switches and self checking.

- The licensee did not consistently account for the times necessary to manually operate motor-operated valves.

- The time estimate for ensuring that both emergency diesel generators were operating was only two minutes (total for both diesels). This could entail starting the diesels if they weren't operating. However, the team observed that it took operators approximately 12 minutes to manually start each unit. The procedure writers had estimated only the time to verify that each diesel generator was operating, but had not estimated the time it would take to start the diesel generators.

The licensee provided an analysis discussing the consequences of operators not securing letdown and establishing make-up within the analyzed timelines. This analysis entitled, "Evaluation of Pressurizer Level," is provided as Attachment 5 to this report. In this analysis, the licensee concluded that the time for restoring the make-up function would be extended, as long as operators tripped the reactor coolant pumps prior to level going below the bottom of the pressurizer surge line. The team determined that permitting pressurizer level to drop below the indicating range does not meet the requirements of 10 CFR Part 50, Sections III.L.1 and III.L.2. As discussed above in Section 1R05.4 of this report, the licensee challenged the team's view of these requirements. The team considered the resolution of this issue to be dependent on the resolution of URI 05000313; 368/2004010-01, discussed above in Section 1R05.4 of this report. Therefore this issue is part of URI 05000313; 368/2004010-01 which is unresolved pending further NRC review of its compliance aspects.

The licensee initiated a fire impairment and entered this finding into their corrective action program as Condition Report CR-ANO-C-2004-01758

Analysis: The issue is greater than minor because it has the potential to impact the mitigating systems cornerstone objective to ensure the availability, reliability, and capability of systems that respond to external events (such as fire) to prevent undesirable consequences. The consequence of implementing an alternate shutdown procedure in which operators could not secure letdown and establish make-up in accordance with an analyzed timeline would be the potential for reactor coolant level to fall below pressurizer indication. This issue is part of URI 05000313; 368/2004010-01, which is unresolved pending further review of its compliance aspects. The significance of this issue will be determined resolution of this URI.

Enforcement. Technical Specification 5.4.1.c requires the licensee, in part, to establish and maintain procedures covering fire protection program implementation. Contrary to the above, the licensee implemented a fire protection alternate shutdown procedure (Procedure 1203.002), in which operators could not perform some of their actions within the times analyzed in their alternative shutdown analysis. The consequence of not meeting the analyzed time line would be the potential for reactor level falling below the indicating range of the pressurizer. The requirement in 10 CFR Part 50, Appendix R, Section III.L.2 to maintain level within the indicating range of the pressurizer has been challenged by the licensee, as discussed above in Section 1R05.4 of this report. This issue is part of URI 05000313; 368/2004010-01, Failure to Maintain Reactor Inventory Within the Pressurizer Indicating Range and Inadequate Alternate Shutdown Procedure), which is unresolved pending further review of its compliance aspects.

.6 Communications

a. Inspection Scope

The team reviewed the communication systems required to implement fire fighting and operations to achieve and maintain a safe shutdown condition. The team reviewed the plant radio system and the PAX (telephone) system which were to be used by operations personnel to perform an alternative shutdown outside of the control room. The team reviewed the design of the radio system to (1) ensure the radio system was sufficient to support alternative shutdown operator actions, and (2) ensure that damage from a control room fire will not impact the performance of the rest of the system. The team also reviewed the use of the portable radio system for use during fire fighting activities. The portable communication systems were reviewed for the impact that damage from fires in the selected fire areas could have on the licensee's ability to achieve and maintain safe shutdown conditions. This review included verification that the design of the systems was adequate to support operator and fire brigade actions, as applicable.

b. Findings

No findings of significance were identified.

.7 Emergency Lighting

a. Inspection Scope

The team reviewed the adequacy of emergency lighting for performing actions required in Procedures 2203.014, "Alternate Shutdown Unit 2, " Change 015-03-0, and 1203.002, "Alternate Shutdown Unit 1," Change 015-06-0, which included access and egress routes. The team reviewed test procedures, test data, and battery trending to verify that the individual battery operated units were able to supply light for the required 8-hour period. The team also reviewed emergency light drawings.

b. Findings

No findings of significance were identified.

.8 Cold Shutdown Repairs

a. Inspection Scope

The team reviewed the licensee's safe shutdown circuit analysis and plant procedures for responding to fires and implementing safe shutdown activities in order to determine if any repairs were required in order to achieve cold shutdown. The licensee had identified two systems (Decay Heat Removal and Low Pressure Safety Injection) that could potentially require repair. The repairs to these systems consisted of the replacement of parts to three control valves (CV-1428, CV-1429, and CV-5017-1) that could be overtorqued in the event of a fire. The replacement of these damaged parts would restore the ability to reach cold shutdown based on the safe shutdown methodology implemented. The team verified that the replacement parts and tools were available and the procedure to perform the repairs was feasible. The team also evaluated whether cold shutdown could be achieved within the required time using the licensee's procedures and repair methods.

b. Findings

No findings of significance were identified.

