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U.S. NUCLEAR REGULATORY COMMISSION
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Report Nos.: 50-321/88-12 and 50-366/88-12

Licensee: Georgia Power Company
P.O. Box 4545
Atlanta, GA 30302

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Facility Name: Plant Hatch

Inspection Dates: May 2-10, 1988

Inspection At: Hatch site near Baxley, Georgia

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Inspection Summary: Inspection on May 2-10, 1988 (Report No. 50-321/88-12 and 50-366/88-12)

Areas Inspected: Special announced team inspection of the Emergency Operating Procedures (EOPs) to include a comparison of the EOPs with the BWR Owners Group Emergency Procedure Guidelines and the Plant Specific Technical Guidelines for technical adequacy, reviews of the EOPs through control room and plant walkdowns, evaluation of the EOPs on the plant simulator, human factor analysis of the EOPs, EOP training, on-going evaluation program for EOPs, QA measures, quality of the control room drawings and an evaluation of the containment venting provisions.

Results: See Executive Summary in report.

Executive Summary

Following the Three Mile Island (TMI) accident, the Office of Nuclear Reactor Regulation developed the "TMI Action Plan" (NUREG-0660 and NUREG-0737) which required licensees of operating reactors to reanalyze transients and accidents and to upgrade emergency operating procedures (EOPs) (Item I.C.1). The plan also required the NRC staff to develop a long-term plan that integrated and expanded efforts in the writing, reviewing, and monitoring the plant procedures (Item I.C.9). NUREG-0899, "Guidelines for the Preparation of Emergency Operating Procedures," represents the NRC staff's long-term program for upgrading EOPs, and describes the use of a "Procedures Generation Package" (PGP) to prepare EOPs. The licensees formed four vendor type owner groups corresponding to the four major reactor types in the United States; Westinghouse, General Electric, Babcock & Wilcox, and Combustion Engineering. Working with the vendor company and the NRC, these owner groups developed Generic Technical Guidelines (GTGs) which are generic procedures that set forth the desired accident mitigation strategy. These GTGs were to be used by the licensee in developing their PGP. Submittal of the PGP was made a requirement by Confirmatory Order dated February 21, 1984. Generic Letter 82-33, "Supplement 1 to NUREG-0737 - Requirements for Emergency Response Capability" requires each licensee to submit to the NRC a PGP which includes:

i. Plant-specific technical guidelines with justification for differences from the GTG

ii. A writer's guide

iii. A description of the program to be used for the validation of EOPs

iv. A description of the training program for the upgraded EOPs.

From this PGP, plant specific EOPs were to have been developed that would provide the operator with directions to mitigate the consequences of a broad range of accidents and multiple equipment failures.

Due to various circumstances, there were long delays in achieving NRC approval of many of the PGPs. Nevertheless, the licensees have implemented their EOPs. To determine the success of the implementation, a series of NRC inspections are being performed to examine the final product of the program, the EOPs.

On May 2-10, 1988, an NRC team of inspectors consisting of two reactor inspectors, a reactor system consultant, an operator licensing examiner/inspector, a human factors specialist, and the resident inspector conducted an inspection of the Emergency Operating Procedures at Hatch Units 1 and 2. Hatch is a BWR-4 with a Mark I containment. The objectives of the team were to determine if: the EOPs are technically correct, the EOPs can be physically carried-out in the plant, and the EOPs can be performed by the plant staff.

The objectives would be considered to be met if review of the following areas were found to be adequate: comparison of the Emergency Operating Procedures (EOP) with the Plant Specific Technical Guidelines (PSTG) and the BWR Owners Group Emergency Procedures Guidelines (EPG), review of the technical adequacy of the deviations from the EPG, control room and plant walkdowns of the EOPs, real time evaluation of EOP usage by running EOP exercise scenarios on the plant simulator, evaluation of the licensee program on continuing improvement of the EOPs and performance of human factor analysis of the EOPs. The inspection focused on the adequacy of the end product and did not depend on review of the process to develop EOPs. However, because of the complexity of the Hatch EOPs a review of the EOP development process was performed. In addition, containment venting provisions were reviewed. Containment venting provisions for all BWRs with Mark I containments are being performed across the country as an NRC inspection initiative.

Due to the complexity of the Hatch flow charts, prior to the site visit the inspection team had difficulty in utilizing the flow charts. Once the facility explained the flow chart, how it is set up and how the flow charts are used, the team could then begin to effectively review the EOPs as implemented at Plant Hatch.

The inspection findings appear to have a common source namely, the facility considered the PSTG as a guideline whereas the NRC considered the PSTG as the technical basis upon which to develop the Emergency Operating Procedures and upon which their technical adequacy is judged.

The facility had developed the PSTG from the vendor guidelines with essentially no deviations. However, the EOPs developed from the PSTG have many deviations from the PSTG. Documentation was not available to justify the deviations taken from PSTG. Examples of the deviations taken include the values in the procedure and logic of the procedures. These are discussed in Section 4 and 5 of the report. The QA organization on site had also identified that differences from the PSTG existed in the EOPs. The facility responded to the specific QA items, but did not aggressively pursue the root cause for the differences. The independent technical review recently performed by General Electric also identified differences between the EOPs and PSTG.

Since the NRC considers the PSTG the technical basis for the EOPs, the procedures that satisfy the PSTG requirements similarly are considered by the NRC to be a necessary part of the Emergency Operating Procedures. At Plant Hatch, the procedures that satisfy the PSTG requirements include selected Alarm Response Procedures (ARP), abnormal operating procedures (AOP), flowcharts, end path manuals (EPM) and to some extent the Emergency Plan - Emergency Implementing Procedures. In practice the facility only considered the EOPs to include the flow charts and end path manuals. Development, technical adequacy, administrative, training and quality concerns regarding the ARP, AOP portion of the EOPs were identified (See sections 3, 4, 5, 7, 8, 9, 11, and 12).

The primary concern identified from the walkdowns was the inconsistency between plant labels and the procedures. The control of jumpers/tools and the indication that local equipment is EOP related was quite good. The procedures were judged to be able to be physically carried out in the plant. (See Section 6).

NRC review of the development program concluded that, whereas a team approach in the development, validation and verification was attempted, human factors involvement was not sufficient. Verification activities were essentially conducted by one individual with team involvement only in the differences identified (see Section 3).

The primary human factors concern identified in the Plant Hatch EOPs is the overall complexity of the flowcharts. This high level of complexity is caused by the interaction of a number of human factors concerns contained in the flowcharts, resulting in procedures that are difficult to use, understand, and read.

The high level of flow chart complexity dominates the human factor concerns. Human factor concerns were also identified in the other procedures that implement the EOPs. Section 8 discusses the human factor analysis.

The simulator portion of the inspection was the key to understanding the Plant Hatch EOPs. Due to the complexity of the EOPs, the team developed simulator scenarios based on the logic of the PSTG to achieve desired end points. The simulator exercises resulted in the desired end points being achieved by the procedures, with the procedures directing the actions to be taken when required. The simulator exercises provided confirmation that the plant staff can use the procedures, and pointed out weaknesses in the procedures for concurrent actions on primary and secondary containment control.

In summary, the team concluded that the EOPs at Plant Hatch need improvement. The facility lacks adequate justification for differences between the EPG and EOPs. The procedures do contain human factor concerns in areas that affect operator performance. The development, validation, verification program did not fully implement a multi-discipline team approach. Training in EOP entry conditions other than a plant scram is required. Procedures to better implement primary and secondary containment and rad release control entry conditions are needed. However, based on the walkdowns and plant simulator exercises, the teams concludes that the Plant Hatch personnel can carry out the EOPs and that the current EOPs can get the plant to a safe condition if called upon.

