U. S. NUCLEAR REGULATORY COMMISSION

REGION II

EMERGENCY OPERATING PROCEDURES TEAM INSPECTION

Docket No.: 50-302
License No.: DPR-72

Report No.: 50-302/97-12

Licensee: Florida Power Corporation

Facility: Crystal River 3 Nuclear Station

Location: 15760 West Power Line Street
Crystal River, Florida

Dates: October 20 through 24, 1997, December 8 through 12, 1997, and January 5 through 9, 1998

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Enclosure 2

EXECUTIVE SUMMARY

Crystal River Nuclear Plant, Unit 3
NRC Inspection Report 50-302/97-12

Five headquarters and regional inspectors used a sample approach to assess the adequacy of the emergency operating procedures (EOPs) development process. The team observed operating crews respond to numerous simulated emergency conditions developed by the team to test specific sections of the EOPs. The inspection guidance was Inspection Procedure 42001, "Emergency Operating Procedures." Three weeks of on-site inspection were performed with draft EOPs and supporting documents inspected during the first on-site week. Plant Review Committee approved EOPs and supporting documents were used during the other two on-site weeks.

Operations

- At the beginning of the inspection, the licensee had deviated from the Technical Bases Document (TBD) numerous times without providing any technical justification or adequate technical justification for the deviations. Following NRC identification, the licensee upgraded the technical justification documents and/or revised the EOPs. After the upgrade, some of the justifications were still not adequate. These actions require additional justification or revision of the EOPs to ensure the mitigation strategy is accomplished. In addition, there were other less significant actions differing from the TBD. Also, TBD actions to be accomplished by the TSC were not incorporated into procedures. The examples of inadequate justifications, lack of technical justifications, limited technical justifications and procedure omissions were indicative of numerous EOP development process weaknesses. A number of thes examples were part of a violation (section 03.1).

- At the beginning of the inspection, the licensee's in-plant portion of the verification and validation (V&V) process, which was being performed on the draft EOPs, was insufficient. There were no specific concerns regarding the control room portion. In response to the team's perspectives, the licensee provided additional guidance for the in-plant V&V, and the team noted improvements. However, even with the improvements, there were other specific and general deficiencies reflecting inadequacies in the in-plant V&V process. Also, some of the team's original concerns were not adequately addressed partially due to inadequate correction actions to a problem previously identified by the licence associated with in-plant operator accessibility. The disparity between licensed operators being able to perform control room EOP actions and non-licensed/support personnel not always being able to perform in-plant EOP actions was consistent with the way in which the V&V process was established and implemented. Consequently, the actions directed by the EOPs within the control room could always be performed but, numerous in-plant actions either could not be performed due to the lack of support personnel, the lack of properly stagged equipment, technically incorrect procedure steps, not incorporating the actions

into procedures or the radiological consequences of performing the actions had not been assessed. A number of these inadequacies were part of a violation (section O3.2).

- The EOP Writer's Guide was comprehensive and adequately implemented in the construction of the EOPs. This contributed to operators rarely having trouble reading or understanding the EOP steps during the simulator scenarios (section O3.3).

- Following revision, the licensee's EOP User's Guide was acceptable (section O3.4).

- The maintenance and revision procedure was adequate. The scope of the NRC review did not include set point control (section O3.5).

- The operating crews were capable of mitigating the transients presented by the team. However, there were some examples of performance inconsistent with an EOP step, licensee management expectations or the licensee's administrative guidance. These performance problems were being dispositioned consistent with their significance (section O4).

- The EOP/AP training program for licensed operators was adequate. There was a program weakness of not training secondary plant operators on resetting the emergency feedwater turbine's over speed trip. The licensee provided corrective actions consistent with the significance of the weakness (section O5).

Maintenance

- The work control process did not consider that work could inhibit access to in-plant EOP action locations. The licensee was formulating corrective actions to this weakness (section M3.1).

- The licensee's program for implementing Technical Specification 5.6.2.4 was not adequate, but the actual external leakage did not exceed post-accident dose consequences requirements. The licensee was taking appropriate corrective actions to correct this non-cited violation. (section M3.2)

- The technical content of the periodic inventory controls for in-plant EOP equipment was adequate (section M3.3).

Engineering

- Generally, calculations issued prior to 1995 contained numerous errors. Occasionally, the calculations did not contain enough information to enable a person, who was technically qualified in the subject, to review and understand the analyses and verify the adequacy of the results without recourse to the originator. This was a violation. Prior to the team's arrival, the corrective actions to known calculational inadequacies had not extended to the EOP set point calculations which was an example of a violation. Although a small sample size was

reviewed by the team, the calculations issued in 1997 to support EOP set points were far better (section E1.1).

- During at least two time periods after the operating license was granted, there was no procedural guidance to use the LPI crossover line with flow split between the two LPI lines to mitigate the consequences of a LOCA. Also, a recent change to the USAR regarding the LPI crossover line method of long term core cooling was inconsistent with applicable topical reports. The NRC will further review these unresolved matters (section E1.2).

- The MUPs used for ECCS high pressure injection were not purchased to specifications commensurate to the duty to be incurred during a postulated post-accident LOCA. This was a violation. (section E1.3)

- The EDG air start circuitry was properly designed to prevent continued application of starting air to an EDG until depletion of the staring air, and appropriate operator training had been provided on how to respond to a tripped EDG (section E1.4).

- The LPI injection valves were maintained normally closed, consistent with the FSAR. However, in a letter dated 1/13/76 the licensee committed to maintain the valves normally open and update the FSAR accordingly. Those actions were never accomplished. The NRC will further review this unresolved matter (section E1.5).

- The licensee identified a wiring error in the control room heating and ventilation system. The license was taking appropriate actions to correct this non-cited violation. (section E8.1)

Report Details

Summary of Plant Status

Crystal River Unit 3 was shutdown with Reactor Coolant System temperature below 200° Fahrenheit during the inspection period.

Introduction

The primary objective of this inspection was to assess the adequacy of the process used to develop and implement emergency operating procedures (EOPs). The team used a sampling approach to evaluate technical content, administrative controls, verification and validation and, engineering calculations and analyses supporting the EOPs.

I. Operations

O3 Operations Procedures and Documentation

O3.1 Conformance to the Technical Bases Document (TBD)

a. Inspection Scope (42001)

The team reviewed substantial portions of the EOPs against the procedural guidelines of the B&W Owners' Group EOP TBD (74-1152414 Rev. 8) and two owners' group approved TBD changes which will be incorporated into the next revision. Where deviations were noted, the team evaluated the licensee's technical justification documents (TBD - EOP Cross Step Document & EOP - TBD Cross Step Document) to verify that deviations from the TBD such as additions, omissions, and sequence changes were technically justified and did not affect the mitigation strategy. During the October onsite inspection, the team reviewed the draft EOPs scheduled for PRC approval in November. During the December onsite inspection, the team reviewed the PRC conditionally approved EOPs. During the January onsite inspection, the team continued to review select (PRC) conditionally approved EOPs and, due to previous NRC team findings, revisions to the EOPs.

Due to the numerous design changes being implemented and outstanding Technical Specification requests yet to be approved by the NRC Office of Nuclear Reactor Regulation (NRR), the team based the review, assuming that License Amendment Requests (LAR) 210 (dated June 14, 1997), (LAR) 214 (dated October 31, 1997) and (LAR) 218 (dated September 9, 1997), would be acceptable to NRR without deviation. The team did not review the technical adequacy of the EOP actions dealing with boron precipitation control since the adequacy of the licensee actions in this area was being reviewed by NRR.

b. Observations and Findings

1. During the October onsite inspection, the team determined that the licensee deviated from the TBD guidelines numerous times. The omissions and additions were typically identified in the deviation

documents. However, most of the justifications were not adequate. Also, the licensee did not identify any step sequence changes as deviations or confirm that the sequence deviations were non-consequential with regard to the mitigation strategy.

(a) Specific examples of inadequately justified deviations were:

- TBD III.B, Lack of Adequate Subcooling Margin, step 8.2.b provided direction to maintain OTSG tube to shell temperature differentials within limits. The licensee omitted this step and documented its omission in the deviation document. However, the justification was very general and did not provide adequate details to assess the deviation.

- TBD, SBLOCA/SBLOCA Cooldown, step 17.4 directed establishing auxiliary spray, if desired. The licensee omitted this step and justified its omission solely on it being an optional action.

- TBD, SBLOCA/SBLOCA Cooldown, step 8.0, directed verifying flow in <u>each</u> LPI line > [min flow]. The EOPs stated to verify flow in <u>any</u> LPI line. TBD Volume III stated the basis was to verify adequate LPI flow for core cooling prior to transitioning to LBLOCA CD. The licensee's justification discussed identifying pressure below LPI pump head without discussing whether there was adequate core cooling.

- TBD, LBLOCA Cooldown, step 1.2 directed opening the LPI crosstie if only one LPI pump was available to ensure injection through both lines. The ECPs omitted this step. The justification was that the motor operated valves may or may not have power available which didn't address why the step could not be accomplished or its impact on the mitigation strategy.

(b) Specific examples of deviations that were not identified and justified were:

- TBD III.A, Immediate Actions and Vital System Status Verification (VSSV), steps 2.3 and 2.4, directed that adequate primary to secondary heat transfer be attempted and to begin maximum boric acid addition if reactor power was not decreasing when the reactor was required to be tripped (i.e. an Anticipated Transient Without a Scram (ATWS)). EOP-02, VSSV, did not address primary to secondary heat transfer or initiating boric acid addition until much later in the procedure. Consequently, during a complete ATWS from

90% reactor power simulator scenario, the operating crew was not able to perform the TBD mitigation strategy.

- TBD III.B, Lack of Adequate Subcooling Margin, step 4.0, directed isolating possible RCS Leaks (4.1) and verifying RB Cooling (4.2). The licensee did not direct isolating possible RCS leaks until step 3.17 of EOP-03, Inadequate Subcooling Margin. Verification of RB Cooling was performed in step 3.9. The sequence deviation and impact on delaying corrective actions was not identified in the deviation document.

- TBD III.B, Lack of Adequate Subcooling Margin, steps 18.0 - 18.6, were moved to EOP-14, EOP Enclosures, Enclosure 16, RCP Recovery, without technical justification.

- The TBD periodically repeated critical checks and procedural transitions. The licensee replaced these periodic checks with carryover steps without technical justification.

- EOP-03, Inadequate Subcooling Margin, Steps 3.37 - 3.55, were imported from TBD SBLOCA Cooldown without technical justification as to why the steps were not contained in EOP-08, LOCA Cooldown.