.9 Compensatory Measures

a. Inspection Scope

The team verified, by sampling, that adequate compensatory measures were put in place by the licensee for out-of-service, degraded, or inoperable fire protection features and post-fire safe shutdown equipment, and systems. The team reviewed the items on the fire impairment list in effect at the time of the inspection and compared them to the fire areas receiving hourly fire watch rounds. The team reviewed the fire protection impairment list to verify that the impairments had been entered into the licensee's corrective action program and that corrective actions to restore the impaired equipment were timely and appropriate.

b. Findings

No findings of significance were identified.

.10 Fire Protection Systems, Features, and Equipment

a. Inspection Scope

For the selected fire areas, the team evaluated the adequacy of selected fire protection features, such as fire suppression and detection systems, fire area barriers, penetration seals, and fire doors. The team observed the material condition and configuration of the installed fire detection and suppression systems, fire barriers, and construction details and supporting fire tests for the installed fire barriers. In addition, the team reviewed license documentation, such as NRC safety evaluation reports and deviations from NRC regulations and the National Fire Protection Association codes to verify that fire protection features met license commitments.

b. Findings

No findings of significance were identified.

4OA6 Meetings, Including Exit

On October 29, 2004, the team leader presented preliminary inspection results to Mr. Cliff Eubanks, General Manager of Plant Operations and other members of his staff who acknowledged the findings. On December 14, 2004, the team leader presented the final inspection results in an exit meeting to Mr. Clifford Eubanks, General Manager, Plant Operations, and other members of the licensee's staff , who acknowledged the findings. The team leader confirmed that proprietary information was not provided or examined during this inspection.

ATTACHMENTS:

1. Supplemental Information
2. ANO Position on the Requirements of 10 CFR Part 50, Appendix R, Section III.L
3. Summary of Integrated Calculation Process Used at ANO for App. R
4. Integrated Analysis Discussion

ATTACHMENT 1

SUPPLEMENTAL INFORMATION

KEY POINTS OF CONTACT

Licensee personnel

R. Dukes, Consultant, NISYS Corporation
C. Eubanks, General Manager, Plant Operations
J. Forbes, Vice President, Operations
B. Greeson, Acting Engineering Programs and Components Manager
R. Hendrix, Fire Protection Technical Specialist
D. James, Manager, Licensing
J. Johnson, Fire Protection Specialist
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R. Loveland, Reactor Operator
K. Parkinson, Consultant
R. Puckett, Supervisor, Fire Protection
T. Robinson, Fire Protection Technical Specialist
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D. Smith, Fire Protection Specialist
J. Storbakken, Reactor Operator
C. Tyrone, Manager, Quality Assurance
L. Valmonte, Consultant, Framatome
L. Young, Consultant

NRC personnel
E. Crowe, Resident Inspector, Arkansas Nuclear One
G. Mizuno, Office of General Counsel
D. Nelson, Office of Enforcement
P. Qualls, Office of Nuclear Reactor Regulation, NRC
G. Wiseman, Region II

LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

Open

05000313; 368/2004010-01	URI	Failure to Maintain Reactor Inventory Within the Pressurizer Indicating Range (Section 1R05.4) and Inadequate Alternate Shutdown Procedure (Section 1R05.4 and 1R05.5)

LIST OF DOCUMENTS REVIEWED

Calculations

85E-0053-48, “IPEEE/Fire Evaluation for Unit 2,” Revision 1

85-0072-03, “Time To Loss of Subcooling or Loss of Pressurizer Liquid Inventory From Plant Trip with no Makeup Available Under Various Leak Path Scenarios,” Revision 2

85-E-0072-04, “Normal/Excess Letdown Inventory Loss"

85-E-0086-01, "Safe Shutdown Capability Assessment Unit 1," Revision 4

85-E-0086-02, "Manual Action Feasibility and Common Results," Revision 0

85-E-0086-03, "Manual Action Feasibility Study, Fire Area I, Fire Zones 98-J, 99-M & 112-I," Revision 0

85-E-0087-01, "Safe Shutdown Capability Assessment, Unit 2," Revision 6

85-E-0115-00, “Report on Determination of Minimum Design Objective Received Signal Level for Radiax Antenna System,” Revision 1

85-E-0116-00, “Report of Susceptibility of Selected Measurement and Control Circuit to Electromagnetic Interference Created by Radio Frequency Fields Produced by UHF Radio Transmissions,” Change no. 001-02-1

85-E-0117-00, “Distributive Antenna System Final Report and Performance Evaluation,” Revision 1

85-E-0122-00, ”Evaluation of Arkansas Nuclear One Radio System Suitable for Alternate Shutdown Communications,” Revision 1

87-E-0003-01, Revision 1, “Time to Isolate Main Feedwater,” Revision 1

89-E-0047-20, “Time to Restore Emergency Feedwater,” Revision 1

1CNAA039401, “Time to Isolate Main Feedwater”

Framatome Technologies Calculation 32-1266115-00, (ANO-1 Turbine Trip Analysis)

BWNP-20007, 86-1118045-00 (Steam Generator Tube Rupture and Loss of Normal AC Power)