REPORT DETAILS

1. Persons Contacted

Licensee Employees

*J. T. Beckham, Jr., Vice President, Plant Hatch
*S. Bethay, Nuclear Safety and Compliance Supervisor
*J. Betsill, Operations Support Superintendent
*L. Byrnes, Senior Nuclear Engineer
*C. Coggin, Training and EP Manager
G. Czech, Senior Plant Engineer
*P. Fornel, Manager, Maintenance
*O. M. Fraser, QA Site Manager
*R. Hayes, Deputy Manager of Operations
R. King, Engineering Supervisor
R. Knoble, Consultant
C. Lane, Consultant
*H. Nix, Plant Manager
*D. Read, Plant Support Manager
*D. Self, Oglethorp Power Company
*L. Sumner, Manager of Operations
*S. Tipps, Nuclear Safety & Compliance Manager
*O. Vidal, Shift Technical Advisor
*R. Zavadoski, Manager, HP/Chemistry

The inspectors also contacted other licensee personnel including senior reactor operators, reactor operators, training personnel, shift technical advisors and other plant and engineering staff.

NRC

*L. Crocker, Project Manager, Hatch, NRR
*M. Ernst, Deputy Regional Administrator, Region II
*W. Hehl, Deputy Director, Division Reactor Projects, Region II
*C. Julian, Chief, Operations Branch, Region II
*G. Lainas, Assistant Director for Region II Reactors, NRR
*D. Lange, Chief, BWR Section, DRS, Region I
*J. Menning, Senior Resident Inspector, Plant Hatch
*C. Patterson, Project Engineer, Region II
*W. Regan, Chief, Human Factors Assessment Branch, NRR
*M. Sinkule, Project Section Chief, Region II
*W. Troskowski, EDO, Region II Coordinator, NRC HQS

*Denotes those present at exit meeting on May 10, 1988

2. EOP Development

In mid-1983 an EOP implementation team was formed at Plant Hatch. The team was staffed by contractors, six engineers and a project manager. In addition, Plant Hatch operations personnel participated in a rotational capacity in development activities and in contractor oversight. Four Plant Hatch shift supervisors participated in development activities including simulator testing and desk top review of the many iterations of the early EOPs.

A human factors review was conducted by a contractor during May-September, 1984. The review consisted of interviews with two operators, review of Plant Hatch emergency procedure documents, observation of simulator exercises, interviews with personnel at Brunswick Station about their experiences with similar flowcharts, and review of a sample of early Plant Hatch flowcharts.

The EOP implementation team development activities continued through early 1986, including simulator and plant walkthrough validation.

Pre-implementation training began in early 1986, consisting of 120 hours of classroom study of the philosophy, content and use of the new procedures. Following the classroom component of the training, 40 hours of simulator exercise were conducted. Operator comments were solicited during the simulator training for possible integration into the EOPs. These comments were evaluated by the EOP implementation team staff, in consultation with Plant Hatch management, and a response was provided each operator on the resolution of his comment.

Currently Revision 2 of the flowcharts is in effect.

Findings

Several concerns have been generated by a review of the Plant Hatch EOP development process. There was an inadequate team approach in the development, validation and verification of the EOPs. Human factors involvement was lacking in the fundamental development phase of the EOPs. After basic development of the EOPs was completed, human factor involvement was very limited.

The verification activities were conducted primarily by one STA, with limited support from other STAs. The only evidence of a team approach in the verification was review by other operations personnel of STA verification of proper plant nomenclature in the EOPs.

The supporting documentation for the EOP development process and formal validation is under contractor control, not under Georgia Power control.

The formal validation done on those steps not exercised in the simulator was done by table top analysis and did not include a walkdown of the procedures in the plant.

EOP validation and verification on those ARPs and AOPs that implement the PSTG was minimal.

3. Basic EOP/BWR Owners Group Emergency Procedure Guideline (EPG) Comparison

A comparison of revision 3 of the EPG and the EOPs was made to ensure that the licensee had procedures as indicated in the EPGs. This comparison was made difficult by the unique and complex nature of the implementation of the EOPs at Plant Hatch. The EOPs as implemented at Plant Hatch are contained in a group of procedures. The EOPs at Plant Hatch consist of the following procedures:

a. Alarm Response Procedures (34AR Series)

b. Abnormal Operating Procedures (34AB Series)

c. Flow Charts

d. End Path Manuals (EPM)

e. Emergency Plan Implementing Procedures (EPIP)

Each group of procedures listed above contains procedural guidance from the EPG. All of the above listed procedures are required to implement the symptom based EOPs at Plant Hatch.

Pre-scram EPG directed operator actions are contained in Alarm Response Procedures (34AR Series). These procedures direct immediate operator actions, and direct the operator to Abnormal Operating Procedures (34AB). These procedures contain procedural guidance from the EPG, and direct the operator to manually scram the reactor, at which time the flowcharts are entered.

The flowcharts are entered following ANY scram, or failure to scram. These immediate procedural steps are contained on 5 complex flow charts, with subsequent operator actions contained in text procedures, called End Path Manuals. The Primary Containment Control and Secondary Containment Control are identified in the flow charts to be executed concurrently and the instructions to control these items are contained in the End Path Manuals. Radiation Release Control instructions are also contained in the End Path Manual but are not directed as a concurrent instruction. The Emergency Plan Implementation Procedure was also identified by the licensee documents as a source of instructions for radiation release control but the facility was unable to identify the specific instruction in the EPIP which address EPG steps.

The flow charts are so structured to allow the operator to pick any flow chart, follow the instructions given, and be guided to the appropriate flow chart based upon the answers given to a series of simple questions. The flow charts direct the operator to the appropriate End Path Manual after the immediate operator actions are taken.

There are four End Path Manuals. These manuals also contain the contingency procedures:

a. Level Restoration

b. Emergency Depressurization

c. Alternate Depressurization

d. Alternate Pressure Control

e. Alternate Shutdown Cooling

f. Reactor Vessel Flooding

g. Alternate Water Injection

h. Group Isolation

i. Reference Leg Fill

The End Path Manuals, as well as portions of the flowcharts, contain the procedural guidance from the EPG for the contingency procedures.

The team reviewed the procedures listed in Attachment A. The team concluded that the family of procedures listed above will address the EPG requirements. The team identified that the procedure control for radiation release did not address radiation release at the alert level pre-scram that may occur as an unmonitored release. Specific comments on the procedures were noted as described in the following sections.

4. Independent Technical Adequacy Review of the Emergency Operating Procedures

The Hatch EOPs in Attachment A were reviewed to assure that the procedures are technically adequate and accurately incorporate the BWR Owners Group EPGs. A comparison of the Plant Specific Technical Guidelines (PSTG) to the EPG and EOPs was also performed. Differences between the EPG and PSTG were assessed for adequate technical justification. Selected specific values from the procedures were reviewed to determine that the values were correct.

a. PSTG/EPG

The facility had indicated in prior correspondence to the NRC that they were taking no deviations with the EPG except for inserting the site specific values into the PSTG and not including systems in the PSTG that do not exist at Plant Hatch. The normal vent and purge system to control containment pressures was not utilized by the facility as was allowed by the EPG. No technical discrepancies were identified in this area.

b. PSTG/EOP Comparison

This comparison found many inconsistencies between the two documents. These inconsistencies were apparently caused by the licensee belief that the PSTG is a guidance document and was not the technical basis for the procedure development.

The comparison between flow charts and the PSTG revealed several concerns with the details of the Plant Hatch EOPs. As the flowcharts are designed to provide the operator with detailed procedural check-off lists of specific actions to take while proceeding through them, they contain many steps which are not included in the PSTG. While not necessarily a problem in concept, it was found that in several cases (which are considered to be representative of the flow charts in general), these additional operator actions varied from the logic of the PSTG and introduced delays in mitigating the casualty as rapidly as possible. In some cases the logic of the PSTG was changed by a rearrangement of steps in the transition from the ARP or AOP to the flowcharts and EPMs. In addition, the values for parameters involving action steps in the EOPs are often not the same as those specified in the PSTG. In the EOPs these values are often alarm set points while the PSTG specifies a calculated value or one which was obtained from the technical specifications.