- The following steps were sequenced differently in EOP-07, Inadequate Core Cooling, than TBD III.F, Inadequate Core Cooling, without justification.

TBD Step	EOP-07 Step
10.0	3.29
12.0	3.31
12.1	3.31
12.2	3.33/3.34
12.3	3.35
13.1	3.31
13.3	3.30
13.7	3.32

- The following steps were sequenced differently than the SBLOCA/SBLOCA Cooldown TBD without justification.

TBD Step	EOP-07 Step
2.1	3.10
2.2	3.25
4.1	3.15
4.2	3.32

5.0	3.20
6.0	3.14
7.0	3.36

2. Following NRC identification to the licensee of the generally poor justifications from the TBD, the licensee began upgrading the TBD - Cross step documents and/or revising the EOPs. Consequently, the draft EOP-02 procedure was revised for responding to an ATWS, and TBD step 17.4 of SBLOCA/SBLOCA Cooldown, directing the establishment of auxiliary spray, was added to EOP-08, LOCA Cooldown. Also, in concert with the B&W Owners' Group, the TBD was changed to indicate that steps could be preformed out of sequence provided the mitigation strategy was not compromised.

3. During the December onsite inspection, the team identified inadequacies and weaknesses in the upgraded TBD - Cross step documents.

   (a) The inadequacies included:

   - TBD, LBLOCA CD, step 3.0, directed securing HPI when LPI flow of "x" (the minimum flow for adequate core cooling derived by the licensee) amount existed for greater than 20 minutes. TBD Volume 3 identified that this was due to concerns of: 1) increasing radiation levels in the auxiliary building (AB) during RB sump recirc while in the piggyback mode, 2) pump failure, and 3) possibly avoiding the complex evolution of switching to the piggyback mode. The licensee had removed this guidance and opted for long term operation of the HPI pumps in piggyback mode. The technical justification was not adequate in that it did not address the above items of concern.

   - TBD, LBLOCA CD, Step 1.2, directed opening the LPI crosstie if only one LPI pump was available to allow injection through both LPI lines. The licensee omitted this guidance without adequate technical justification since LPI operation in this manner was a licensing basis requirement. FSAR, Chapter 6, Section 6.1.2.1.2 specifically stated that "the LPI System is provided with a crossover line to permit one LPI string flow of 3,000 gpm to be split equally, thus providing a minimum of 1,500 gpm flow to both core flooding injection nozzles simultaneously should a core flooding line or one LPI pump fail." Also, the B&W topical reports approved by the NRC verifying licensee compliance to 10 CFR 50.46, Acceptance criteria for emergency core cooling systems for light water reactors, listed, "one LPI pump operating with crossover line valves open; flow split between the two

LPI lines by the control valves," as one of three required long term core cooling methods. Section E1.2 of this report contains additional discussion of the licensing basis for this operation.

- TBD Section III.B, Lack of Adequate Subcooling Margin, step 8.0 provided time critical guidance for starting an emergency cooldown if HPI was not available. Volume III of the TBD stated that for SBLOCAs where HPI flow could not be established, "Plant cooldown must start immediately upon a loss of subcooling margin in order to avoid severe core damage." The licensee added nine steps prior to the step which initiated the emergency cooldown due to no HPI. The justification for adding these steps did not address delaying the cooldown. The team observed that an operations crew on the simulator, responding to a total loss of HPI, took 29 minutes to commence the emergency cooldown.

- Step 2.2.1 of EOP-02, Vital System Status Verification, directed de-energizing the CRD system to insert control rods if the reactor protection system failed. Step 2.2.2 directed re-energizing the CRD buses by closing 480 VAC supply breakers, 3305 and 3312. There was no corresponding TBD section or step for re-energizing the buses, and a technical justification for inserting the step was not included in the cross step document. Breaker 3312 was between 4160 VAC ES Bus 3B and the 480 VAC Plant Aux Bus. The effects of re-closure of breaker 3312 on the 4160 VAC ES Bus 3B had not been analyzed. During an ATWS simulator scenario, the team observed an operator momentarily open the 3312 breaker and then reclose it. Subsequent analysis indicated that breaker 3312 must be open for at least three seconds to assure that the currently connected bus loads would not re-trip the bus on over current. Also, there was another breaker, 3222 (the supply breaker from the 4160 VAC ES Bus 3B), in-line with breaker 3312 and 480 VAC Plant Aux Bus. Neither breakers, 3222 or 3312, had been tested under these conditions.

By letters dated October 31, 1980 and December 17, 1982, from D. Eisenhut (NRC) to all licensees of operating plants and applicants for operating licenses and holders of construction permits, the post-Three Mile Island (TMI) requirements, NUREG-0737, "Clarification of TMI Action Plan Requirements," and Supplement 1 to NUREG-0737, "Requirements for Emergency Response Capability," were issued. NUREG-0737 criterion I.C.1, "Guidance for the Evaluation and

Development of Procedures for Transients and Accidents," provided clarification regarding the requirements for reanalysis of transients and accidents. Item 7 of Supplement 1 to NUREG-0737, "Upgrade Emergency Operating Procedures (EOPs)" directed that licensees develop a procedures generation package (PGP) which included a description of the validation program for the EOPs.

By letter dated March 25, 1983, Florida Power Corporation (FPC) submitted a PGP in response to the I.C.1 requirement of NUREG-0737, Supplement 1. The response contained a discussion of the upgraded EOP validation program which stated, in part that the purpose of the validation program was to demonstrate the usability of emergency procedures. The instructions to operators were to be complete, understandable and, compatible with conditions. Licensee procedure AI-402C, AP and EOP Verification and Validation Plan, enclosure 3, required differences between the procedure and the TBD be documented and justified.

On February 21, 1984, the NRC issued an Order modifying the Operating License which confirmed the licensee's implementation of I.C.1. These above examples of inadequate technical justifications affecting the mitigation strategy were examples of violation , VIO 50-302/97-12-01, "Inadequate Implementation of TMI Action Item EOP Order." Also, the significance and number of the examples, was indicative of a weakness in the process for developing the EOPs.

(b) In addition to the inadequacies, there were other actions different from the TBD that were not fully justified in the Cross step documents, but did not appear to affect the mitigation strategy. As an example, the licensee inserted steps 3.4, 3.5, and 3.6 into EOP 05, Excessive Heat Transfer, which were not part of the owners' group guidance. This resulted in step 3.7 (which would have corresponded to step 3.4 in the TBD) being moved to later in the EOP. The only justification for this change was that step 3.7 was placed where it was because "steps 3.4, 3.5, and 3.6 were added to the procedure." While this explanation may account for how the step numbers changed, it provided no technical justification for the change. The new steps appeared minor in terms of effect (both mitigation strategy and time delays). However, the licensee provided no technical basis for this change. Other similar step sequence changes were identified in this and other EOPs, and referred to the licensee. None of the changes appeared to

change the accident mitigation strategy or the timeliness of procedural steps, but the lack of or limited technical justification and documentation was indicative of a weakness in the process for developing the EOPs.

4. Also, in December, during a review of PRC conditionally approved EOP-8, LOCA Cooldown, the team recognized that several TBD step actions were omitted from the EOPs and were justified in the TBD-Cross step documents on the basis that the TSC would provide the guidance required to perform the actions. However, the licensee had not developed any TSC guidance to address the actions stated in the TBD, and therefore the documentation to support the justification for deviation from the B&W guidance was incomplete. Examples of the steps affected included:

TBD	
Step 2.2	Trip RCPs if running.
Step 6.2	Monitor and Control hydrogen concentration in RB in accordance with plant specific method.
Step 6.4	If sump is being diluted... a. check for and attempt to isolate leaks into the RB b. If leaks into the RB are found and cannot be isolated, Then commence boron addition to the RCS as necessary to maintain adequate shutdown margin.
Step 6.6	Maintain RB sump level within appropriate high-low limits.
Step 6.7	If sump water level must be drained THEN ensure radioactive water will be appropriately stored.

These inadequately technically justified actions are additional examples of violation VIO 50/302-97-12-01, "Inadequate Implementation of TMI Action Item EOP Order."

5. The team observed implementation of the revised EOP-02, VSSV, in response to an ATWS simulator scenario in December. The TBD mitigation strategy was accomplished.

6. During the January 98 onsite inspection, the team identified two other actions that were not technically justified with respect to the TBD. These actions were contained in EOP 06, SGTR, and were:

- The time delay insertion of site specific steps 3.1, 3.2 and 3.3 between SGTR identification and determination that the reactor was tripped. The additional steps were not in the TBD. These additional actions impacted the timely attempts to restore pressurizer level in step 3.5, which increased the chances of manually tripping the reactor above the secondary side steam pressure set points for the atmospheric dump valves (ADVs) and main steam safety valves (MSSVs). Opening these valves would increase the radiological dose to the public since these are direct release pathways and should be avoided. The team observed an operations crew on the simulator responding to a SGTR in which the crew did not maximize makeup (complete step 3.5) before manually tripping the reactor a high power per step 3.6. Also, during another SGTR scenario in a previous week, the crew jumped ahead to step 3.5 to maximize makeup as soon as possible. The cross step document indicated that the addition of site specific steps 3.1, 3.2 and 3.3 were not consequential.

- The time delay possible in not isolating the EFWT steam supply from the affected OTSG. If the affected OTSG's steam is used to power the turbine driven EFW pump, the turbine's exhaust would be a direct radiological release path. Step 3.3 of the TBD directed isolating all non-essential steam loads during a rapid power reduction prior to tripping the reactor below the ADV and MSSV set points. The licensee did not isolate the affected OTSG EFWT steam supply until step 3.45 or 3.46. The licensee did justify not isolating the steam supply during the rapid power reduction since its isolation could induce a system perturbation causing a reactor trip above the ADV and MSSV set points. However, following the manual trip, the licensee did not technically justify delaying the steam supply isolation. The team observed an operations crew on the simulator responding to a SGTR in which an hour elapsed before this action was done. The licensee initiated PC-98-0151, based on the team's observations.