Condition Reports

ANO-2-2004-01646	ANO-1-2004-02141
ANO-1-2004-02131	ANO-2-2004-01517
ANO-C-2004-01435	ANO-C-2004-00817
ANO-2-2003-00285	ANO-2-2002-01813
ANO-1-2003-01049	ANO-1-2003-01079
ANO-2-2002-01956	ANO-1-2003-00902
ANO-C-2003-00077	ANO-2-2004-01715
ANO-C-2004-01734	ANO-C-2004-01741
ANO-C-2004-01755	ANO-1-2004-01907
ANO-2-2004-01700	ANO-1-2004-01907
ANO-2-2004-01691	ANO-1-2004-02168
ANO-1-2004-02160	ANO-1-2004-02158
ANO-C-2004-00828	ANO-C-2004-01968

Drawings

E-622, “Lighting and Communication Turbine and Auxiliary Building,” Revision 32

E-639, “Riser Diagram Paging and Pax Telephone System,” Revision 23

E-679, “Conduit & Tray Layout Auxiliary, Building Area 6"

E-703, “Distributive Antenna System ISO-Administration Bldg. Routing,” Revision 1

E-2006, "Low Voltage Safety Systems Power Supplies," Revision 42

E-2904, “Distributive Antenna System Radiax Communication System Riser Scheme,“ Revision 3

E-2905, “ Distributive Antenna System Radiax Cable Routing Plan,” Revision 0

Single Line Diagram E-2014 SH 1, "480V Motor Control Center 2B51," Revision 48

Single Line Diagram E-2014 SH 2, "480V Motor Control Centers 2B52," Revision 37

Single Line Diagram E-2017, SH 1A, "Green Train Vital AC and 125VDC Distribution," Revision 9

Single Line Diagram E-2017, SH 1B, "Red Train Vital AC and 125VDC Distribution," Revision 5

Engineering Requests

ER 010149-E301, “Adequacy of the Radio System During an Alternate Shutdown Scenario,” Revision 0

ER-ANO-2004-0195-000, “ANO - 1& 2Alternate Shutdown Communication System,” Revision 0

ER 010699,E301, “Evaluate New Batteries as an Equivalent Replacement for Exide Battery,” Revision 0

ER-ANO-2002-0745-001, “Appendix R & Loss of Offsite Power,” Revision 0

ER-ANO-2002-0745-034, “Testing Documentation for Adequate Radio Communication Capabilities to Perform U1 & U2 Alternate Shutdown,” Revision 0

ER-ANO-2004-0857-000, "Telephone Cable Damage in Fire Area B," Revision 0

ER-ANO-2004-0860-000, "Turbine Building Fire Impact on Plant Radio and Telephone System," Revision 0

Procedures

1202.001, "Reactor Trip," Change No. 028-02-0

1203.049, "Fires in Areas Affecting Safe Shutdown," Change No. 001-02-0

2104.037, "Alternate AC Diesel Generator Operations, Change No. 007-01

2202.001, "Standard Post Trip Actions," Change No. 006-01-1

2203.014, "Alternate Shutdown," Change No. 015-03-0

2203.034, "Fire or Explosion," Change Nos. 006-00-0 and 006-02-0

2203.049, "Fires in Areas Affecting Safe Shutdown, " Change No. 001-01-0

1305.016, “Safe Shutdown Instrumentation and Equipment Periodic Test,” Change Number 014-00-0

1203.06B, “Alternate Shutdown,” Revision 8

1409.301, “Alternate Shutdown Blackout Lighting Check,” Revision 0

1903.062, “Communications System Operating Procedure,” Change No. 018-03-0

1000.120, “ANO Fire Watch Program,” Change No. 010-01-0

2305.016, “Remote Feature Periodic Testing,” Change 016-00-0

1903.062, “Communications System Operating Procedure,” Change No. 018-03-0

2305.016-Supp. 9, ”Remote Feature Periodic Testing,” Change No. 016-00-0

ULD-0-SYS-07, “ANO Unit 1 & 2 ANO Emergency Lighting System,” Revision 1

2104.037, “Alternate AC Diesel Generator Operations,” Change No. 007-01-0

Work Orders

50278458 01
50970873 01
00557219 01
50971493 01

Miscellaneous

LO-ALO-2004-0006, "Fire Protection Self-Assessment," dated March 22, 2004
Arkansas Unit 1 Safety Evaluation Report, Supporting Amendment No. 35 to Facility Operating License No. DPR-51

NUREG-0223, "Fire Protection Safety Evaluation Report," Docket No. 50-368, dated August 1978

99-R-0002-01, “Engineering Report Evaluation of High/Low Pressure Interface with Respect to 10CFR50, Appendix B,” Revision 0

ANO Fire Hazard Analysis, Revision 9

ATTACHMENT 2

ANO POSITION ON THE REQUIREMENTS OF

10 CFR PART 50, APPENDIX R, SECTION III.L

Purpose

The purpose of this white paper is to provide the ANO position with respect to the NRC regulations stated in 10CFR50, Appendix R, Sections III.L.1 and III.L.2.