Examples of these variances are contained in the following paragraphs:

Example 1. The Reactor Pressure Vessel (RPV) Control guideline in the PSTG is to be entered when RPV water level falls below +10.0 inches, the low level scram set-point. The action step RC/L calls for the monitoring and control of RPV water level. The next sub-step, RC/L-1 calls for the confirmation of or initiation of any of the following: 1. Isolation, 2. ECCS, 3. Emergency diesel generator. The next step calls for restoration and maintenance of RPV water level between +10.0 and +56.5 in. with one or more of the systems capable of refilling the RPV. The final step calls for proceeding to the cold shut down condition.

Comparing the mitigation of a low level entry condition on Path 3 of the EOP flow charts (the normal SCRAM procedure) with the Level response of the PSTG above shows the following: The procedure asks if a group 2 or 5 isolation auto initiation signal is present and if it is, directs the operator to a series of steps to determine if isolations have occurred, but not if the isolations should have occurred. Then the status of the pneumatic system in the Drywell is checked and corrected if wrong. There is no reference to a potential level problem at this juncture, and there is no reference to the confirmation of ECCS or emergency diesel initiation. Forty three steps later (in the direct flow path without deviation for other actions) the flow path asks the operator if level can be maintained above +12 inches and if not directs him to Path 4. In Path 4, the various potential sources of water to the RPV are addressed in a serial manner, with deviation notes to check for fire conditions and system line-ups prior to initiation of water supply to the RPV.

The level limits specified in this example are +10 and +56.6 inches in the PSTG and +12 and +50 inches in the EOP.

Example 2: The PSTG entry condition for RPV pressure control is 1054 psig. If any Safety Relief Valve (SRV) is cycling, SRVs are to be manually opened until RPV pressure drops to 927 psig. Pressure is then to be controlled below 1090 psig with the main turbine bypass valves which may be augmented by one or more of several additional systems. When all control rods are inserted beyond position 02, the RPV is to be depressurized and the cooldown rate maintained below 100 degrees F/hr. Then shutdown cooling is initiated using RHR, systems used for depressurization, or if that does not work. Alternate Shutdown Cooling. The entry question on Flow Path 3 for RPV Pressure control is Reactor Pressure above 1042 psig. If it is, you are directed to activate low low pressure set by momentarily opening an SRV and then maintaining pressure between 850 and 1040. It appears that the low low set activation step is the equivalent of the cycling SRV step in the PSTG because its activation prevents cycling. If the pressure cannot be maintained in this range, then the flow path directs the operator to an "SRVs stuck open" question. This is an action which is not required by the PSTG. If a valve is stuck open, the operator is directed to take action to shut the valves thus diverting his attention from maintaining reactor pressure control in accordance with the PSTG. Following the "SRVs stuck open" question, a block on the flow chart states "use SRVs as necessary to maintain reactor pressure below 927 psig." The PSTG states at this point that the SRVs may be used to augment the main turbine bypass valves but only when suppression pool water level is above 58 in. A flowchart question relating to the use of turbine bypass valves for pressure control does not appear until 14 steps later. If available, the operator is to maintain pressure below 927 psig using the bypass valves. The other pressure control augmentation methods are found in the EPMs after proceeding through many other steos on the flowchart and within the EPMs. Note that the values used as control points again vary between the PSTGs and the EOPs.

Example 3: The entry condition for the monitoring and control of reactor power in the PSTG is a condition which requires reactor scram, and reactor power above 3% or cannot be determined. The actions which are to follow are: Confirm or place the reactor mode switch in SHUTDOWN (RC/Q-1); if the main turbine-generator is on-line and the MSIVs are open, confirm or initiate recirculation flow runback to minimum (RC/Q-2); trip the recirculation pumps if reactor power is above 3% or cannot be determined (RC/Q-3); boron injection is required with Standby Liquid Control (SLC) and automatic initiation of Automatic Depressurization System (ADS) is prevented if the reactor cannot be shutdown before suppression pool temperature reaches 110 degrees F.

The EOP flow path response, starting with Path 3, takes the operator to the top of Path 1 if the Nuclear Engineer cannot confirm negative reactivity insertion sufficient for cold shutdown which is a time consuming action not called for in the PSTG. In Path 1, instead of immediately reducing recirculation flow to minimum followed by recirculation pump trip, the EOPs send available operators to execute sequence insensitive rod insertions, line up recorders, verify or initiate alternate rod insertion, continue to try and insert rods, check power supplies, and if the suppression pool is not above 110 degrees F, start checking out the process computer. All these steps are being done before recirculation pumps are run-back or tripped. The step to check the suppression pool temperature is also done prior to recirculation pump trip. Accomplishing these sequential steps is different than the logic of the PSTG which is based on the insertion of negative reactivity into the reactor as rapidly as possible.

In the boron injection phase, the EOPs call for the operator to attempt SLC injection and if not successful, try to repair the standby liquid control systems. The PSTG logic required the operators to immediately attempt the alternate methods of boron injection. As the event progresses and power control by level reduction is required, the EOPs call for level to be maintained at the point of MSIV closure while the PSTG calls for the reduction in water level to the top of active fuel if necessary to control level.

Example 4: For RPV flooding the PSTG indicates that the first step is to close the Main Steam Isolation Valves (MSIVs) and drains as well as High Pressure Coolant Injection (HPCI) and Reactor Core Isolation Cooling (RCIC) steam lines. The facility uses the HPCI and RCIC as alternate boron injection system if SLC should fail. The facility implementation of RPV flooding accounts for the provision to not isolate HPCI and RCIC if being used for boron injection even though this action is in apparent conflict with the PSTG.

Example 5: The entry condition into Primary Containment Control on suppression pool HI-Level is 150 inches as stated in the PSTG, SP/L-3. However, End Path Manual 5.121, paragraph 3.1 does not require operator action until level has risen to 152 inches.

Example 6: Flow Chart 1, Caution 21 requires entry into Primary Containment Control at a drywell hydrogen concentration of 2%. This entry condition is not listed in the PSTG.

Example 7: Flow Chart 1, Grid B-2 asks if suppression pool temperature is above 110 degrees F. If so, inject SLC. The PSTG requires the initiation of SLC before 110 degrees F is reached.

Example 8: Entry condition into Secondary Containment Control is required at 0 pounds DP as stated in the PSTG. This entry condition is not included in either End Path Manual 4.126 or 4.127.

Example 9: PSTG Caution #14 requires that the operator not depressurize the RPV below 100 PSIG (HPCI low pressure isolation setpoint) unless motor driven pumps sufficient to maintain RPV water level are running and available for injection. End Path Manual 4.125, step 3.12 lists 128 PSIG as this value.

Example 10: In the Primary & Secondary Containment Control Procedures both pre-scram and in the End Path Manual, concurrent control of all containment parameters (i.e. Suppression Pool Temperature, Suppression Pool Level, Containment pressure etc.) was not procedurally required whenever an entry condition existed as provided for in the PSTG.

The above are examples of inconsistencies between the PSTG and EOPs. Documentation to support the variances was lacking. Inconsistencies similar to the above examples were identified throughout the flowcharts and in the EPMs.

In situations where the PSTG entry conditions exist without scram, the licensee relies on Alarm Response and Abnormal Operating Procedures to accomplish the emergency mitigating actions. The inspection team traced several of these procedures to determine if the logic of the PSTG was preserved. These procedures were found to be under revision making tracing difficult. The torus high temperature Abnormal Operating Procedure was found to still refer to the Scram procedure which was cancelled by the EOP Procedure. Several Alarm Response Procedures were found to be "dead ended." If the mitigating action called for in the procedure was not successful, there was no path to direct the operator to an Abnormal Operating Procedure. The affected Alarm Response Procedures included Suppression Chamber Level High, 34AR-601-127-2S; Suppression Chamber Level High "RCIC", 34AR-602-230-2S; Torus Water Level High/Low, 34AR-654-080-2S; Primary Containment High Pressure Trip, 34AR-603-106-2S.