These two inadequately technically justified actions are additional examples of violation, VIO 50/302-97-12-01, "Inadequate Implementation of TMI Action Item EOP Order.".

c. Conclusions

At the beginning of the inspection, the licensee had deviated from the TBD guidelines numerous times. The omissions and additions were typically identified in the deviation documents. However, most of the justifications were not adequate. Also, the licensee did not identify any step sequence changes as deviations or confirm that the sequence deviations were non-consequential with regard to the mitigation strategy. Following NRC identification of the generally poor

justifications from the TBD, the licensee upgraded the technical justification documents and/or revised the EOPs. After the upgrade, some of the justifications were still not adequate to support deviating from the TBD since the actions affected the TBD mitigation strategy. These actions require additional justification or revision of the EOPs to ensure the mitigation strategy is accomplished. In addition to the inadequacies, there were other less significant actions differing from the TBD which did not appear to affect the mitigation strategy that were not fully technically justified. Also, the licensee failed to ensure that TBD actions to be accomplished by the TSC were incorporated into procedures. The examples of inadequate technical justifications, lack of technical justifications, limited technical justifications and procedure omissions were indicative of numerous process weaknesses in developing the EOPs a number of these examples were part of a violation.

03.2 Verification & Validation (V&V) Guidelines

a. Inspection Scope (42001)

The team reviewed the licensee's V&V instruction (Verification and Validation Plan AI-402C, Rev. 4) to ensure that it adequately addressed the issues associated with verifying the technical and human factors adequacy of the procedures and validated that the procedures could be used by the operators to mitigate transients and accidents. The team reviewed a sample of the V&V records maintained as part of the EOP development program. The team observed licensed and non-licensed operators respond to simulated emergency conditions developed by the team to test specific sections of the EOPs. The evaluation of operator actions included the ability of the operators to carry out those designated actions, both inside and outside the control room. From these direct observations the team could partially determine whether the V&V instruction and its implementation was adequate. Also, the team independently walked down selected in-plant operator actions to determine whether the actions could be completed as written, components were accessible, the necessary equipment was pre-staged and controlled, and that environmental conditions such as post-accident radiation levels, temperatures, and lighting would not hamper accomplishment of the tasks. These direct observations also provided another method to determine whether the V&V instruction and its implementation was adequate. During the October onsite inspection, the team used the draft EOPs scheduled for PRC approval in November. During the December onsite inspection, the team used the PRC conditionally approved EOPs. During the January onsite inspection, the team continued to use select PRC conditionally approved EOPs and, due to previous NRC team findings, revisions to the EOPs.

b. Observations and Findings

1. In October the team recognized that the licensee was in the process of performing the V&V on the draft EOP in-plant actions. However, based upon the licensee's response as to how certain

areas of the V&V had been dealt with and direct observations from in-plant walkdowns, the team expressed a concern to the licensee that the in-plant portion of the V&V process was insufficient. Specific findings and observations supporting this perspective were:

- EOP-14, Enclosure 13, Steps 13.3 and 13.5, directed the PPO to align four valves in the 119 feet AB penetration area. These valves were required to be operated to initiate and secure high pressure auxiliary spray. One of the valves was approximately 10 feet above the floor and may be accessible with a tall stepladder. However, only an extension ladder was staged for the job and it could not be positioned to provide access to the valve due to piping configurations. Upon identification to the licensee, PC3-C97-7324 was initiated.

- EOP-14, Enclosure 20, Steps 20.12 detail item 6 and 20.27, incorrectly identified "MUP-1A, A Makeup Pump," 4160 V breaker being in cubicle 3A-3. The correct location was 3A-10.

- EOP-14, Enclosure 21, Step 21.1, directed I&C to install flow instrumentation. Numerous problems were identified with this step such as: incorrect part numbers; the equipment was available for general use; I&C technicians were not trained on the step; the equipment did not have a current calibration; the transmitters were not wired up requiring the technicians to obtain the tech manual and wiring diagrams from document control (not always manned); the parts were in the warehouse (not always manned) outside the protected area and required operating a forklift to get them off the shelves; and the required gaskets were not identified or pre-staged. The licensee initiated PC3-C97-7365 regarding Enclosure 21.

- EOP-14, Enclosure 6, step 6.3.1 required the installation of a hose between valves CXV-358 and MSV-524 to fill the OTSG blowdown line. At the request of the team a non-licensed operator attempted to perform this action. The hose to accomplish this task was comprised of numerous segments connected by Chicago fittings and was not long enough to join the two points. Also, the hose reel storing the "hose" and the hose were not positively secured. Upon identification, the licensee initiated PC3-C97-7125.

- Based upon verbal licensee responses the radiological mission doses for performing in-plant actions, except initiating RB purge for hydrogen control, had not been appropriately considered.

- The licensee did not have time studies for accomplishing in-plant actions. Without such information there was no way to ascertain the integrated effect on personnel resources that the in-plant actions would have.

- Following the team's inquiry as how chemistry sampling actions could be accomplished under postulated electrical bus failures, the licensee initiated PC3-C97-7244 stating that chemistry did not have procedures or equipment to support the EOPs with a loss of ES train B power or during an SBO.

- Based on the team's walkdowns, it was not apparent that the licensee had taken into account that an extra operator may be necessary to stabilize some of the ladders used to operate equipment based on physical constraints. Typically it would take approximately 15 minutes to operate each valve requiring a ladder for access. Also, in some cases, the operators would be hampered by a lack of emergency lighting, which could not be compensated for by using a conventional flashlight, e.g., the job took two hands and was 15 feet above the floor.

2. In response to the team's perspectives, the licensee provided additional guidance to the personnel performing the V&V to ensure lighting, labeling, proper equipment staging and spatial restrictions were appropriately addressed. Pictures were taken of the equipment to be operated in detail enough to see the equipment labeling. A time study was performed to help recognize any conflict in resource allocation for in-plant actions, including maps depicting the most probable routes non-licensed operators would use. Specific equipment staging deficiencies such as the hose for OTSG blowdown and the ladder for the pressurizer auxiliary spray were quickly rectified. The team's observations regarding mission dose were considered for action.

   Extensive short term and long corrective actions for chemistry sampling were established which would be implemented over a number of months. However, the licensee's V&V process would not have identified these problems since the V&V efforts as implemented were exclusive to operator actions and did not extend to support personnel. This limitation in the way the V&V process was implemented also explained why the licensee had not identified the need for TSC procedures as discussed in section 03.1.b.3. Failure to ensure chemistry actions could be performed when directed by the EOPs was another example of violation, VIO 50/302-97-12-01, "Inadequate Implementation of TMI Action Item EOP Order," in that instructions were not complete and compatible with conditions (differing electrical bus availabilities).

3. In December 97 and January 98, following completion of the

licensee's V&V of the EOPs, the team noted improvements with respect to delineating the preferred ingress-egress pathways, support tools and equipment, and determining expected duration times necessary to complete activities. These additional actions were the result of management providing a list of expectations for performing in-plant validations which will be incorporated directly into AI-402C.

However, some of the team's October 97 concerns were not adequately addressed. These included the lack of radiological mission dose assessments for numerous in-plant EOP actions and the questionable ability to perform post-accident RB hydrogen control actions.

(a) On 3/3/97 the licensee initiated PC3-C97-1533 identifying concerns with operators accessing a MCC in the intermediate building following a SBLOCA due to the environment. This concern expanded into restart issue D65, "Post Small Break LOCA access to Intermediate Building and Auxiliary Building for required operator actions." As part of the resolution to the extent of condition for the PC and D65 the licensee determined that there were "required" and "not required" actions primarily based on a vendor analysis of EOP in-plant operator actions completed in July of 1997. This analysis was based upon whether alternate actions were available to perform the same function. The analysis did not evaluate whether the actions could be accomplished based upon radiological conditions. Also, the EOPs or the V&V of the EOPs did not take into consideration whether an action was "required" or "not required." Therefore, all EOP actions would be attempted, whether accessible or not.

On 10/18/97 the licensee initiated PC3-C97-7125 on the lack of a radiological dose assessment for initiating OTSG blowdown following a SGTR. The PC was dispositioned to perform the dose calculation by 3/30/98, after the scheduled restart of the reactor. The PC further stated that this was not a required action, following the philosophy used to disposition PC3-C97-1533. This was the rationale as to why a large number of in-plant EOP actions such as initiating OTSG blowdown, aligning high pressure auxiliary spray and equalizing pressure across the MSIVs did not have dose assessments.

As previously mentioned, NUREG-0737, I.C.1, required in part, via the Confirmatory Order issued February 21, 1984, that licensee validation programs ensure that instructions to operators in emergency procedures be compatible with the conditions. Also, NUREG 0737, II.B.2, "Design Review of Plant Shielding and Environmental Qualification of Equipment for Spaces/Systems Which May be Used in Postaccident

Operations," stated that licensees were to provide adequate access to vital areas to increase the capability of operators to control and mitigate the consequences of an accident. Per II.B.2, a vital area was defined as, "Any area which will or may require occupancy to permit an operator to aid in the mitigation of or recovery from an accident is designated as a vital area." The licensee was required to comply with NUREG 0737, Criterion II.B.2 in a Confirmatory Order issued March 14, 1983.

Due to the inadequate disposition of PC3-C97-1533, an untimely corrective action was specified in PC3-C97-7125. Also, due to an inadequate extent of condition disposition of PC3-97-1533 the licensee did not comply with the 2/21/84 Confirmatory Order associated with NUREG I.C.1, the 3/14/83 Confirmatory Order associated with NUREG II.B.2 or Administrative procedure AI-402C, AP and EOP Verification and Validation Plan, Enclosure 5, Evaluation Criteria for Procedure Validation, which required an assessment to ensure in-plant actions are not hampered by inaccessibility or environmental conditions. 10 CFR 50, Appendix B, Criterion XVI, Corrective Action, requires conditions adverse to quality be promptly identified and corrected. Failure to adequately and promptly correct the conditions adverse to quality identified in PC3-C97-1533 and PC3-C97-7125 is an example of violation, VIO 50/302-97-12-02, "Inadequate Corrective Actions," of 10 CFR 50, Appendix B, Criterion XVI.

(b) The licensee wrote a new EOP-14, Enclosure 21, RB Hydrogen Management, to bring the actions for post-accident containment hydrogen management into the EOP network. During the inspection the licensee decided to leave these actions in OP-417, Containment Operating Procedure, Rev. 73, due to questions concerning equipment and personnel availability to install flow elements and the actions would not be required until at least ten days after the accident. However, neither the EOPs nor the TSC procedures directed the operators to implement OP-417 if RB hydrogen levels increased. This is another example of the 1984 Confirmatory Order violation, VIO (50/302-97-12-01), "Inadequate Implementation of TMI Action Item EOP Order," in that instructions were not complete. Also, OP-417, step 4.8.2, directed I&C to install flow instrumentation but, no dose calculations were performed for this job. This is another example of inadequate corrective action violation, VIO 50/302-97-12-02, "Inadequate Corrective Actions."