Discussion

The regulations of 10CFR50, Appendix R, include redundant safe shutdown equipment/circuit separation requirements in Section III.G.2 for components within a single fire area. The regulations provide options for maintaining compliance when these separation requirements are not met. Section III.G.3 states that alternative or dedicated shutdown capability should be provided when the separation requirements specified in Section III.G.2 are not met. Section III.L provides the detailed regulatory requirements for alternative and dedicated shutdown capability. This paper will focus on items 1 and 2 of Section III.L.

Section III.L.1 states, "Alternative or dedicated shutdown capability provided for a specific fire area shall be able to (a) achieve and maintain subcritical reactivity conditions in the reactor; (b) maintain reactor coolant inventory; (c) achieve and maintain hot standby conditions for a PWR (hot shutdown for a BWR); (d) achieve cold shutdown conditions within 72 hours; and (e) maintain cold shutdown conditions thereafter. During the postfire shutdown, the reactor coolant system process variables shall be maintained within those predicted for a loss of normal a.c. power, and the fission product boundary integrity shall not be affected; i.e., there shall be no fuel clad damage, rupture of any primary coolant boundary, of (sic) rupture of the containment boundary."

Section III.L.2 states, "The performance goals for the shutdown functions shall be:

a. The reactivity control function shall be capable of achieving and maintaining cold shutdown conditions.
b. The reactor coolant makeup function shall be capable of maintaining the reactor coolant level above the top of the core for BWRs and be within the level indication in the pressurizer for PWRs.
c. The reactor heat removal function shall be capable of achieving and maintaining decay heat removal.
d. The process monitoring function shall be capable of providing direct readings of the process variables necessary to perform and control the above functions.
e. The supporting functions shall be capable of providing the process cooling, lubrication, etc., necessary to permit the operation of the equipment used for safe shutdown functions."

Section III.L.1 provides the absolute parameters to be maintained, while Section III.L.2 provides performance goals to be achieved and maintained eventually during the alternative and dedicated shutdown process. Section III.L.1 includes plant specific parameters such as "…the reactor coolant system process variables shall be maintained within those predicted for a loss of normal a.c. power…" which could be different for individual plants[1], but then refines this with further guidance that "…there shall be no fuel clad damage, rupture of any primary coolant boundary, of (sic) rupture of the containment boundary." Section III.L.1 defines the boundaries that cannot be exceeded to meet the regulation. It establishes the box that defines the limits of system parameters which must be maintained throughout the alternative and dedicated shutdown.

Generally, the ANO-1 and ANO-2 (as well as other PWR's) response to a loss of normal a.c. power is to heat up the reactor coolant system expanding the primary fluid such that pressurizer level is off scale high initially. Therefore, it appears the regulatory intent of including the loss of normal a.c. criterion in Section III.L.1 is to provide the broad boundaries of an acceptable recovery. Based on an understanding of typical PWR response to a loss of normal a.c. power, it is clear that Section III.L.1 expects the plant response to exceed the performance goals listed in Section IIII.L.2.

Section III.L.2 provides performance goals that shall be met. The use of the phrase "performance goals" clearly means that the plant may be in a condition outside these goals, but must have capability to return each identified function within the boundaries identified by these goals. The definition of the word goal in Webster's dictionary is "the end toward which effort is directed." If the intent of this section was to define a box of operation that could not be exceed, like III.L.1, then the wording would not have specifically identified the functions as goals. In addition, each "lettered" item under this section includes the phrase, "The…(identified function)…shall be capable of…," which does not limit the equipment identified in this section to maintain specified parameters within a defined box, but requires the capability to bring the plant back to a point defined in this section.

Footnote [1]: IE Bulletin 79-05, "Nuclear Incident at Three Mile Island," Enclosure 2 discusses the loss of pressurizer level indication that occurred after a loss of offsite power led to a loss of feedwater transient at a PWR facility. The bulletin noted that this condition appeared to be a common issue with B&W designed plants and that GDC 13 of 10CFR50 Appendix A required instrumentation to monitor variables over their anticipated ranges including a loss of offsite power scenario. The evaluation of the event stated, "However, provision of a level indication that would cover all anticipated occurrences may not be practical. As discussed above, the loss of feedwater event can lead to a momentary condition wherein no meaningful level exists, because the entire primary system contains a steam water mixture." In addition, this document states, "…we believe that the inability of the pressurizer tnd (sic) normal coolant makeup system to control some transients does not provide a basis for requiring more capacity in these systems."

Therefore, the combination of Sections III.L.1 and III.L.2 can be understood to mean the plant must not exceed the parameters set by III.L.1 under any circumstances for a post-fire safe shutdown using alternative and dedicated shutdown capability, while the goals set by III.L.2 may be exceeded as long as the component functions specified are met without exceeding the boundaries established by III.L.1, and that prompt actions are taken to restore plant parameters within the III.L.2 goals.