The licensee did not prepare a deviation document between the EPG/PSTG, when in fact, as the EOPs were implemented, they are taking deviations from the EPGs. Since the facility only considered the PSTG as a guidance document and not a technical directive upon which the technical adequacy of the procedures can be based, the facility only assessed that the intent of the PSTG was being met. The facility did not prepare technical justification for the differences between the PSTG/EOPs. Technical justification for the deviations of the EOPs from the EPG is needed.

c. Administrative Controls for Alarm Response Procedures and Abnormal Operating Procedures that Implement PSTG Requirements.

The inspectors inquired if the administrative controls on the Alarm Response Procedures (ARP) and Abnormal Operating Procedures (AOP) that implement the PSTG requirements were the same as the flowcharts and EPMs. The facility responded that those AOPs and ARPs that implement the PSTG requirements were not reviewed and controlled like the flow charts and EPM. The facility is in a major rewrite of the AOPs and ARPs. The facility management immediately directed its staff that until further notice, all ARPs and AOPs and changes will be reviewed by the EOP Group before implementation to assure that the PSTG requirements are met. This is a temporary action until the licensee formalizes the administrative controls for these procedures.

5. Control Room and Plant Walkdowns

The inspectors walked down selected EOPs to confirm that the procedures can be accomplished. The purpose of the walkdowns was to verify instruments and controls as designated in the procedures are consistent with the installed plant equipment, ensure that the indicators, controls, annunicators referenced in the procedures are available to the operator, and ensure that the task can be accomplished. Detailed comments identified are noted in Attachment B. General comments and observations are discussed below:

The most significant general comment is that the plant labeling and procedure nomenclature do not agree. This appears to be the result of the verification activities which did not have clear guidance regarding this area (See Section 3).

The flowcharts in the control room are located in an appropriate place. However, as discussed in Attachment C, adequate table space for concurrent use of the procedures and EPM is lacking.

The facility control of tools/jumpers for EOP use is considered quite effective and knowledge of plant personnel on these specialized tools/jumpers is widespread.

Whereas the team did find labeling inconsistencies, the facility has taken care to assure that key relays and fuse locations and other equipment are appropriately marked to distinguish them as EOP equipment. This is quite evident throughout the facility.

The teams considered that in spite of items identified during the walk-downs, the procedures were able to be performed by the staff at Plant Hatch.

6. Simulator

Five scenarios were run on the plant specific simulator with two teams of licensed operators. The first team consisted of both staff and current on-shift licensed operators. The second team consisted of the current on-shift crew in training for the week. The team utilized different numbers of personnel to conduct these scenarios. Scenarios were run with 2-SROs, 2-ROs, and STA (minimum Tech Spec crew as well as minimum administrative procedure crew) and 2-SROS,3-ROs, and the STA (normal shift crew size). The simulator scenarios provided information on real time activities.

The purpose was to determine that the procedures provide operators with sufficient guidance such that their responsibilities and required actions during the emergencies, both individually and as a team are clearly outlined, verify that the procedures do not cause operators to physically interfere with each other while performing the EOPs, verify that the procedures did not duplicate operator actions unless required (i.e., Independent Verification) when a transition from one EOP to another EOP or other procedure is required, precautions are taken to ensure that all necessary steps, prerequisites, initial conditions, etc., are met or completed; and, operators are knowledgeable about where to enter and exit the procedure.

Due to the complex nature of the Hatch EOPs the team initially had difficulty in the understanding of how to use the EOPs when the simulator scenarios were being developed. As a result the team developed the scenarios based upon the logic of the PSTG to achieve a desired end point. If the procedures being utilized by the operator achieved the desired endpoint, the team would conclude that the EOPs were capable of bringing the plant to a safe condition. The scenarios were designed to evaluate the EOPs during various plant upset conditions, both before and after a reactor scram. Following each scenario, detailed discussions were held with the operating crew.

The conclusions and observation of the team follow:

The EOPs utilized took the simulator to the desired end point.

The operators were observed to effectively use the procedures, even in reduced lighting situat' .

The procedures directed the actions of the operators in a time frame that was generally in agreement with the scenario development.

The Safety Parameter Display System (SPDS) was effective in assisting the information needs to respond to the scenarios.

The concurrent execution of Primary, Secondary, and Radiation Release Controls are not procedurally required when entry conditions for these exist. The training program also does not address concurrent entry into these controls.

With a staffing level of 2-SROs, 2-ROs and 1 STA the team observed the SROs being required to operate the controls. With a level of 2-SROs, 3-ROs and 1 STA the SRO did not have to operate the controls. This is a concern on the adequacy of the minimum staffing level requirements of the administrative procedures and technical specification requirements.

The team concluded the EOPs can mitigate and control plant upset conditions, and place the plant in a safe condition.

7. Human Factors Analysis

As a result of the human factors analysis of the Plant Hatch EOPs, a list of specific concerns has been generated (see Attachment C). An initial desktop review of the EOPs was conducted prior to the on-site inspection. Observation of simulator exercises, interviews with Plant Hatch staff, and plant walkdowns were used to both corroborate those problems noted during the desktop review and to identify additional concerns.

Findings

The primary human factors deficiency identified in the Plant Hatch EOPs is the overall complexity of the flowcharts. This high level of complexity is caused by the interaction of a number of human factors concerns contained in the the flowcharts, resulting in procedures that are difficult to use, understand, and read.

The major contributing factor to the complexity of the Plant Hatch flowcharts is the high level of detail in the procedures. The large amount of information has led to several specific concerns in the procedures for example: extensive movement, lengthy action steps, placement of cautions, reduced print size, and overall small size of the flowcharts. Activities required to correct concerns within the EOPs include an evaluation and reduction of the amount of information contained in the procedures.

The technical concerns resulting from the high level of detail can generally be divided into two categories: (a) those with a strong relationship to potential human error (areas 1 through 5) and (b) those less directly related to potential human error but which also affect useability and understandability of the procedures (areas 6 through 8). A summary of concerns in each of these areas, including those found in the EPMs, follows.

a. Movement (Transitions)

Movement (also known as transitions) within and between procedures is often required of an operator during the execution of EOPs. An operator may be directed to concurrently perform more than one flow path, or more than on procedure, or to completely exit the procedure being executed and move to a different EOP. An operator may also be required to reference tables, charts, supplemental information, or non-EOP procedures. Movement within and between EOPs can be disruptive, confusing, and cause unnecessary delays and error. Therefore it is particularly important that these transitions be minimized. When movement cannot be avoided, it is important that the transition directions to the operator be clearly and consistently structured.

Throughout the Plant Hatch flowcharts and EPMs, many transitions are required of the operator. Not only is the movement extensive, but the transition directions to the operator are indicated in multiple, inconsistent, and sometimes unclear methods. The number and types of transitions required in the Plant Hatch EOPs make the procedures more difficult to use and hold potential for error.

b. Decisions

When individuals are subjected to emotional or environmental stress, such as those which may be present during the use of EOPs, difficulties may be experienced in a number of cognitive areas. For example, information drawn from long term memory may be incomplete or inaccurate, short term memory capacity may be reduced, and the ability to accurately assess the importance of details may be degraded. Any or all of these problems will lead to difficulty in decision-making. Because decisions can be extremely important to the execution of EOPs, it is critical that they be clearly, consistently, and appropriately made.

In the Plant Hatch EOPs, numerous types of decisions are required. Because these many decisions are also inconsistently structured, they can be difficult for operators to use in emergency situations with a potential for error.

c. Memory Requirements

As mentioned above, difficulties may be experienced with both long and short term memory when individuals must perform under stressful conditions. During execution of EOPs, operators must draw upon their experience and training (long term memory). In addition steps and information within the procedures, such as time dependent or recurrent steps, depend upon the use of short term memory. When procedures are designed to include multiple demands upon operator memory, the potential for operator error is increased.