4. In December 98 and January 98, the team identified other specific and general deficiencies reflecting inadequacies in the V&V process for in-plant actions. These included:

   - During a SGTR simulator scenario, the SPO was unable to find the correct fitting in the EOP box for venting the OTSG blowdown line prior to placing the line in service per EOP-14, Enclosure 6, step 6.3. There were over ten fittings in the box but only one of the fittings would have fit. This box contained equipment associated with numerous EOP enclosures, not just Enclosure 6, and the licensee did not dedicate this unique fitting for Enclosure 6 within the box. The licensee initiated PC3-C97-8459.

   - Adequate support staff was not designated to perform the EOP actions. Two chemistry personnel were necessary to reasonably accomplish EOP actions. Although two were normally on shift, only one was required by the licensee's administrative procedures. EOP-06, SGTR, step 3.15 required maintenance personnel to repair a MSSV that would not reseat. The licensee did not maintain qualified maintenance personnel on back shifts to perform this EOP action and no administrative procedure required their presence.

   - In January 97, during an SBO simulator scenario, the team observed operators attempt to implement Enclosure 1 of AP-770, Failed EDG Recovery, when directed to by EOP-12, SBO. At step 3.1 the crew could not perform a reset of relay EDG 86, stopping the recovery. The location and the alpha-numeric designator of the lockout relay was mis-stated in the procedure. The licensee initiated PC3-C98-0103.

   These inadequacies were indicative of not always dedicating EOP equipment to a specific task or enclosure, not adequately expanding the V&V process to include EOP actions performed by personnel other than operators and, less rigorous V&V efforts for EOP actions not specifically delineated in an EOP. Also, these were additional examples of violation, VIO 50/302-97-12-01, "Inadequate Implementation of TMI Action Item EOP Order," in that the EOP instructions were not complete or usable.

5. Other less significant weakness observed by the team in December 97 and January 98 were:

   - During the performance of a simulator scenario on 12/9/97, the team observed the PPO performing the actions specified in EOP-14, Enclosure 18, Control Complex Chiller Startup, as directed by the control room operators. The PPO completed the enclosure and verified proper operation of the chiller. Subsequently the PPO was requested by the control room operators to perform step 17.8 of Enclosure 17, Control

Complex Emergency Ventilation, which required actions to align the chilled water source to the running fan. The PPO opened the CHV-2 valve and closed the CHV-4 valve to complete the alignment. During the scenario activities, it was determined that if the alignment actions required in step 17.8 of Enclosure 17 (i.e., flow balancing) were not performed properly, the running chiller unit could trip. Additionally if the chiller unit was tripped in this manner, re-establishing chiller operation could require an additional 30 minutes. This possible negative interaction between the actions specified in the enclosures was not recognized as part of the licensee's verification and validation efforts. This is an open item pending further analysis and review, IFI 50/302-97-12-03, "Enclosure 17/18 Interaction."

- While performing an SBO simulator scenario the PPO was directed to open the EFIC cabinet doors to enhance cooling. He accomplished the task within the time critical criteria but was slowed down by the lack of specific labeling as to which key went to which EFIC cabinet door.

- Some of the signs, indicating which EFIC doors were to opened in an SBO, were not placed in the optimum human factored location. Subsequently, the licensee placed the signs in the optimum location.

- The ladder for operating valve SWV-60 in EOP-14, Enclosure 18, Control Complex Chiller Startup, was not optimal.

6. Throughout the inspection (including October), the team observed that the operator actions within the control room could always be performed with the labeling in the procedure consistent with the simulator.

7. Throughout the inspection period the team found the V&V records to be a comprehensive accounting of the issues raised during the EOP development process, including operator comments, training personnel observations, in-plant walk-down evaluations, and the resolutions implemented for each issue. Additionally, the validation book contained a list of all procedural steps evaluated during similar exercises with the operating crews to ensure all potential mitigation paths through the EOPs were formally evaluated during the V&V process. Overall, the team considered the detail captured in the V&V evaluation records to well be detailed and thorough. However, the V&V efforts as captured in these records concentrated upon control room operator actions and discrete in-plant operator actions. There had been limited V&V efforts integrating control room and the in-plant operator actions and no efforts involving non-operators.

c. Conclusions

At the beginning of the inspection, the licensee's in-plant portion of the V&V process, which was being performed on the draft EOPs while the team was onsite, was insufficient. There were no specific concerns regarding the control room portion, based upon documentation. In response to the team's perspectives, the licensee provided additional guidance to the personnel performing the V&V, and the team noted improvements. However, even with the improvements, the team identified other specific and general deficiencies reflecting inadequacies in the V&V process for in-plant actions due to not always dedicating EOP equipment to a specific task or enclosure, not adequately expanding the V&V process to include EOP actions performed by personnel other than operators and, using less rigorous V&V efforts for EOP actions not specifically delineated in an EOP. There were examples of a violation. Also, some of the team's original concerns were not adequately addressed, partially due to inadequate correction actions to a problem previously identifed by the licensee associated with operator in-plant accessibility.

This disparity between licensed operators being able to perform control room EOP actions and non-licensed and support personnel not always being able to perform in-plant EOP actions was consistent with the way in which the V&V process was established and implemented. Consequently, the actions directed by the EOPs within the control room could always be performed, but numerous in-plant actions either could not be performed due to the lack of support personnel, lack of properly stagged equipment, technically incorrect procedure steps, not incorporating the actions into procedures or the radiological consequences of performing the actions had not been assessed.

03.3 Writer's Guide For EOPs

a. Inspection Scope (42001)

The team reviewed the licensee's EOP Writer's Guide for Abnormal and Emergency Operating Procedures (AI-402A, Rev. 8) to ensure that it adequately addressed developing procedures consistent with NUREG 1358, Supplement 1, "Lessons Learned from the Special Inspection Program for Emergency Operating Procedures." The team reviewed the EOPs to determine if the guidance in procedure AI-402A, Rev. 8 was adhered to during the development of the EOPs and referenced procedures. The team observed operators during simulator scenarios to determine whether the steps were readable and the actions clear.

b. Observations and Findings

The team determined that the writer's guide described the aspects of procedure step development, including format and layout considerations, procedure developer responsibilities, and step construction requirements in a comprehensive manner. The EOPs adequately conformed to procedure

AI-402A, Rev. 8. The definition section did reveal ambiguity in the definitions of the terms "verify" and "ensure." Because of the significance of these terms as implemented in the EOPs, a clear differentiation between the definitions was imperative. The licensee stated the definitions would be reviewed and rewording considered to better reflect the expectations for the terminology. However, rarely, during simulator scenarios, did the team observe operators having trouble reading or understanding the direction provided in any EOP step.

c. Conclusions

The EOP Writer's Guide was comprehensive and adequately implemented in the construction of the EOPs. This contributed to operators rarely having trouble reading or understanding the EOP steps during the simulator scenarios.

03.4 EOP User's Guide

a. Inspection Scope (42001)

In October 97 the team reviewed the licensee's draft EOP User's Guide, Conduct of Operations During Abnormal and Emergency Events (AI-505, Rev. 2), to ensure that it adequately addressed roles and responsibilities of crew members, and described the expectations for procedure usage. This included the communications protocols required to correctly implement the EOP mitigation strategies. In December the team reviewed the PRC approved guide.

b. Observations and Findings

The team determined that procedure AI-505 provided sufficient guidance regarding the roles and responsibilities of the operating crew members, communication protocols to be observed during transient response, methods and expectations for procedure step usage including transitions and immediate actions. The guidance also described the expectations for procedure compliance, priority of symptoms for entry into the EOPs, and exceptions to the prioritization scheme. Generally, the draft guidance was sufficient with the following weaknesses:

- Section 4.1.1.3, Performing steps out of Sequence, allowed the crew to depart from the pre-defined sequence of mitigation steps provided the step transitioned to: 1) could be carried out to completion, 2) was within the current procedure in use, and 3) delaying carrying out the step would negatively impact the mitigation attempts. Additionally, the procedure recommended prior Nuclear Shift Supervisor (NSS) concurrence with such a departure. During an October simulator exercise, the team observed the crew implement this rule. When questioned the crew responded that NSS concurrence was required not merely recommended. The team noted that the licensee did not have any administrative controls to evaluate sequence deviations and

operating crews could consistently use this method without realizing that a step was mis-placed. Additionally, a departure from the pre-determined mitigation strategy might negatively impact the mitigation strategy and any such departures should have a sound technical basis. In the December version of AI-505 sequence deviations were required to be evaluated.

- Section 4.2.1.3, Exceptions to Symptoms, defined four situations which were exceptions to the protocol of entering the highest priority EOP based on the appearance of the predefined symptoms. From the initial review of the EOPs it was not clear that these exceptions were directly defined in the EOPs which might be affected by such conditions. Subsequently, the licensee highlighted the four situations in the applicable EOP sections.

c. Conclusions

Following revision, the licensee's EOP User's Guide was acceptable.

03.5 EOP Maintenance & Revision Guide

a. Inspection Scope (42001)

The team reviewed the licensee's EOP Maintenance & Revision Guide, New Procedures and Procedure Change Processes for EOPs, APs, and Supporting Documents (AI-400F, Rev. 4), except for sections 4.11 and 4.12, to ensure that it adequately addressed aspects of procedure maintenance and revision necessary to ensure the retention of quality procedures during the facility operating life.

b. Observations and Findings

The team verified that the guidance adequately described the responsibilities of individuals tasked with EOP revisions, differentiated between minor and significant changes, and described the processes to be implemented for revision and modification of the procedures and supporting bases documentation.

c. Conclusions

The maintenance and revision procedure was adequate. The scope of the NRC review did not include set point control.

04 Operator Knowledge and Performance

a. Inspection Scope (42001)

During the three onsite weeks, the team observed licensed and non-licensed operators respond to simulated emergency conditions developed by the team to test specific sections of the EOPs. The licensed operators were in the simulator and the non-licensed operators were in

the actual facility. The non-licensed and licensed operators communicated to each other via portable radios. The team evaluated operator performance with respect to whether the procedures were followed, the administrative controls of procedure AI-505 were followed and whether management expectations were met.

b. Observations and Findings

The team determined that the operating crews were capable of mitigating the transients presented. Three party communications were routinely used by all operating crews and place keeping was adequate to maintain control of the mitigation actions. Also, the crews adequately implemented the required carry-over actions when the conditions were satisfied for entry into specific carry-over steps. Indicative of this performance was the successful execution of the EOPs in response to a simulated SBLOCA with a failure of the B battery. All operators accomplished their tasks and all time critical tasks, such as starting the control rooms fans and chillers, were accomplished within their required time frames.