An analogy is that Section III.L.1 provides the outer limits of plant shutdown parameters that define a box whose boundaries must not be exceeded. Section III.L.2 establishes the goals of a smaller box, located inside the III.L.1 box, which defines the functional capabilities which must be achieved and maintained without exceeding the larger boundaries set by Section III.L.1. Alternative and dedicated shutdown operation outside the smaller box may occur during the post-fire safe shutdown as long as the capability has been provided to bring the plant back into the Section III.L.2 box.

Pressurized water reactors, in general, will have plant transients of short duration which may cause certain reactor coolant process variables and their indications, such as pressurizer level, to exceed those predicted for a loss of offsite power. These transients would occur for a short period and could result from a delay in reactor trip or from a delay in equipment manipulations such as the time to properly realign emergency feedwater valves following fire induced spurious operations. The consequences of these transients are not safety significant as long as no unrecoverable plant condition will occur. An unrecoverable plant condition is defined as the loss of any shutdown function(s) for such duration as to ultimately cause the reactor coolant level to fall below the top of the reactor core and lead to a subsequent breach of the fuel cladding. The reactor coolant level is defined as the collapsed liquid level since two-phase cooling is sufficient to maintain fuel integrity. To avoid reaching an unrecoverable plant condition, adequate time margin must be maintained to ensure this condition is not reached. Therefore, actions that need to be taken outside of the control room within the early stages of shutdown (less than 60 minutes) have been physically verified by timed walkdowns to ensure an adequate margin is provided for these actions. Adequate margin is further assured at ANO by identifying the limiting operator action times to loss of subcooling or loss of pressurizer level in the surge line. The analysis criteria will ensure conditions are far from those where the collapsed liquid level of the reactor coolant would be near the top of the reactor core.

A related concern is that since the reactor coolant inventory would be below pressurizer level indication during this worst-case scenario, the operators could be operating the plant with no indication of reactor coolant inventory for a period of time. Plant procedures (OP-1203.002 and OP-2203.014) ensure the operators take appropriate actions to establish makeup/charging flow to return pressurizer level indication within an established band when indication has been lost. Operators are trained in Initial Licensed Operator qualification and retrained during Licensed Operator Requalification training as specified in Operations Training Sequence (OP-1063.008) on these procedures and how to establish makeup/charging flow without level indication in the pressurizer. Therefore, this condition has been appropriately addressed to ensure actions are taken to safely shutdown ANO-1 or ANO-2 following a fire which causes the loss of level indication in the pressurizer.

The timeline studies, procedural guidance, and operator training assure that there is adequate reactor coolant inventory surrounding the fuel to prevent cladding damage, in accordance with III.L of Appendix R.

The above understanding of the wording used in 10CFR50, Appendix R, Section III.L is further supported by NRC guidance provided in the following documents:

- Generic Letter 86-10, “Implementation of Fire Protection Requirements,” (Enclosure 2, Question 3.8.4) addresses control room fire considerations (alternative shutdown). This section notes that actions other than reactor trip in the control room must be assured by actions outside the control room. The analysis for these actions should demonstrate, “…that any malfunction of valves that permit the loss of reactor coolant can be corrected before unrestorable conditions occur.” This demonstrates the difference between the goals of Section III.L.2 and the boundaries set by Section III.L.1 to ensure an unrecoverable condition does not occur.
- Generic Letter 86-10 “Implementation of Fire Protection Requirements,” (Enclosure 2, Question 5.3.5) specifies that it is acceptable to utilize a water solid pressurizer.   A water solid pressurizer would require a level higher than the instrument taps and thus, would be outside of the pressurizer indication (i.e., off-scale high).
- Generic Letter 86-10 “Implementation of Fire Protection Requirements,” (Enclosure 2, Question 5.3.10) defines the design basis transients per Section III.L in that a loss of offsite power must be assumed concurrent with additional failures (single spurious actuation or signal, loss of all automatic function, spurious actuation of the redundant valves in any one high-low pressure interface line). This clearly shows that the NRC expects the analyzed condition to exceed the plant response to a loss of offsite power.

- NRC SER, dated May 30, 1991, issued to the Davis-Besse plant that addressed alternative shutdown capability, stated, “At Davis-Besse *as with other pressurized water reactors* (emphasis added), some plant transients of short duration may cause certain reactor coolant process variables and their indications, such as pressurizer level, to exceed those predicted for a loss of offsite power.” “The staff has evaluated the consequences of these transients and concludes that they are not safety significant as long as no unrecoverable plant condition will occur.” The licensee did not request an exemption from Appendix R in this area and the NRC did not identify the need for an exemption for this clarification of the meaning in Section III.L.
- Recently, NRC Task Interface Agreement (TIA) 2003-06, dated February 6, 2004, confirmed the acceptability of the above SER (dated May 30, 1991) on this issue. The NRR staff conclusion states, “This configuration assures that there is adequate RC surrounding the fuel to prevent cladding damage, in accordance with III.L of Appendix R.”