The Plant Hatch EOPs evidenced numerous demands upon operator memory. While some reminders and backup systems are provided to assist operators, the Plant Hatch EOPs as a whole appear to place a unnecessarily large burden upon the operator and could lead to error.

d. Cautions and Notes

Cautions are used to describe hazardous conditions that can cause injury or equipment damage. They should describe the consequence of the hazard. Notes are intended to provide supplemental information to the operator. Neither cautions nor notes should contain directions to the operator. Because of the critical nature of the information contained in cautions, it is particularly important that cautions be emphasized in a way that distinguishes them from notes and that they be located where operators will not overlook them.

The human factors analysis revealed a number of concerns related to format, structure, location, and labeling of cautions and notes in the Plant Hatch EOPS. These deficiencies in the treatment of both critical and supplemental information could lead to delay or operator error.

e. Graphics

A number of aspects of the graphics used in the Plant Hatch flowcharts have contributed to difficulty in readability. These include inadequate print size, lack of sufficient white space, light glare off laminate, and low contrast color use. It should be noted that the extent and number of graphics inadequacies in the Plant Hatch flowcharts are such that this category is likely to have a greater relationship to potential error than is usually attributed to graphics issues in procedures.

f. Sentence Structure

Both the Plant Hatch Writer's Guide and NUREG-0899 indicate that sentences should be short, simple, including one idea per sentence, and should avoid the use of imprecise adverbs. It was found that steps throughout the Plant Hatch EOPs were written in a complex manner, using multiple action verbs, imprecise adverbs, supplemental information, and inconsistent structure. The numerous examples of overly complex steps identified in the Plant Hatch EOPs could lead to operator error.

g. Writer's Guide

In order to prepare clear, consistent EOPs that will aid the operator and help minimize errors that can occur when operators execute procedures during emergencies, a complete and clear writer's guide is necessary. A number of inadequacies were identified in the Plant Hatch Writer's Guide. These deficiencies result in a writer's guide which does not provide the guidance necessary for consistent production and revision of high quality procedures.

It should also be noted that, due to the extensive use of ARPs, AOPs, and EPIPs in conjunction with the EOPs, guidance for their preparation and revision was not included in the writer's guide for EOPs. Because they are part of the EOP system, it is critical that format be consistent throughout these procedures and that the quality of the documents be controlled as strictly as that of the flowcharts and EPMs.

h. Miscellaneous

A number of other miscellaneous inadequacies in the Plant Hatch EOPs were identified through the human factors analysis. For example, abbreviations and acronyms were used inconsistently throughout the EOPs. Placekeeping spaces in the EPMs were located on the right side of the steps, not at the step number. References to the flowcharts were inconsistent through EOPs and satellite procedures, ranging from "the flowcharts" to 31ED-EOP-001-1S. Other miscellaneous inadequacies are detailed in Attachment C.

8. EOP Training

Discussions were held with the Director of Training and Emergency Preparedness and senior staff instructors. From these discussions and a review of LT-IH-20101-00 INTRODUCTION TO EMERGENCY OPERATING PROCEDURES, the team concluded that the training organization demonstrated weakness in the proper training of the entry conditions into the EOPs.

Plant Hatch utilizes an unique method of implementing the EOPs. They are a group of procedures, made up of:

a. Alarm Response Procedures
b. Abnormal Operating Procedures
c. Flow Charts
d. End Path Manuals
e. Emergency Implementing Procedures

As currently instructed, the operating staff considers only the Flowcharts and End Path Manuals to be the EOPs. As currently instructed, the operating staff enters the EOPs (the Flow Charts and End Path Manuals) only on the following conditions.

a. Manual Scram
b. Auto Scram
c. Failure to Auto Scram

These instructions are inadequate and represent a weakness in the EOP construction. Primary Containment Control, Secondary Containment Control and Radiation Release Control Guidelines are required in the PSTG to be entered, and executed concurrently when any condition, as specified in the PSTG, are met. These entry conditions can be met, irrespective of a reactor scram.

Due to the highly complex nature of Plant Hatch flowcharts, they are considered difficult to use. In order to provide operators the familiarity and understanding necessary to use the flowcharts, a large burden is placed on training. Observation of operators in the simulator and discussion with personnel during this inspection provided the following information:

a. Operators are provided the training and familiarity necessary to use the flowcharts.

b. In order to provide the needed training, the training department must devote substantial time and effort to EOP training.

c. Simplification and reduction of level of detail of the flowcharts would reduce the burden on training.

d. Operators believe that, (a) the flowcharts provide more detail than they require to perform the procedures and, likewise, (b) their overall training is sufficient to allow the reduction of level of detail within the flowcharts.

9. Ongoing Evaluation of EOPs

Ongoing evaluation of Plant Hatch EOPs consists of three different evaluaion activities.

First, an annual review of all EOPs is conducted in accordance with Administrative Procedure 10AC-MGR-003-0S, Preparation and Control of Procedures, section 8.4.13. These annual reviews are tracked by the Administrative Control Department, and in the case of EOPs are initiated by the Manager of Operations. The reviews are conducted by operators while undergoing requalification training and are documented using the Procedure Review Form, as described in Administrative Guideline AG-ADM-14-1184N, Administration of Procedure Reviews. The Procedure Review Form contains the number of procedures reviewed, revision number, date of review, an indication of acceptance or non-acceptance, and relevant remarks. The form is signed by the Manager of Operations or his deputy. No indication of the actual reviewer or review methods used is listed on the form. Plant Hatch representatives indicated that there is no method for tracking how or by whom the reviews were actually conducted.

The second method for ongoing review of EOPs is through operator comments recorded during regular training. This method is used for all types of procedures. An interoffice memorandum form is used to describe the operator comment and is placed in a binder in the training office. These comments are then forwarded to an operations supervisor, who refers comments about EOPs to the supervisor of the EOP project. No proactive effort is made to solicit these comments.

The third method used for ongoing review of EOPs is informal communication used by operators to relay their comments when not undergoing training. The supervisor of the EOP project reports that this is a common method for him to receive operator input about the EOPs, however, the largest source of comments is through operator training.

A formal method for requesting changes to any type of Plant Hatch procedure is through the Deficiency Control System, as described in 10AC-MGR-004-0S. Plant Hatch staff ir 'ated that this system is rarely used for EOPs, and it is therefore not .scussed in this section.

Findings

The methods used for ongoing evaluation of EOPs at Plant Hatch have several weaknesses. They are:

a. The specific review methods used for the annual review are not noted on any document. Because of the documentation used, it is not possible to track what type of review was conducted. Therefore, it is not possible to assess the adequacy of the annual review of EOPs.

b. Using operator training as a source of operator input on the EOPs is a good method. However, it would be improved by actively soliciting operator comments on the procedures during training, rather than simply taking comments as they are offered.

c. Relative to the informal communication method of obtaining ongoing operator input on the EOPs outside of training, more active solicitation of operator input comment' would improve the system.

10. QA Involvement in the EOP Program

The team inspected the QA organization involvement in the programatic approach of the EOP Program. The inspection focused on the planned and periodic audit of the EOP development and implementation process.

Discussion were held with the QA Site Manager, and Quality Assurance Audit of Operations 87-PO-2A, dated October 15, 1987 was reviewed. The scope of the EOP audit included the Flow Charts and End Path Manuals. The audit report had findings in areas of:

a. Inconsistencies between plant labeling and EOPs
b. PSTG and EOP differences
c. EOPs not written in accordance with Writer's Guide

The audit report contained findings similar to the findings of the NRC team. Licensee management corrected the specific inconsistencies contained in the QA audit report and did not do an in-depth review to determine the root cause of these findings, nor did it do a followup assessment to determine if the concern was as widespread as the NRC team has identified. The differences between the PSTG and EOPs found by the QA audit did not include the difference in logic between the PSTG and EOP Flowcharts. (Detailed in section 5.0 of this report.)

Because EOP implementation by Plant Hatch includes Alarm Response and Abnormal Operating Procedures, the inspector determined that QA did not audit the entire group of procedures that fully implement the EOPs to ensure compliance with the PSTG and the Writer's Guide.

11. Quality of Control Room Drawings and Procedures

The purpose of this inspection was to review the methods utilized to ensure the critical plant P&ID drawings in the Control Room reflect the as-built condition of Plant Hatch.