However, there were some examples of performance inconsistent with an EOP step, licensee management expectations as emphasized in operator training or the licensee's administrative guidance. These examples were partially due to individual performance errors and partially due to training deficiencies. Specifically:

- In October 97, during a SGTR scenario with a stuck open MSSV, the crew elected not to transition from EOP-06, SGTR, to the higher priority EOP-05, Excessive Heat Transfer, even though they met the entry conditions. Follow up questioning revealed that the SROs could not state that EOP-06 contained all the required steps the crew missed by not transitioning to the excessive heat transfer EOP.

- In December 97, during a LOCA, the procedure reader had to be reminded to review the symptoms after completing the immediate actions of EOP-02. Also, in January during a SBO, the team continued to observe a weakness in scanning for symptoms after performing immediate operator actions. The operating crew did not enter EOP 12, Station Blackout, until prompted twice during the SBO. Six minutes elapsed from the time EOP-04, Inadequate Heat Transfer, (a lower priority symptom) was entered until the crew transitioned to EOP 12. The licensee initiated PC3-C98-0104 on this situation.

- In December 97 and January 98, when given an additional task while performing another task, SPOs occasionally continued with the first task before performing the second task. The SPOs did not inform the control room licensed operators of the conflict and request direction as to which task to perform first, which per the licensee was the appropriate response. As an example, an SPO

continued closing MSV 301 & 303 once directed to shut a failed open ADV, during a SGTR scenario in January.

- In December, during tube ruptures in both OTSGs, the crew was confused at EOP-03, Step 3.15 for securing feed to the affected OTSG since both OTSGs had tube ruptures.

Depending upon the significance of the problem; the licensee initiated a precursor card, was evaluating the observation for feedback into the training program, or was providing feedback to the individual involved as part of the continuing training process.

c. Conclusions

The operating crews were capable of mitigating the transients presented by the team. However, there were some examples of performance being inconsistent with an EOP step, licensee management expectations or the licensee's administrative guidance. These performance problems were being dispositioned consistent with their significance.

05 Operator Training and Qualification

a. Inspection Scope (42001)

The team reviewed selected training records to determine whether licensed personnel had been trained on the recently revised EOPs. The training records reviewed included lesson plans, simulator exercise descriptions, EOP simulator evaluations, and EOP/AP revision documentation. The team reviewed one aspect of non-licensed operator training associated with the turbine driven emergency feedwater pump.

b. Observations and Findings

The team determined that the lesson plan information was detailed. The simulator exercise evaluation forms were self-critical and explicit regarding performance weaknesses and the reasons for such weaknesses. The EOP training update packages, information considered different from the initial training due to EOP/AP changes, were detailed.

During one of the December scenarios, consistent with the EOPs, a licensed operator directed an SPO to monitor the performance of the turbine driven emergency feedwater pump for proper performance. The team ascertained that the SPOs did not receive formal training on resetting the over speed trip on this equipment. This was considered a weakness of the SPO training program. Prior to the end of the inspection period, SPOs were trained on resetting the over speed trip. The team satisfactorily reviewed the training material along with the list of SPO attendees.

c. Conclusions

The EOP/AP training program for licensed operators was adequate to familiarize operators with the EOPs/APs, including procedure changes, and to assess operator performance while using EOPs/APs while in training. There was a program weakness of not training non-licensed secondary plant operators on resetting the emergency feedwater turbine's over speed trip. The licensee provided corrective actions consistent with the significance of the weakness.

08 Miscellaneous Operations Issues

08.1 EOP Content Weaknesses: While observing the simulator scenarios, the team noted select areas where the licensee's EOPs did not optimize the equipment available to mitigate the situation. These were:

- Not optimizing existing plant systems to provide makeup water to the secondary or primary sides of the plant, if necessary, in EOP-02, VSSV, in response to an ATWS.

- Not including procedural direction in EOP-07, Inadequate Core Cooling, to consider using the condensate booster pumps if all the other supply source (EFW, AFW, MFW) prime movers to the OTSGs were not available.

- Not providing a local procedure to start the AFW diesel if it should not start from the control room.

The licensee acknowledged these observations and indicated that they would be reviewed for possible action.

08.2 (Closed) URI 50-382/96-06-10: Justification for Removal of Thermo-Lag Protection from Source Range Instrumentation

The immediate actions of EOP-02, Vital System Status Verification, Rev. 4, step 3.3, required immediate emergency boration of the RCS until the reactor was shutdown if nuclear instrumentation did not indicate the reactor was shutdown following depression of the reactor trip push-button. These actions were consistent with the TBD. EOP-10, Post-Trip Stabilization, Rev. 3, step 3.4 required RCS boron sampling if the source range instrumentation failed. These actions addressed the loss of source range instrumentation via fire which would not involve evacuation of the control room. Therefore, this matter is considered resolved.

II. Maintenance

M3 Maintenance Procedures and Documentation

M3.1 Controls for Maintenance in Proximity to In-Plant EOP Actions

a. Inspection Scope (42001)

As a result of the extensive scaffolding erected within the facility while the plant was in cold shutdown, the team evaluated whether the work control process included consideration that the work could impact in-plant EOP actions by inhibiting access to those locations.

b. Observations and Findings

As a result of the team's questions in this area, the licensee determined that no procedural controls existed to evaluate whether maintenance activities could affect EOP in-plant actions. The licensee initiated PC 3-C97-7923 on this matter. At the end of the inspection the licensee was formulating the corrective actions which the licensee verbally indicated would include adding these administrative controls to the work control process.

c. Conclusions

The work control process did not consider that the work could inhibit access to in-plant EOP action locations. The licensee was formulating corrective actions to this weakness under their established corrective action program.

M3.2 Surveillance Program for ECCS External Leakage Associated with HPI Piggyback

a. Inspection Scope (42001)

The team reviewed the licensee's program to meet TS 5.6.2.4, "Primary Coolant Sources Outside Containment," to ascertain whether components (piping, valves, etc.) of the HPI piggyback function had been included in the program. TS 5.6.2.4 required a program to provide controls to minimize leakage from those portions of systems outside containment that could contain radioactive fluids during a serious transient or accident to levels as low as practicable. The systems include Low Pressure Injection, Reactor Building Spray, and Makeup and Purification. The program included the following: a) Preventative maintenance and periodic visual inspection requirements; and b) Integrated leak test requirements for each system at refueling cycle intervals or less.

b. Observations and Findings

The team determined that Compliance Procedure (CP) 149, Primary Coolant Sources Outside Containment Program, Revision 2, implemented this TS required program. In response to the team's questions regarding the piggyback function, the licensee reviewed the issue in detail and identified that portions of the HPI system were not included in CP-149. The licensee initiated PC 3-C97-8496 on December 13, 1997, to resolve this deficiency. During the PC follow up, the licensee further identified that there was not a program to meet the periodic inspection

requirement. These inadequacies were a violation of TS 5.6.2.4. The team reviewed the licensee's planned corrective actions for the PC and determined that the corrective actions would adequately correct the deficiencies. Also, when all applicable external leakage that presently existed was tabulated, the post-accident dose consequences requirements were not exceeded. This licensee-identified and corrected violation is being treated as a Non-Cited Violation, NCV 50/302-97-12-04, "Inadequate External Leakage Surveillance Procedure," consistent with Section VII.B.1 of the NRC Enforcement Policy.

c. Conclusions

The licensee's program for implementing TS 5.6.2.4 was not adequate, but the actual external leakage did not exceed post-accident dose consequences requirements. The licensee was taking appropriate corrective actions to correct this non-cited violation.

M3.3 Technical Content of Periodic Inventory Program for In-Plant EOP Equipment

a. Inspection Scope (42001)

In January the team reviewed the EOP/AP toolbox surveillance checklist to ensure that the necessary tools were properly staged in the designated locations consistent with SP-306, Weekly Surveillance Log. This was accomplished by selectively observing whether the contents of EOP/AP tool boxes contained the equipment listed on the licensee's surveillance checklist. The team also verified whether all the keys required for EOP/AP implementation per SP-306 were in the designated key box in the control room.

b. Observations and Findings

The team observed one difference between the box and the checklist for the boxes reviewed. EOB-06 contained two female fittings while the checklist required at least three. The licensee immediately placed another fitting into the box and initiated a precursor card. After preliminary evaluation the licensee verbally informed the team that the checklist was in error. All keys were present in the control room key box. The keys contained a number designator consistent with the EOPs. They did not include a label with the specific purpose for the key which could reduce confusion in identifying the correct key. Most of the tool boxes were not physically restrained. When the team questioned the licensee, the team was informed that the boxes had been previously walked down and satisfactorily evaluated by engineering personnel.

c. Conclusions

The technical content of the periodic inventory controls for in-plant EOP equipment was adequate.

III. Engineering

E1 Conduct of Engineering

E1.1 Calculations Supporting EOP Actions

a. Inspection Scope (42001)

During the onsite weeks the team reviewed several engineering calculations supporting EOP actions or set points. The team reviewed these calculations for accuracy, appropriate assumptions, and compliance with applicable standards. The applicable standards included: Instrument Society of America (ISA) 67.04, part II, as referenced by instrumentation and controls Design Criteria Instrument String Error/Set point Determination Methodology and ANSI 45.2.11, 1974, Quality Assurance Requirements for the Design of Nuclear Power Plants.

b. Observations and Findings

The team's observations and findings were:

1. During the first onsite week (October), the majority of the calculations supporting the EOPs were being created or revised. Therefore, the bulk of the calculations reviewed during the first onsite week were issued prior to 1995. During the second onsite week (December), some of the calculations were still being created or being revised, partially due to corrective actions from the team's observations during the first onsite week. A substantial portion of the calculations were completed just prior to the team's arrival onsite. Therefore, during the second on-site week, only a limited number of these newer calculations were reviewed. During the third onsite week (January), a slightly larger sample of the newer calculations were reviewed.