The existing ANO post-fire alternative safe shutdown procedures (OP-1203.002 and OP-2203.014) include actions taken in the control room to isolate letdown and initiate makeup/charging prior to leaving the control room to take up control and monitoring from outside the control room. These actions are not credited in establishing the time available for operator actions to ensure an unrecoverable condition does not exist (meet III.L.1 criteria). The approach of taking actions in the control room and then following up with confirmation outside the control room provides defense-in-depth to meet both the limits in III.L.1 and ensure the plant can achieve and maintain the performance goals established in III.L.2.

<u>Conclusion</u>

The regulatory requirements in 10CFR50, Appendix R, III.L.1 provide the boundaries allowed in reactor coolant system process variables for a post-fire alternative and dedicated shutdown (i.e., there shall be no fuel clad damage, rupture of any primary coolant boundary, or rupture of the containment boundary). The requirements that follow in Section III.L.2 provide performance goals that may be temporarily exceeded as long as an unrecoverable plant condition will not occur, but the functional capability must be maintained to allow eventual attainment of the identified goals for a post-fire alternative and dedicated shutdown.

ATTACHMENT 3

SUMMARY OF INTEGRATED CALCULATION PROCESS

USED AT ANO FOR APP. R

Summary of Integrated Calculation Process Used at ANO for App. R

- The current set of calculations used to determine minimum operator response times are identified and summarized in calculation 85-E-0086-02, Attachment 1, Section 5.0.

- Existing calculations, for the most part, were adopted for Appendix R use and were not originally developed for this purpose.

- Calculations generally show plant response over a range of conditions and had to be screened for suitability to bound Appendix R criteria.

- The same set of calculations is being used for alternative shutdown and safe shutdown (non-alternative).

- Alternative shutdown performance goals bound safe shutdown (non-alternative) performance goals which allow the same calculation to be used for both cases

- Performance goals (loss of subcooling, pressurizer level out the surge line, RCS level to top of fuel) used in evaluating calculations were frequently based on the type of data available, but were bounding for our understanding of III.L criteria.

- A Condition Report has been written to finalize a standard set of performance goals and then utilize the results to evaluate existing calculations or develop new calculations.

- Several independent Condition Report corrective actions have been written to evaluate some of the existing calculations for potentially overly conservative inputs.

- The screening process to determine suitable calculations focused on one worst case spurious actuation, assumed a loss of automatic control when it would maximize significance of the spurious actuation, with and without offsite power.

- An example of a worst case spurious is the "maximum letdown flow event". This event was coupled with a total loss of feedwater to maximize primary fluid loss due to continued high pressure from no secondary cooling (loss of offsite power with no automatic control (e.g. diesel doesn't start and load and feedwater doesn't initiate)). This case is insensitive to operator response time to restore feedwater and gives the shortest possible response time to isolate letdown and restore makeup.

- A related example is the loss of feedwater calculation chosen for ANO-1. This calculation used zero letdown flow to shorten the time to primary overpressure and open the primary safety valves. Again, this case is insensitive to operator action time to isolate letdown and provides the shortest operator response time for restoration of feedwater.

- Therefore, the process used at ANO to identify calculations for determining operator response times will bound Appendix R criteria for either alternative shutdown or safe shutdown events independent of how the events are integrated.

- Existing Condition Report actions will standardize the performance goals and review the calculations for any updates or changes based on the final standard chosen.

ATTACHMENT 4

INTEGRATED ANALYSIS DISCUSSION

NRC Comment:

An integrated analysis approach was not found. The ANO calculations used to provide the basis for minimum operator action times were not consistent in the targets used (pressurizer level, level out the pressurizer surge line, loss of subcooling, level to top of active fuel) and did not appear to address some combinations of events. For example, the letdown timing analysis did not consider a dry steam generator for the amount of time needed to manually restore EFW.

ANO Response:

We believe the following additional information will be helpful in resolving the NRC concerns listed above.

The calculations utilized for determining minimum operator response time were, for the most part, existing calculations that were previously developed for other licensing or design related activities and adopted for Appendix R. However, each calculation was reviewed to ensure it would be bounding for use in evaluating the Appendix R fire scenario before it was used in developing operator action timing limits. The calculation base for safe shutdown is the same as that for alternate shutdown. Since all circuits are potentially impacted by a control room/cable spreading room fire the alternate shutdown calculations will bound the failures that could occur in safe shutdown areas. Additionally, the acceptance criterion for alternate shutdown was considered to be bounding. Because of the origin of these calculations, they do not use a consistent set of targets. Most of the calculations currently being used for post-fire safe shutdown manual action timing input provide a curve of the plant response to various initial conditions. The Appendix R target information was extracted from this data. The calculations provide a broad picture of plant response to input changes and are not limited to a single target.