Discussions were held with the Superintendent of General Engineering and Support, procedures Design Control 40AC-ENG-003-0S, and DCR Processing 42EN-ENG-001-0S were reviewed. The inspector also reviewed the critical plant drawings in the Control Room.

Corrections to the drawings in the Control Room are made by hand following plant modifications. This is deemed necessary by the licensee, and in accordance with procedures, due to the lead time necessary to update the drawings. The inspector reviewed these changes and found them to be legible and made neatly. Each change was properly documented on the drawings. From discussions held, procedures and drawings reviewed the inspector found no unacceptable conditions.

The following items regarding the quality of the control room EOPs were identified.

a. Overall poor upkeep of EPIP and non-upgraded ARPs. (Facility responded to items during inspection)

   - torn pages
   - poor xerox quality
   - lack of tabs or labels
   - broken binder

b. AOP and ARP EOPs lacked appropriate emphasis (e.g., binders were not labeled or colored in a manner that easily distinguishes them from non-EOP-related procedures).

c. Expired TCN noted in 34AB-OPS-015-2S (expired 4/18/88), was replaced with extension to 6/5/88, rather than correct procedure.

d. Poor xerox quality noted in EPMs; e.g., EPM2, Unit 1.

12. Containment Venting

Plant Hatch is a two unit facility, utilizing GE Mark I primary containment configurations. The Mark I containment design consists of a light bulb shapped drywell and a doughnut shaped torus. The drywell is interconnected to the suppression pool by downcomers which submerge into the suppression pool water. Vacuum breakers are provided in the interconnections between the drywell, torus and Reactor Building. The containment atmosphere is inerted with nitrogen during normal plant operation. Both the drywell and suppression pool chamber are designed to withstand a maximum of 62 psig internal pressure.

Containment venting is accomplished using components of the Primary Containment Purge and Inerting system and the Standby Gas Treatment system. Venting the drywell or torus can be performed in one of two ways. The first path utilizes two 18 inch lines which are generally used for containment purging and startup inerting. The second path uses redundant 2-inch lines which are used to vent excess pressure during plant heatup and normal operation. Regardless of the vent path used, the volume vented from the drywell or torus is routed to the Standby Gas Treatment system and released via the plant stack. The 120 meter tall plant stack assures elevated vent gas releases to the environment.

Each of the two 18-inch lines (one line is connected to the torus and the other is connected to the drywell) have two butterfly air operated valves (AOV) that perform containment isolation functions. Each of the four 2 inch lines (two lines are connected to the torus and two connected to the drywell) have two globe AOVs that perform containment isolation functions, and one valve that is used for vent flow control purposes. The AOVs in the 2 inch lines receive air from the non-interruptable air supply system. All AOVs fail closed on loss of air supply. The containment vent piping and valves have a design pressure of 150 psig.

The vent flow control valves in the 2 inch lines receive signals from controllers located in the main control room. The valves are throttled to vent at the desired flow rate and downstream pressure. The vent flow control valves are air operated in Unit 2 and hydraulically operated in Unit 1. If any of the Unit 2 AOVs lose air supplies, the valves will fail closed. The valves can then be operated manually by connecting portable air or nitrogen bottles to the valves locally. The electro-hydraulic valves in Unit 1 will fail closed on loss of power or hydraulic pressure. If this occurs, alternate vent paths (possibly using the 18-inch purge lines) have to be used, because the manual handwheels were not purchased with the valves. The valves that perform containment isolation functions are environmentally qualified, but the 2 inch flow control valves are not. Operator access to the valves could be limited during certain accident conditions, due to potentially high radiation levels present in the vicinity of the valves.

The Unit 1 containment purge lines (18 inch lines) have normally closed, manually operated valves downstream of the two containment isolation AOVs. Unit 2 does not have these manual valves. Another difference in design between Unit 1 and Unit 2 containment venting is the number of penetrations. The Unit 2 system has three drywell and three torus penetrations, one for each vent line. The Unit 1 system has only one drywell and one torus penetration. In Unit 1, the 2 inch lines are connected to the two 18 inch lines penetrating the drywell and torus.

All vent lines discharge into a single 18 inch line that is connected to the suction of the Standby Gas Treatment system (SGTS). Excess flow isolation dampers are installed in the line leading to SGTS. The isolation dampers prevent high pressure from a LOCA from reaching SGTS if the 18 inch purgelines are open. The dampers will shut on excessive vent flow, and will route the flow through a 2 inch bypass line to SGTS. The isolation dampers protect SGTS filter trains from overpressure (SGTS plenum design pressure is 2 psi) and possible rupture. The rupture of SGTS could result in an uncontrolled release of radioactivity, steam or hydrogen into secondary containment. This condition could preclude operator access to essential safety equipment and complicate post accident recovery efforts.

For emergency venting of containments, the BWR owners group recommended the following in Revision 3 of the EPG (guidance step PC/P-7):

"If suppression chamber pressure exceeds the Primary Containment Pressure Limit, vent the containment in accordance with the (procedures for containment venting) to reduce and maintain pressure below Primary Containment Pressure Limit".

At Plant Hatch, the instructions on when and how to vent the containment during an emergency are provided in the End Path Manuals, Containment Control Guideline, Drywell Pressure and Temperature Control, Procedure Number 3.123. The procedure provides instructions to start SGTS and open the drywell 2 inch vent valves if suppression chamber pressure exceeds the Primary Containment Pressure Limit. The Primary Containment Pressure Limit varies between 53 to 62 psig, depending on primary containment/suppression pool water levels. Instructions are also provided to close the drywell 2 inch vent valves when suppression chamber pressure can be maintained below the Primary Containment Pressure Limit. Therefore, the Plant Hatch procedures follow EPG, Revision 3, guidance step PC/P-7 recommendations.

Venting at Plant Hatch is performed only through the two 2 inch drywell vent lines. In this flow path, the drywell pressure is vented through two 2 inch lines to the SGTS. Pressure in the torus is vented to the drywell through twelve torus to drywell vacuum breakers. The vacuum breakers operate at a differential pressure of 0.5 psi. Torus to Reactor Building differential pressure is protected by two additional vacuum breakers. If the pressure in the drywell is excessive (above 62 psig), high flow may result in the vent line to the SGTS. The high flow could close the excess flow isolation dampers in the 18 inch SGTS line, resulting in flow through the single 2 inch bypass line around the isolation dampers.

An alternate vent path, using the 18 inch purge line was not used primarily because of the excess flow isolation dampers. The flow through the 18 inch line would probably be excessive if drywell or torus pressure was 62 psig, resulting in excess flow isolation damper closure. With isolation damper closure, the flow would be directed to the 2 inch damper bypass line, in an attempt to protect SGTS integrity. However, the use of drywell purge for containment pressure control is allowed by EPG guidance step PC/P-7.

Another alternate vent path, via the two 2 inch torus vent valves, also was not used by Plant Hatch procedures. Venting through the torus is not used in case of RPV flooding from external sources (filling the containment with water from sources outside the containment). Under this condition, the possibility of filling the 2 inch torus vent lines with water exists. If the RPV flooding condition did not exist or suppression pool level was acceptable, venting through the torus is the preferred method. By venting through the torus, the primary containment atmosphere will be scrubbed in the suppression pool prior to venting to the environment. In this way, the offsite exposures would be generally restricted to noble gases only.

Several potential problems exist with the current Plant Hatch design for emergency venting. For example, the 2 inch drywell vent lines may not be physically capable of venting the primary containment at the flow rate needed to deal with the expected severe accident challenges of containment overpressurization. The vent lines may be inadequate for the rate of steamflow associated with dissipation of decay heat following reactor shutdown.

If fast containment venting is required, the 18 inch purge line could not be used effectively because of potential rupture of the SGTS filter trains. Also, the 2 inch excess flow isolation damper bypass line would limit the flow out of containment. Additionally, if the 2 inch drywell vent lines were used concurrently with high drywell pressure, the pressure at SGTS filter train may exceed the design pressure of 2 psi anyway.