2. During the first onsite week, numerous EOP instrument loop calculations contained the same errors as discussed in NRC Inspection report 50-302/97-01. The calibration temperatures were not specified and the procedures for calibration of instruments located in the AB did not assure that the AB temperatures were maintained within the temperature ranges assumed in the instrument loop uncertainty set point calculations. Additionally, other calculational assumptions were not verified. An example was calculation I90-0022, Revision 0, associated with EFW flow which assumed the transmitters in the AB were calibrated at 75°F. However, the full temperature range was 55 - 95°F. Therefore, the instrumentation could be calibrated at the low end of the temperature band and operated in the high end. This would induce a process bias in the instrument loop uncertainty not accounted for in the calculation. The licensee documented the error in calculation I90-0022 on PC 3-C97-7154. Another example was

documented in PC 3-C97-8447. The PC was written to document Analysis/Calculation deficiencies identified when assessing the loop uncertainties in I91-0028 Revision 1, FWP-7 Flow Indication. The calculation failed to include ambient temperature effects, static pressure zero effect, static pressure span effect, static pressure, span shift, and other process effects due to temperature and pressure.

The extent of the licensee's corrective actions to Violation 50-302/97-01-07, Instrument Loop Uncertainty Set point Calculation Assumptions Not Translated Into Procedures, was inadequate. 10 CFR 50, Appendix B, Criterion XVI, Corrective Action, requires conditions adverse to quality be promptly identified and corrected. The licensee's failure to identify and correct calculations supporting EOP related set points as part of the corrective actions for Violation 50-302/97-01-07 is an example of an inadequate corrective actions violation, VIO 50-302/97-12-02, "Inadequate Corrective Actions."

3. During the December onsite week, one of the few existing radiological dose calculations was determined as inadequate. Calculation M93-0006, Rev. 0, determined the post-accident mission doses to purge the RB for hydrogen control. The calculation assumed a non-conservative time frame to initiate the purge as well as other errors. The doses were calculated starting 25 days after the accident. FSAR Section 14B.3.3 stated that purging may start as early as 250 hours after the accident. Also, the time assumptions for operating valves were not validated. Step 4.9.8.2 of OP-417, Containment Operating Procedure, directed throttling open LRV-121 or 123 and establishing a calculated flow rate. The time to accomplish this step was assumed to be 5 minutes. This time was not validated and may be non-conservative since the valve was located approximately 10 feet from the flow indicator and the flow indicator would be facing away from the valve. The licensee documented the problems with this calculation in PC 3-C97-8366.

   The licensee's Quality Assurance Program as described in the USAR listed ANSI 45.2.11, 1974, "Quality Assurance Requirements for the Design of Nuclear Power Plants," under the committed standards. ANSI 45.2.11, subsection 3.2 states in part "The design input shall include but is not limited to ... Environmental conditions anticipated during ... operation such as ... nuclear radiation," and ... "Operational requirements under various conditions, such as ... plant emergency operation ..." Failing to consider radiological effects properly during the design input is an example of violation, VIO 50/302-97-12-05, "Poor Calculations," of ANSI 45.2.11.

4. Numerous other calculations issued prior to 1995 were not consistent with ANSI 45.2.11, subsection 4.2. This subsection states "Analysis shall be sufficiently detailed as to purpose,

method, assumptions, design input, references and units such that a person technically qualified in the subject can review and understand the analyses and verify the adequacy of the results without recourse to the originator." As an example, Calculation E-90-0023, Evaluation for Containment Spray between pH 4.0 and 12.5, assumed a corrosion rate for carbon steel piping exposed to a boric acid containment spray of 50 mil per year. The calculation stated that the expected corrosion rate was 10 mils but, corrosion rates could be greater than 50 mils. Nowhere in the calculation was the rational for the selected corrosion rate provided. Upon identification to the licensee, the licensee initiated a precursor card report. This is an example of violation, VIO 50/302-97-12-05, "Poor Calculations," of ANSI 45.2.11.

5. Although a small sample size was reviewed by the team, the calculations issued in 1997 were far better and did not contain any of the errors discussed above. Only one minor problem in the "new" calculations was observed. This was the failure to reference an affected calculation when a value in the base calculation changed.

c. Conclusions

Generally, calculations issued prior to 1995 contained numerous errors. Occasionally, the calculations did not contain enough information to enable a person, who was technically qualified in the subject, to review and understand the analyses and verify the adequacy of the results. This was a violation. Prior to the team's arrival, the corrective actions to known calculational inadequacies had not extended to the EOP set point calculations which was an example of an violation. Although a small sample size was reviewed by the team, the calculations issued in 1997 to support EOP set points were far better.

E1.2 Low Pressure Injection Crossover Mode of Operation

a. Inspection Scope (42001)

Due to the licensee not directing the crossover mode of LPI operation be used in the EOPs, the team reviewed the licensing basis documents for long term core cooling following a LOCA as discussed in 10 CFR 50.46 and 10 CFR 50, Appendix K. These documents included B&W topical reports, the licensee's FSAR, a safety evaluation to change the current FSAR and applicable correspondence. Also, the team reviewed the NRC's SERs associated with ECCS with respect to long term core cooling.

b. Observations and Findings

1. The team determined that during at least two time periods after the operating license was granted, there was no procedural guidance to use the LPI crossover line with flow split between the

two LPI lines (the crossover line method of long term core cooling, option #1 in BAW 10103A and BAW 10104) to mitigate the consequences of a LOCA. The first time period was from 7/79 until 6/89. The second time period was 5/2/96 until the issuance of Procedure EM-225E, Guidelines for Long Term Cooling, on 1/27/98. EM-225E was issued, due to the NRC EOP inspection team identifying the lack of such a procedure to the licensee in December, 1997.

Originally, depending upon plant conditions, the licensee used the crossover line method of long term core cooling in two procedures. The procedures were EP-106, Loss of RC/RC Pressure, and OP-404, Decay Heat Removal. In 1979 both procedures were revised such that EP-106 referenced OP-404 and, in Revision 24 dated 7/3/79 of OP-404, the use of the crossover line method was deleted.

In June 1983 the licensee instituted the first set of symptom based procedures for dealing with transients and accidents with AP-380, Engineered Safeguards Actuation, superseding EP-106. In Revision 20, dated 6/29/92 of AP-380, a new step 3.8 was added directing use of the crossover method if an LPI pump was unavailable. Also, Revision 73, dated 6/12/89 of OP-404, re-instituted the use of the crossover lines with flow in both injection lines provided there was adequate subcooled margin in section 4.13. In Revision 83, dated 3/4/92 to OP-404, the use of the crossover line method of core cooling was transferred to section 4.12. However, step 3.8 to AP-380 was deleted in Revision 22 on 4/8/93 and, section 4.12 to OP-404 was revised on 5/2/96 in revision 101. Revision 101 removed the crossover method along with the deleting the pressurizer auxiliary spray as a boron precipitation control method. Therefore, for a second time period, 5/2/96 until the NRC EOP inspection identified to the licensee in 1997, there was no procedural guidance on using the crossover line method of long term core cooling. Section 6.1.2.1.2, Low Pressure Injection, in the licensee's USAR stated "The LPI System is provided with a crossover line to permit one LPI string flow of 3,000 gpm to be split equally, thus providing a minimum of 1,500 gpm flow to both core flooding injection nozzles simultaneously should a core flooding line or one LPI pump fail. Redundant transmitters and indicators are provided for LPI flow measurement and indication. The LPI crossover injection mode of operation is accomplished by opening the crossover line, provided with a two-way flow element between the separate and independent LPI strings, and remotely adjusting the flow through the crossover line to 1,500 gpm via two (one in each LPI string) electric motor operated valves (see Figure 9-6)."

Section 14.2.2.5.4, ECCS Qualification, stated that, "In order to qualify the ECCS, the NRC placed requirements on the ECCS to ensure that the health and well being of the public is not impacted. These requirements are specified in 10 CFR 50.46 and 10 CFR 50, Appendix K. The criteria contained in Part 50.46 are

applicable to all sizes of LOCAs and are necessary in order to verify adherence. These criteria are as follows ... A path to long-term cooling must be established." This section further stated that BAW-10104, Rev. 3, was the methods report on how the computer model used to ensure compliance with 10 CFR 50.46 will be assembled and run. Also, the "The LBLOCA application report for the 177 FA lowered loop plants is BAW-10103A."

Topical Report BAW-10103A, Rev. 3, "ECCS Analysis of B&W 177-Fuel Assembly Lowered-Loop NSSS," and Topical Report BAW-10104, Rev. 3, "ECCS Analysis Of B&W's 177-FA Lowered-Loop NSS," discussed use of the LPI crossover in Chapter 10, Long-Term Cooling. Section 10.2 stated in part that "Several alternate modes of operation of the ECC systems can be used during long-term cooling, if necessary, while maintenance is being performed on normal equipment:

1. One LPI pump operating with crossover line valves open; flow split between the two LPI lines by the control valves.

2. Each LPI string operating and the LPI pump in each LPI string operating and pumping through its own injection line.

3. One LPI pump operating with injection through its associated injection line and with the crossover to the associated HPI string open; the associated HPI pump would be pumping through its HPI lines."

Section 10.2 further stated in part that "With either of the two LPI pumps operable, ECCS injection flow can be maintained through two flow paths."

Pending further NRC review of the safety evaluations associated with these procedural changes (revision 101 to OP-404 on 5/2/96 and revision 24 to OP-404 on 7/3/79), this matter is considered unresolved, URI 50-302/97-12-06, "Previous LPI Crosstie Safety Evaluations."

2. The team determined that the a recent change to the FSAR describing the LPI crossover method of long term core cooling following a LOCA was not consistent with the topical reports mentioned above.

Prior the initial licensing of Crystal River, a number of issues arose regarding the ECCS performance evaluation. Earlier versions of Topical Report BAW-10103A, BAW-10104 and BAW-10064, "Multinode Analysis of Core Flood Line Break for B&W 2568-MWt Internal Vent Valve Plants," made up a part of the applicant's method of showing compliance with 10 CFR 50.46 and 10 CFR 50, Appendix K. In NRC

SER supplement 3, 12/30/76, the NRC concluded that the method used by B&W in calculating the fuel cladding temperature during the blowdown phase did not conform to the requirements of 10 CFR 50, Appendix K. This directly impacted BAW-10064, which was a computer analysis that essentially terminated once ECCS flow (via an HPI pump and the intact core flood tank) exceeded the boil-off rate. Therefore, the analysis terminated within a half hour of accident initiation. Subsequently, B&W properly performed the analysis and submitted it as Appendix C to BAW-10103, Rev. 3, which was accepted by the NRC. The new analysis also terminated once the ECCS exceeds the boil-off rate within 20 minutes of accident initiation. Therefore, the NRC accepted Topical Report BAW-10103A, Rev. 3, "ECCS Analysis of B&W 177-Fuel Assembly Lowered-Loop NSSS," and Topical Report BAW-10104, Rev. 3, "ECCS Analysis Of B&W's 177-FA Lowered-Loop NSS," as the method and applications for complying with 10 CFR 50.46.