Several condition report corrective actions have been initiated to evaluate the need to develop new calculations or refine the existing calculations to be consistent with the NRC guidance on Appendix R. The final set of targets will be determined based on the NRC response to the ANO position paper on Section III.L of 10CFR50, Appendix R. The summary of calculations used for the manual actions taken for post-fire safe shutdown (non-alternative shutdown) are described in calculation 85-E-0086-02, which also lists the Condition Report corrective action numbers for each calculation identified to be updated or replaced, as necessary (CR-ANO-C-2004-0755, CA-90 to 94). In addition, Condition Report CR-ANO-C-2004-1758 provides a sequence of actions to define the final set of targets to be used for extracting data from existing ANO calculations or guidance for an update to those that are affected by a change in the targets. These actions will resolve the NRC concern for providing supporting calculations based on a consistent set of targets for minimum operator action times. In the interim, the existing set of calculations provides a reasonable basis for continued safe plant operation. The calculations evaluate the impact of the worst case fire induced failures in each zone where manual actions are relied upon (alternate and safe shutdown). Conservative assumptions for transient evaluations are made and the results of the calculations show RCS inventory stays well above the top of the fuel thus ensuring fuel damage does not occur. Future activities to refine or focus these calculations on the Appendix R set of scenarios are expected to provide additional margin to the current timing limitations placed on operator actions due to the conservative approach currently being used in some of the calculations. If the final resolution on defining an appropriate target differs from ANO's current understanding, then the time available for operator actions to meet target could be reduced.

The set of calculations used to support the minimum operator action times to perform post-fire safe shutdown activities were selected to bound the combination of events described in NRC guidance documents including the Generic Letter 86-10 response to Question 5.3.10, "Design Basis Transients" (one worst case spurious, loss of all automatic control, with and without offsite power available). The current best single source of this information is calculation 85-E-0086-02, Attachment 1, Section 5.0, "Timeline Results." This section provides a listing of the calculations and a summary of the results used for each category (worst case spurious) of concern identified. For example, there is a category for "Normal/Excess Letdown Inventory Loss" and a separate category for "Time to Restore Emergency Feedwater." The intent of listing the calculations under each of the defined categories was to be sure all significant aspects of an Appendix R scenario were addressed independently and conservatively. The process does not require a combination of worst case spurious actuations. The process requires that each category (worst case spurious) is evaluated with loss of automatic control of cables in the area with and without offsite power available. While the bounding nature of each calculation used in a given category may not be apparent from reading the text of each summary description in calculation 85-E-0086-02, it will be clear when the detailed basis behind each calculation is reviewed. The following provides the additional information behind the calculations associated with the NRC concern, that the letdown timing for ANO-1 did not consider the loss of secondary cooling for the time period required to manually restore feedwater.

The ANO-1 calculations (85-E-0072-02 and 85-E-0072-03) for letdown inventory loss are based on an assumption within one of the calculations that states, "It will be assumed that primary to secondary heat transfer is accomplished by whatever means is necessary to achieve the specified final RCS average temperature within the specified time. This is conservative since the absence of such heat transfer will hold up the RCS temperature which will limit the shrinkage of the RCS. A limited RCS shrinkage will result in a higher pressurizer liquid inventory and a higher pressure than with a greater RCS shrinkage, thereby also increasing the subcooling margin…" Basically, this assumption shows that less secondary cooling (loss of feedwater) will not shorten the time for operator action. Conversely, excess feedwater or faster restoration of feedwater will not shorten operator response times since additional cooling would cause lower RCS pressure which slows the rate of letdown. Also, overcooling is addressed separately. The implementation of the above assumption within the letdown inventory loss calculations ensures that the timing of feedwater restoration will not adversely impact the timing provided for minimum operator response times to isolate letdown and restore makeup.

Similarly, the ANO-1 calculation (89-E-0047-20) for a loss of all feedwater is not adversely affected by the amount of letdown assumed. A review of the input deck for this calculation shows that zero letdown was assumed, which is conservative. The loss of feedwater calculation causes excessive primary pressure due to overheating and lifting of the primary safety valves. The minimum time for operator action is based on how long this may continue until primary inventory is depleted such that restoration of feedwater will cause the collapsed liquid level to fall to the top of the active fuel. At first glance it may appear that the amount of letdown assumed is of primary importance in determining this time. However, a review of the results of more detailed calculations performed for ANO-2 described below, and a review of thermal-hydraulic principles will demonstrate that excess letdown will increase the time available for operator action. Basically, the earlier the primary pressure increases to the setpoint of the primary safety valves, the shorter the time available for operator action. Increased letdown flow will lengthen the time to reach primary safety valve opening pressure since the loss of fluid will help depressurize the system. Limiting letdown flow will shorten the time to open the primary safety valves which pass significantly more mass than is possible through the letdown system and shortens the time available for operator action to restore feedwater.

The ANO-2 calculation (85-E-0072-04) for letdown inventory loss is based on the same assumption used for ANO-1, described above, and will not be repeated here. The ANO-2 calculation (01-E-0011-03) for a loss of all feedwater is considerably more detailed than for ANO-1. This calculation conservatively assumed that the reactor did not trip at T=0, but remained at full power for ~10 seconds and tripped on high pressure which added more heat to the primary than would occur during a fire initiated plant shutdown. In addition, the RCP's were not tripped until 15 minutes into the event, again adding more heat than would be expected, and assumed no charging flow to the RCS after the time of reactor trip through out the remainder of this event. While letdown is automatically controlled during this analysis, the calculation notes that other cases where letdown exceeds the charging flow are not bounding because letdown delays pressurizer overfill and the time to core uncovery. Basically, earlier opening of the pressurizer safety valves will expel much more inventory than is possible with letdown and shorten the time to core uncovery and fuel damage. The combination of loss of all feedwater and no charging to determine the minimum time available for restoration of secondary feedwater is more conservative than the NRC guidance for this event and provides an integrated bounding time for minimum operator response times.