In conclusion, the current design and procedures used to emergency vent the containment requires further licensee review. The vent path through the torus is considered the preferred path, with the drywell vent path as an alternate on high water levels inside containment.

13. Exit Interview

At the conclusion of the inspection on May 10, 1988, an exit meeting was conducted with those persons indicated in paragraph 2. The inspection scope and findings were summarized. The licensee did not identify as proprietary any of the materials provided to or reviewed by the inspectors during the inspection. At the exit meeting, the licensee was requested to discuss the corrective action to be taken as a result of the inspection findings. The licensee indicated that based on the NRC identified areas as well as those previously identified by other organizations as well as in their own organization that a disciplined approach would be taken to address all concerns. The facility indicated that an approach would be developed, with some actions already initiated, such as contacting other utilities to determine their method of EOP usage and then a plan would be finalized. The plan will be furnished to the NRC.

ATTACHMENT A

Documents Reviewed

Flow Charts & End Path Manuals

31EO-EOP-001-2S	REV	00	EPM 2 -
31EO-EOP-001-2S		00	EPM 3 -
31EO-EOP-001-2S		00	EPM 4 -
31EO-EOP-001-2S		00	EPM 5 - Section 50
31EO-EOP-001-2S	Flow Chart 1	01 & 02	Path 1 Flow Chart
31EO-EOP-001-2S	Flow Chart 2	01 & 02	Path 2 Flow Chart
31EO-EOP-001-2S	Flow Chart 3	01 & 02	Path 3 Flow Chart
31EO-EOP-001-2S	Flow Chart 4	01 & 2	Path 4 Flow Chart
31EO-EOP-001-2S	Flow Chart 5	01 & 2	Path 5 Flow Chart
31EO-EOP-001-2S	Max	00	Max Section for EPM 2 3 4 & 5
31EO-EOP-001-2S	x.00	02	Cover Procedure/EPM 2 3 4 & 5 - Section 0
31EO-EOP-001-2S	x.120		CCG/Supp. Pool low water control -2.120 3.120 4.120 & 5.120
31EO-EOP-001-2S	x.121		CCG/Supp. Pool high water control -2.121 3.121 4.121 & 5.121
31EO-EOP-001-2S	x.122		CCG/Supp. Pool temp control - 2.122 3.122 4.122 & 5.122

x=Manuals 2, 3, 4 5

31EO-EOP-001-2S	x.123	02	CCG/Drywell press & temp control - 2.123 3.123 4.123 & 5.123
31EO-EOP-001-2S	x.124	00	CCG/H2 control - 2.124 3.124 4.124 & 5.124
31EO-EOP-001-2S	x.125		CCG/Secondary cont temp control - 2.125 3.125 4.125 & 5.125
31EO-EOP-001-2S	x.126		CCG/Secondary cont water level control -2.126 3.126 4.126 & 5.126
31EO-EOP-001-2S	x.127	00	CCG/Secondary cont rad control - 2.127
31EO-EOP-001-2S	x.80	00	Contingencies/level restoration - 2.80 3.80 4.80 & 5.80
31EO-EOP-001-2S	x.81	01	Contingencies/Emergency Depressurization - 2.81 3.81 4.81 & 5.81
31EO-EOP-001-2S	x.82	01	Contingencies/Alternate Depressurization - 2.82 3.82 4.82 & 5.82
31EO-EOP-001-2S	x.83	01	Contingencies/alternate pressure control 2.83 3.83 4.83 & 5.83
31EO-EOP-001-2S	x.84	00	Contingencies/alternate shutdown cooling - 2.84 3.84 4.84 & 5.84
31EO-EOP-001-2S	x.85	00	Contingencies/reactor vessel flooding - 2.85 3.85 4.85 & 5.85
31EO-EOP-001-2S	x.86	00	Contingencies/alternate water injection 2.86 3.86 4.86 & 5.86
31EO-EOP-001-2S	x.87	00	Contingencies/group isolation - 2.87 3.87 4.87 & 5.87
31EO-EOP-001-2S	x.88	00	Contingencies/reference leg fill - 2.88 3.88 4.88 & 5.88

Alarm Response Procedures

34AR-601-302-2S--Drywell High Pressure Initiation
34AR-601-127-2S--Suppression Chamber Level High
34AR-601-306-2S--Drywell High Pressure Initiation
34AR-602-144-2S--Containment High Rad Or Inop
34AR-602-230-2S--Suppression Chamber Level High "RCIC"
34AR-654-080-2S--Torus Water High/Low Level
34AR-650-233-2S--Drywell/Torus High Pressure
34AR-603-115-2S--Primary Containment High Press.
34AR-603-106-2S--Primary Containment High Press. Trip

Abnormal Operating Procedures

34AB-OPS-002-2S--Small Break Inside Primary Containment
34AB-OPS-034-2S--Torus Temperature Above 95 deg.
34AB-OPS-007-2S--SRV Stuck Open

Miscellaneous:

Human Engineering Difficiencies Summary from the DCRDR

Responses to V & V Document Comments

Other Documents

DI-OPS-22-0287N Temporary EOP Flow Chart Change. Rev 0. 5/4/87.

10AC-OPS-004-0S Emergency Procedures (Writer's Guide). Rev 1. 2/14/88.

30AC-OPS-006-0S EOP Verification Procedure. Rev 0. 10/17/85. Plant Hatch.

30AC-OPS-007-0S Emergency Operating Procedures Revision Requirements. Rev. 2. 5/29/87. Plant Hatch.

AG-ADM-14-1184N Administration of Procedure Reviews. Rev 1. 4/8/88. Plant Hatch.

ATM-0012 Rev. 0 Procedure Review Forms dated 1/7-8/88. Annual review of Unit 2 EOPs.

EOP Implementation Plan for Emergency Response Capability Project. Rev 1. 8/2/85. Plant Hatch.

Meeting Summary on Information Presentation to NRC, EPRI, INPO on Georgia Power Company - Plant Hatch Emergency Operating Procedures Upgrade Program and overhead projection transparencies. April 25, 1985. Paul Springer, III. Georgia Power.

Human Factors Review of Plant Hatch EOP Flowcharts. Status Report. November 15, 1984. General Physics Corporation, Columbia, Maryland.

Edwin I. Hatch Nuclear Power Plant Control Room Emergency Operating Procedures Validation Report. January 17, 1986. General Physics Corporation, Columbia, Maryland.

Response to Plant Hatch EOP Validation Study Comments. C. Land and R. Knoble. March 24, 1986. Georgia Power interoffice correspondence to J. R. Jordan.

31EO-EOP-001-2S, Emergency Operating Procedure Inside Control Room Unit 2, Containment Control Guideline Drywell Pressure and Temperature Control, Procedure 3.124, Revision 2.

31EO-EOP-001-1S, Emergency Operating Procedure Inside Control Room Unit 1, Containment Control Guideline Drywell Pressure and Temperature Control, Procedure 3.124, Revision 2.

34SO-E41-001-2S, High Pressure Coolant Injection (HPCI) System, Revision 5

34SO-E51-001-2S, Reactor Core Isolation Cooling (RCIC) System, Revision 6

ATTACHMENT B

Plant Walkdown Comments

A. EOP Equipment Cabinet

An inspection of the Unit 2 Emergency Operating Procedure (EOP) equipment cabinets was performed. One normally locked filing cabinet was noted to contain emergency procedures, end path manuals, jumpers filed by component to be jumped, phone, bolt cutters, and several rings of keys, including keys to the remote shutdown panels. The two equipment cabinets (large tool boxes) contained hoses, fittings, tools and meters required to perform emergency system manipulations. Also noted in the vicinity of the cabinets were tables and ladders needed to support emergency operations. The cabinets were noted to be wire sealed, organized and contained only equipment (identified by the color pink) necessary for use in an emergency. The NRC inspector expressed a concern over the security of the keys in the filing cabinet. The operators stated that the filing cabinet (a standard office type cabinet with a single lock in the upper right hand corner) was located in a vital area (security controlled access area) and the cabinet lock was sufficient security. The operator also stated the cabinet was inspected weekly for inventory of contents.