Never was the applicability of the long term core cooling methods described in the original versions of BAW-10103 and 10104 an issue. The original SER of 7/5/74, stated in part "The low pressure injection system lines are equipped with a crossover line inside the auxiliary building so that each LPIS pump is connected to both core flooding tank (CFT) nozzles on the reactor vessel. Manually operated valves in the crossover line will be arranged so in the unlikely event of the simultaneous occurrence of a break at the worst location in a CFT line and the loss of one LPIS, half of the flow of the other LPIS pump will reach the reactor pressure vessel to insure adequate long term core cooling."

On 1/2/98 the licensee's onsite review committee, the Plant Review Committee, approved a safety evaluation completed the day before authorizing a change to the Updated Safety Analysis Report (USAR). The USAR change was FSAR6-R24-33 and concluded that no unreviewed safety question existed. The USAR change revised a portion of section 6.1.2.1.2, Low Pressure Injection, and inserted a new section, 6.1.3.1.3, Core Flood Tank (CFT) Line Break SBLOCA. The section 6.1.2.1.2 revision did not address the use of the LPI crossover if a core flood tank line failed and/or one LPI pump failed due to plant specific design limitations. The new section 6.1.3.1.3 discussed the CFT line break consistent with BAW 10103, Rev. 3, Appendix C. This USAR change appeared to be in response to the NRC's EOP inspection team identifying the previous procedure changes eliminated using the crossover line for long term core cooling.

Pending further NRC review of the safety evaluation surrounding this change, this matter is unresolved, URI 50-302/97-12-07, "Current LPI Crosstie Safety Evaluation."

c. Conclusions

During at least two time periods after the operating license was granted, there was no procedural guidance to use the LPI crossover line with flow split between the two LPI lines (the crossover line method of long term core cooling, chapter 10, option #1 in BAW 10103A and BAW 10104) to mitigate the consequences of a LOCA. The first time period was from 7/79 until 6/89. The second time period was 5/2/96 until the present. A recent change to the USAR regarding the LPI crossover line method of long term core cooling was inconsistent with applicable topical reports. The NRC will further review these unresolved matters.

E1.3 ECCS Piggyback Mode of Operation

a. Inspection Scope (42001)

Due to the licensee directing unrestricted HPI operation in piggyback, in December and January the team reviewed the technical requirements contained in the original purchase order for the MUPs (HPI) and compared these requirements to how the EOPs directed use of the pumps.

b. Observations and Findings

The team determined that the original purchase order only specified one day of post-accident operation. Whereas, post-accident LOCA operation of the MUPs while taking suction from the discharge of the LPI pumps which in turn take suction from the reactor building sump, known as the piggyback mode, could be necessary for 30 days. EOP-08 directed use of the piggyback mode for an unspecified period of time. Operation in this piggyback mode was option #3 of the long term core cooling options stated in BAW 10103A and 10104 (see E1.2 above). Chapter 10 of BAW 10103A and BAW 10104 stated in part, "The duration of long-term cooling is the period between the onset of long-term cooling and the end of core cooling requirements.... The exact duration of long-term cooling will vary.... A realistic assessment of the duration for the worst case is approximately one month."

Not purchasing the pumps for the appropriate post-accident time duration is violation, VIO 50/302-97-12-08, "Incorrect HPI Pump Purchase Order," of 10 CFR 50, Appendix B, Criterion IV, Procurement Document Control. This criterion requires that measures be established to assure applicable regulatory requirement and design bases are suitably included in the documents for procurement of equipment.

c. Conclusions

The MUPs used for ECCS high pressure injection were not purchased to specifications commensurate to the duty to be incurred during a postulated post-accident LOCA. This was a violation.

E1.4 (EDG) Start Logic

a. Inspection Scope (42001)

The team reviewed the EDG logic and control arrangement interface with the air-start motor controls to ensure that the design was consistent with regulatory requirements. The review was prompted by a discussion with a licensed operator when it was inferred that the EDG start circuitry could allow the continued application of starting air to an EDG until depletion of the starting air.

b. Observations and Findings

The team determined that the air start circuitry did not allow such a set of conditions, and was designed to prevent such an occurrence automatically. Operator training was being provided to prevent restarting a tripped EDG until after an emergency shutdown relay was allowed to "time out" for at least 60 seconds prior to attempting a restart. The team reviewed training records and interviewed operators to assure operators were aware of this requirement.

c. Conclusions

The EDG air start circuitry was properly designed to prevent continued application of starting air to an EDG until depletion of the staring air, and appropriate operator training had been provided on how to respond to a tripped EDG.

E1.5 Position of LPI Injection Valves, DHV-5 and DHV-6

a. Inspection Scope (42001)

Due to discussions with the licensee as to why the LPI crossover lines were not being used in the EOPs, the team reviewed the circumstances surrounding why the LPI injection valves, DHV-5 and 6 (originally designated DH-V4A and DH-V4B), were normally closed.

b. Observations and Findings

The team determined that as part of the licensing review for Crystal River, the NRC issued a 12/8/75 request for information regarding the ECCS analysis. One question specifically addressed the normal position of valves DH-V4A and DH-V4B, the LPI injection valves. Question 2c stated "FSAR Figure 9-6 shows LPI valves DH-V4A and DH-V4B to be normally closed. To allow low pressure injection subsequent to a CFT line break and a single active component failure, these valves must be required by Station Technical Specifications to be open, power removed, and breakers locked open. ... These changes provide assurance that abundant core cooling is available for a CFT line break and further minimize the potential for a LOCA outside containment."

The license applicant responded to the question in a letter dated 1/13/76 which stated in part "Valves DH-V4A and DH-V4B will be placed in the normally open position. FSAR Figure 9-6 will be revised in Amendment No. 48 to indicate this revision to the Decay Heat Removal System. However, as previously committed to and accepted by the NRC and ACRS, power must be available to these valves as they are required to be throttled in order to split the decay heat (LPI) flow. The Low Pressure Injection System is provided with a crossover line to permit one LPI string flow of 3000 gpm to be split equally, thus providing a minimum of 1500 gpm flow to both core flooding injection nozzles simultaneously should a core flooding line or one LPI pump fail. The LPI crossover injection mode of operation is accomplished by opening the crossover line, provided with a two-way flow element, and remotely adjusting the flow through the crossover line to 1500 by throttling the two electric motor operated valves DH-V4A and DH-V4B. Acceptance of this mode of operation by the NRC is further exemplified in the staff's SER on page 6-13 and 6-14, Section 6.3.2 System Design. Therefore, valves DH-V4A and DH-V4B will be placed in the normally open position..."

On 3/15/76 the applicant submitted FSAR Amendment 48 without indicating the injection valves as normally open or changing operating procedures. Subsequently, an operating license was granted on 12/3/76 which considered the information contained in amendments 1 through 49 as a description of the facility. At no time since license approval had the LPI injection valves been "normally open," nor has the FSAR ever shown them as open. Pending further NRC review, the matter is unresolved, URI 50-302/97-12-09, "Failure to Normally Position LPI Injection Valves Open."

c. Conclusions

The LPI injection valves are maintained normally closed, consitent with the FSAR. However, in a letter dated 1/13/76 the licensee committed to maintain the valves normally open and update the FSAR accordingly. Those actions were never accomplished. The NRC will further review this unresolved matter.

E8 Miscellaneous Engineering Issues

E8.1 As-Built Plant Discrepancy

During a simulator scenario observed by the team, an operator determined that a control room HVAC fan control switch operated differently when changing fan speed than in the actual facility. Subsequent follow up identified that the switch in the simulator was consistent with the approved schematic drawing and the switch in the facility was not consistent with the drawing. 10 CFR 50, Appendix B, Criterion V, Instructions, Procedures and Drawings, requires drawings be appropriate to the circumstance. Having the drawing and switch reflect different wiring configurations was a violation of that requirement. The licensee initiated PC3-C98-0161 and established corrective actions. The team

reviewed the licensee's planned corrective actions for the PC and determined that the root cause analysis was appropriate and the corrective actions specified in the PC would adequately correct the deficiency. The mis-wiring did not affect the ESF feature of the fan. This licensee-identified and corrected violation is being treated as a Non-Cited Violation, NCV 50-302/97-12-10, "Wiring Error," consistent with Section VII.B.1 of the NRC Enforcement Policy.

E8.2 (Closed) VIO 50-302/97-01-07: Instrument Loop Uncertainty Set point Calculation Assumptions Not Translated Into Procedures

As discussed in section E.1.1.b.2 above, the licensee failed to identify and correct calculations supporting LOP related set points as part of the corrective actions for Violation 50-302/97-01-07. Consequently, these calculations contained the same type of errors. Violation 50-302/97-01-07 is considered closed and the balance of the corrective actions associated with this violation will be tracked as part of the corrective actions for the violation identified in section E.1.1.b.2.

IV. MANAGEMENT MEETINGS

X1 Exit Meeting Summary

The team leader discussed the progress of the inspection with licensee representatives on a daily basis and presented the inspection results to members of licensee management and staff listed below at an interim exit on December 12, 1997 and at the conclusion of the inspection on January 9, 1998. The licensee acknowledged the findings presented.

At the final exit the team leader asked the licensee whether any materials examined during the inspection should be considered proprietary. No proprietary information was identified.