Therefore, each set of calculations may be used independently without the need to combine the results since the detailed assumptions behind each calculation ensures it provides a basis for bounding the minimum time available for operator action.
The calculations are effectively integrated because, as discussed in the paragraphs above, each 'worst case spurious' is addressed (e.g., letdown fails open) coupled with conservative assumptions regarding other system status/response.

The Condition Report corrective actions listed above will ensure these calculations will be updated or replaced, as appropriate, to ensure data is extracted using a consistent set of targets among the post-fire safe shutdown supporting calculations, but it is clearly bounding for use until these issues are resolved.

In summary, although the above discussion does not address all the calculations used at ANO for post-fire safe shutdown analysis, it does present a description of the methodology used in choosing bounding calculations. We believe this approach has ensured these calculations are suitable for use until Appendix R specific analyses can be prepared, as needed. The intent of the process used in selecting or developing the calculations currently used to define minimum timing for operator actions included consideration of factors that should address combinations required by NRC guidance on Appendix R scenarios.

ATTACHMENT 5

EVALUATION OF PRESSURIZER LEVEL

NRC Comment:

The ANO-1 time for isolating letdown and restoring makeup to keep the water level within the pressurizer surge line was calculated to be 2 minutes, and 55 minutes, respectively. However, the NRC walkdown results show 5-1/2 minutes were taken to isolate letdown and over 50 minutes to restore makeup. This appears to exceed the allowable calculated time.

ANO Response:

The calculated times were developed in calculation 85-E-0072-02 and were bounding values for a condition with off-site power available, as the amount of time available for an operator to take action for a loss of off-site power was considerably longer. The limiting criterion for this scenario was the loss of pressurizer inventory down to the bottom of the pressurizer surge line as subcooling margin was not lost. The calculation shows the relationship between letdown isolation time and the time available to restore makeup to prevent pressurizer inventory loss to the bottom of the surge line for the case of **off-site power remaining available** as follows:

Letdown Iso. Time	Makeup Restoration Time	Subcooling Margin
2 Min.	55.6 Min.	+59 F
4 Min.	41.7 Min.	+61 F
6 Min.	28.3 Min.	+64 F

The calculation shows the relationship between letdown isolation time and the time available to restore makeup to prevent pressurizer inventory loss to the bottom of the surge line for the case of a **loss of off-site power** as follows:

Letdown Iso. Time	Makeup Restoration Time	Subcooling Margin
10 Min.	188.3 Min.	+7 F
12 Min.	157.1 Min.	+15 F
14 Min.	115.0 Min.	+26 F

The principal difference between the two cases is the difference in primary to secondary cooling being more closely coupled by forced RCS flow using the RCP's (with off-site power) and the higher differential temperature necessary to support natural circulation (without off-site power). The higher average primary temperature needed to support natural circulation maintains pressurizer inventory longer than the lower relative primary temperature associated with forced primary circulation.

The operator timing issue identified above was for the alternative shutdown scenario. The alternative shutdown procedure (OP-1203.002) ensures that off-site power is isolated for the 4160V and 480V power supplies both in the Control Room prior to evacuation (Step 3.4) and the RCP's are confirmed tripped by CRS follow-up actions (Section 1B, Step 3.5) after leaving the control room with subsequent power provided by the diesel generators after shedding non-essential loads. The actions to confirm the RCP's are tripped from outside the Control Room are expected to take less than 5 minutes to complete after leaving the Control Room based on discussions with operations. However, as long as these actions to trip the RCP's are taken prior to the pressurizer level going below the bottom of the surge line, then the time to restore makeup will be extended. Using the stated NRC walkdown times for letdown isolation in less than 6 minutes, the CRS will have as much as 28 minutes to take the actions to confirm the RCP's are tripped. As soon as the RCP's are tripped, then the secondary cooling will be based on natural circulation (higher temperature difference between the primary and secondary sides) and allow the RCS to reheat and swell to refill the pressurizer as if the entire scenario were the same as a loss of off-site power event. Based on the procedurally required operator actions, the analysis for the **loss of off-site power** would reflect the plant conditions for alternative shutdown. As stated above, if the time for operator actions to isolate letdown occurs in 10 minutes or less, then approximately 3 hours (188 minutes) would be acceptable for restoration of the makeup function. Therefore, the timing values identified during the NRC walkdown would be acceptable for maintaining the pressurizer level within the pressurizer surge line. This provides an example where the ANO calculations being used for minimum operator response times are conservative, even if they were not developed specifically for the Appendix R safe shutdown process.