PARTIAL LIST OF PERSONS CONTACTED

LICENSEE:

* J. Baumstark, Director, Quality Programs
*# G. Becker, EOP Project
* M. Collins, Operations Engineer
# J. Cowan, Vice-President, Nuclear Production
* R. Davis, Assistant Plant Director, Operations
*# R. Grazio, Director, Regulatory Affairs
* S. Greenlee, Manager, Nuclear Operations Engineering
*# B. Gutherman, EOP Project
*# J. Holden, Site Director
*# M. Kelly, EOP Project
* D. Kunsemiller, Manager, Nuclear Licensing
*# J. Lind, Manager, Nuclear Operator Training
*# C. Pardee, Director, Plant Operations
* W. Pike, Manager, Nuclear Regulatory Compliance
*# D. Porter, EOP Project
*# K. Rass, EOP Project
* M. Rencheck, Director, Engineering
*# T. Taylor, Director, Nuclear Training
* G. Wadkins, Licensing Engineer
*# R. Widell, EOP Project

NRC:

* S. Cahill, Senior Resident Inspector
*# G. Galletti, NRR
*# P. Harmon, RII
*# L. Mellen, RII
*# J. Bartley, RII
L. Reyes, RII, Regional Administrator
J. Jaudon, RII, Division Director, Division of Reactor Safety
*# W. Rogers, RII

personnel present at the 12/12/96 interim exit
* personnel present at the 1/9/98 exit

LIST OF INSPECTION PROCEDURES USED

IP 42001 Emergency Operating Procedures

LIST OF ITEMS OPENED

50-302/97-12-01 VIO Inadequate Implementation of TMI Action Item EOP Order,(Sections 03.1.b.3.(a) 03.1.b.4, 03.1.b.6, 03.2.b.2, 03.2.b.3(b), 03.2.b.4)

50-302/97-12-02 VIO Inadequate Corrective Actions (Sections 03.2.b.3(a), 03.2.b.3(b), E1.1.b.2)

50-302/97-12-03	IFI	Enclosure 17/18 Interaction, (Section O3.2.b.5)
50-302/97-12-04	NCV	Inadequate External Leakage Surveillance Procedure, (Section M3.2)
50-302/97-12-05	VIO	Poor Calculations, (Section E1.1.b.3 and E1.1.b.4)
50-302/97-12-06	URI	Previous LPI Crosstie Safety Evaluations, (Section E1.2.b.1)
50-302/97-12-07	URI	Current LPI Crosstie Safety Evaluation, (Section E1.2.b.2)
50-302/97-12-08	VIO	Incorrect HPI Pump Purchase Order, (Section E1.3)
50-302/97-12-09	URI	Failure to Normally Position LPI Injection Valves Open, (Section E1.5)
50-302/97-12-10	NCV	Wiring Error, (Section E8.1)

LIST OF ITEMS CLOSED

50-302/96-06-10	URI	Justification for Removal of Thermo-Lag Protection from Source Range Instrumentation, (Section O8.2)
50-302/97-01-07	VIO	Instrument Loop Uncertainty Set point Calculation Assumptions Not Translated Into Procedures, (Section E8.2)

Appendix A

LIST OF DOCUMENTS REVIEWED

LIST OF INDUSTRY INFORMATION DOCUMENTS REVIEWED

ISA-S67.04, Part I, "Set points for Nuclear Safety-Related Instrumentation," dated September 1994

ISA RP67.04, Part II, "Methodologies for the Determination of Set points for Nuclear Safety-Related Instrumentation," dated 1994

NRC Regulatory Guide 1.105, "Instrument Set points for Safety-Related Systems," Revision 2, dated February 1984

LIST OF PROCEDURES REVIEWED

AI-400F, New Procedures and Procedure Change Processes for EOPs, APs, and Supporting Documents, Rev. 4
AI-402A, EOP Writer's Guide for Abnormal and Emergency Operating Procedures, Rev. 8
AI-402C, AP and EOP Verification and Validation Plan, Rev. 04
AI-505, Conduct of Operations During Abnormal and Emergency Events, Rev. 02
AP-380, Engineered Safeguards Actuation, Rev. 20 & 22
AP-510, Rapid Power Reduction, Rev. 01, Rev. 01 Draft
AP-581, Loss of NNI-X, Rev. 07 Draft
AP-582, Loss of NNI-Y, Rev. 06 Draft
AP-770, Emergency Diesel Generator Actuation, Rev. 23, Rev. 23 Draft J, Rev. 23 Draft O
CP-149, Primary Coolant Sources Outside Containment Program, Rev. 02
OP-404, Decay Heat Removal, Rev. 6, 8, 12, 22, 24, 26, 44, 48, 51, 56, 63, 66, 67, 68, 73, 74, 75, 78, 87, 99, 101, 102
OP-417, Containment Operating Procedure, Rev. 73
SP-306, Weekly Surveillance Log, Rev. 17
EOP-01, EOP Entry Conditions, Rev. 02, Draft Rev. 02 Draft
EOP-02, Vital System Status Verification, Rev. 04, Draft L
EOP-03, Inadequate Subcooling Margin, Rev. 05, Rev. 05 Draft P
EOP-04, Inadequate Heat Transfer, Rev. 04, Rev. 04 Draft T
EOP-05, Excessiver Heat Transfer, Rev. 03, Rev. 03 Draft T
EOP-06, Steam Generator Tube Rupture, Rev. 05, Rev. 05 Draft F, Rev. 05 Draft H, Rev. 06
EOP-07, Inadequate Core Cooling, Rev. 04, Rev. 04 Draft J
EOP-08, LOCA Cooldown, Rev. 05, Rev. 05 Draft N
EOP-10, Post-Trip Stabilization, Rev. 03, Rev. 03 Draft M
EOP-12, Station Blackout, Rev. 02, Rev. 02 Draft J
EOP-13, EOP Rules, Rev. 03, Rev. 03, Draft J
EOP-14, Enclosure 1, SPO Post-Trip Actions, Rev. 02, Rev. 02 Draft T
EOP-14, Enclosure 2, PPO Post Event Actions, Rev. 02, Rev. 02 Draft T
EOP-14, Enclosure 5, MSIV Recovery, Rev. 02 Draft S, Rev. 02 Draft T

EOP-14, Enclosure 6, OTSG Blowdown Lineup, Rev. 02, Rev. 02 Draft R, Rev. 02 Draft T
EOP-14, Enclosure 7, EFP-2 Management, Rev. 02, Rev. 02 Draft S, Rev. 02 Draft T
EOP-14, Enclosure 8, MFW Restoration, Rev. 02, Rev. 02 Draft S, Rev. 02 Draft T
EOP-14, Enclosure 10, Alternate OTSG Feedwater Supply, Rev. 02, Rev. 02 Draft N, Rev. 02 Draft T
EOP-14, Enclosure 11, EDG Load Management, Rev. 02 Draft R, Rev. 02 Draft T
EOP-14, Enclosure 13, High Pressure Aux Spray Lineup, Rev. 02 Draft R, Rev. 02 Draft T
EOP-14, Enclosure 14, Station Blackout Main Generator Purging, Rev. 02 Draft T
EOP-14, Enclosure 15, EOP Temperature Log, Rev. 02, Rev. 02 Draft Q, Rev. 02 Draft T
EOP-14, Enclosure 17, Control Complex Emergency Ventilation, Rev. 02, Rev. 02 Draft R, Rev. 02 Draft T
EOP-14, Enclosure 18, Control Complex Chiller Startup, Rev. 02, Rev. 02 Draft S, Rev. 02 Draft T
EOP-14, Enclosure 20, Boron Precipitation Control, Rev. 02 Draft T
EOP-14, Enclosure 21, RB Hydrogen Management, Rev. 02, Rev. 02 Draft P, Rev. 02 Draft T
EOP-14, Enclosure 24, Tables, Rev. 02 Draft L
EP-106, Loss of RC/RC Pressure, Rev. 8, 13, 16, 17, 20

LIST OF CALCULATIONS REVIEWD
M96-0035, Rev. 0, Criteria for Termination of RB Spray
M95-0016, Rev. 2, BWST Swapover and Minimum Allowable Level
M93-0015, Rev. 1, Condensate Storage Tank Volume
I91-0026, Rev. 2, CR-3 CFT Press/LPI Flow Evaluation
M95-0009, Rev. 1., CR-3 Sump Solution pH Calculation -Report
I88-0027, Rev. 0, Responses to NRC Questions Regarding Tripping RC Pumps on Loss of Subcooling Margin
I91-0002, Rev. 0, MU Tank Level Loop Accuracy
M93-0056, Rev. 0, LOCA RB Spray Sensitivity Study
I84-0006, Rev. 0, Analytical Justification for the Treatment of RCP During Accident Conditions
I90-0022, Rev. 0,
I91-0028, Rev. 1, FWP-7 Flow Indication
M93-0006, Rev. 0, RB Purge Dose Evaluation
E90-0023, Rev. 1, Evaluation for Containment Spray between pH 4.0 and 12.5

Appendix B

List of Acronyms Used

AB	Auxiliary Building
ACRS	Atomic Concerns and Reactor Safety
ADV	Atmospheric Dump Valve
AFW	Auxiliary Feedwater
AI	Administrative Instruction
ANSI	American National Standards Institute
AP	Abnormal Procedures
ATWS	Anticipated Transient Without Scram
CFR	Code of Federal Regulations
CFT	Core Flood Tank
CHV	Chilled Water Valve
CP	Compliance Procedure
CR	Crystal River
CRD	Control Rod Drive
CXV	Cross-tie Valve
DH	Decay Heat
DHV	Decay Heat Valve
ECC	Emergency Core Cooling
ECCS	Emergency Core Cooling System
EDG	Emergency Diesel Generator
EFIC	Emergency Feedwater Isolation Logic
EFW	Emergency Feedwater
EFWT	Emergency Feedwater Tank
EOP	Emergency Operating Procedure
ES	Engineered Safeguards
ESF	Engineered Safeguards Features
FPC	Florida Power Corporation
FSAR	Final Safety Analysis Report
FWP	Feedwater Pump
HPI	High Pressure Injection
HVAC	Heating, Ventilating and Air-conditioning
IFI	Inspector Followup Item
ISA	Instrument Society of America
LBLOCA	Large Break Loss of Coolant Accident
LOCA	Loss of Coolant Accident
LPI	Low Pressure Injection
LPIS	Low Pressure Injection System
LRV	Leak Rate Valve
MCC	Motor Control Center
MFW	Main Feedwater
MOV	Motor Operated Valve
MSIV	Main Steam Isolation Valve
MSSV	Main Steam Safety Valves
MSV	Main Steam Valve
MUP	Make-up Pump
MWt	Megawatt Thermal

NRC Nuclear Regulatory Commission
NRR Nuclear Reactor Regulation
NSS Nuclear Steam Supply
NSSS Nuclear Steam Supply System
OP Operating Procedure
OTSG Once Through Steam Generator
PGP Procedures Generation Package
PPO Primary Plant Operator
PRC Plant Review Committee
RB Reactor Building
RC Reactor Coolant
RCP Reactor Coolant Pump
RCS Reactor Coolant System
SBLOCA Small Break Loss of Coolant Accident
SBO Station Blackout
SER Safety Evaluation Report
SGTR Steam Generator Tube Rupture
SP Surveillance Procedure
SPO Secondary Plant Operator
SRO Senior Reactor Operator
SWV Service Water Valve
TBD Technical Bases Document
TMI Three Mile Island
TS Technical Specification
TSC Technical Support Center
URI Unresolved Item
USQ Unreviewed Safety Question
UFSAR Updated Final Safety Analysis Report
VAC Volts - Alternating Current
VIO Violation
VSSV Vital System Status Verification