B. End Path Manuals

A walkdown was performed on the procedures written to vent the containment during an emergency. Containment Control Guideline, Drywell Pressure and Temperature Control (Procedure 3.123), provides instructions on containment venting. Both Unit 1 and Unit 2 procedures were reviewed. The Unit 1 procedure is generally identical to Unit 2, but only Unit 2 procedure comments are listed below.

1. In Procedure 3.123, the purpose of step 3.26.2 (determine hydrogen and oxygen concentrations) prior to containment venting was not clear.

2. Step 3.26.5 instructs the operator to override all signals to all valves, including valves that will not be used. The step 3.26.5 does not clearly indicate which valves will by bypassed.

3. Step 3.26.6 instructs the operator to reset the Group II isolation signal. This is an unnecessary action to open the valves (step 3.26.7). The step 3.26.6 appears to be inappropriately located near step 3.27.4, when the valve override signals are removed.

4. Step 3.5.1 instructs the operator to lift leads at an electrical bus. The bus frame numbers were not listed in step 3.5.1.

5. Step 3.27.1 tells the operator to place a bypass switch in the NORMAL position. The switch is actually labelled AUTO-BYPASS.

6. EPM 4.122 steps 3.1.1-3.10.5 are not required in EOPs.

7. When the EPMs are used in a real situation, they are signed and marked upon. The facility does not have procedures or processes formally in place to assure the manuals are restored to their original content after use.

C. Operating Procedures

Flow Path 1 instructs operators to inject boron into the RPV using HPCI and RCIC, if available, on failure of Standby Liquid Control. The two procedures, 34SO-E41-001-2S, HPCI system, and 34SO-E51-001-2S, RCIC system, were reviewed and walked down to assure the procedures could be performed.

1. Several plant labels were noted to be different from the procedure steps. For example, the valve 2G31-F106 (HPCI procedure step 7.4.8.9.1) is called the RWCU Precoat Pump Suction Valve in the procedure, but is labelled the Precoat Tank Outlet Valve Z on the local panel.

2. HPCI step 7.4.8.3 incorrectly lists 2E41-R612 as 2E41-K615.

3. HPCI step 7.4.7.10 incorrectly lists 2H11-P601 as 2H11-P602.

4. A comparison of HPCI to RCIC procedures identified several inconsistencies. RCIC step 7.3.9.8.13 lacked the statement "using one of the following valves" to agree with HPCI step 7.4.8.9.13. In the HPCI procedure, the 2C41-F034 valve is assumed to be a locked closed valve, while the parallel valve is not locked in the RCIC Procedure. The same logic step in HPCI (step 7.4.8.19) and RCIC (step 7.3.9.17) sends the operator to different steps in the RCIC or HPCI Procedures. The RCIC procedure (steps 7.3.8.14 and 7.3.9.14) has a note to turn valve power off, while HPCI procedure (steps 7.4.7.16 and 7.4.8.16) does not have the same note.

5. The HPCI procedure requires operators to throttle valves to initiate boron flow. Step 7.4.8.16 throttles 2E41-F041 while step 7.4.7.16 throttles 2E41-F042.

6. RCIC procedure step 7.3.8.8.5 does not list 2C41-F015 as a valve to throttle to maintain boron level.

7. RCIC steps 7.3.8.12, 7.3.8.18.1, 7.3.9.12 and 7.3.9.23.1 list the wrong electrical frame numbers.

8. RCIC steps 7.3.9.20 and 7.3.9.21 list wrong steps to be repeated.

9. The precoat level instrumentation was not restored in HPCI step 7.4.8.25 and RCIC step 7.3.9.26.

10. Instructions were not found to flush HPCI/RCIC following boron injection.

D. Flow Charts

The most outstanding concern noted throughout the flow chart was associated with plant labelling. Numerous discrepancies between wording and actual plant labels were noted, including: certain switch positions were described as OPEN-CLOSED, but actual positions are NORMAL-SCRAM in the control room; system designators for 2B21 switches are labelled as B21B in the control room; and uses the words suppression pool while the same items are called torus in the control room.

Path 1

1. The statements "If installed" should be deleted from steps in Note 30, grid A-3 and grid J-7.

2. Pump 2E21-C003 is incorrectly listed as 2E21-B003 in grid F-5.

3. Steps in Note 16 are misnumbered (missing step 2.b).

4. In Note 16, step A.1, change system I/II to A/B.

5. Frame locations are missing in step B.1.b for locations of jumpers/lifted leads to be installed.

6. In Note 4, only the TB1-12 termination has to be lifted to allow 2P70-F005 to fail open.

7. The numerical value the operator may have to read on analog meters is more precise than meter increments will allow. For example, 76 psig or 88 psig has to be read on the wide range pressure meter, which has 20 psi increments on the meter scale. Temperatures of 157 degrees or 58 degrees F have to be read on the suppression pool temperature meter which has 5 degree increments. Reactor vessel levels of 31 inches and 97 inches are to be read off a meter which has 10 inch increments. If SPDS or the process computer are available, the numerical values of the above readings can be observed in digital form. If not available, the operator reading of analog meters would result in approximate values.

8. Steps in grids F-1 and H-8 instructs operators to install pressure gauges on either RPS rack, if necessary. The step appears unnecessary since each rack already has pressure gauge meters installed on them.

9. Step in grid C-8 instructs operator to close or verify closed valves without telling the operator the valves are operated locally only.

10. The NRC inspectors observed the operator searching to find specific diagnostic screens on SPDS. Adding the specific SPDS screen numbers to Path 1 steps that refer operators to diagnostic displays would aid the operators in an emergency.

11. Notes 3 & 4 do not include the CRD as per the PSTG.

12. The Top of Fuel Level was not plainly indicated or easily determinable on the Control Room recorder.

Path 3

1. Valves listed in procedure as "2T48-F026" and "2T48-F027" were on the panels as "2T48-MOV-F026" and "2T48-MOV-F027." This was found in other cases on Path 3.

2. Grid 1-J, an example of an inconsistency was found in that various valves listed in the procedure (ie 2E11-F047, 2E11-F003...) have the number "2" at the beginning of the valve no. (The "2" stands for Unit 2). The values in the above grid did not have the "2" in front of the valve number on the panel.

3. Grid 1-K, procedure step states: "energize steam pressure reducing valve pilot solenoid 2E11-F051 by placing mode switch on"

   - The switch has open/close positions in lieu of as indicated in the procedure

   - The switch is labeled as E11-F051,53 in lieu of "2E11-F051".

4. Group 3E isolation valves 2C51-J004A, B, C, D are not labeled on the TIP drawers.

Path 4

1. Grid C4, the EOP flow chart instructs the operator to "Place switches for all stuckopen SRV's to open then close. This is inconsistent with Abnormal procedure 34AB-OPS-007-2S, which does not call for this action. There is no close position on ADS SRVs, only "open" and "auto."

2. Grid C-3, the SRV cycling sequence used in the EOP is not the same as the sequence specified on the SRV panel in the control room. Specifically, the "E" and the "H" SRVs are not listed on the control room panel.

ATTACHMENT C

Human Factors Analysis Examples

The following examples are provided to clarify the types of concerns identified in the eight areas of human factors concerns described in section 8 of this report. These examples are not intended to be viewed as an inclusive list of all such concerns found in the Plant Hatch EOPs, but rather as examples of the types of inadequacies identified through the human factors analysis.

(1) Movement (Transitions)

(a) Excessive transitions

The Plant Hatch EOPs were found to contain transitions so numerous that the resultant movement within and between procedures increases the possibility of error by operators exercising the EOPs. For example, within any flowchart operators are required to (1) move through flowpaths that include extremely long flowlines between columns; (2) scan the entire flowpath before beginning to perform actions in order to check for sequence insensitive steps; (3) move to the right and left sides of the flowchart to read notes and cautions referenced in the flowpaths; (4) move backward in flowpaths to monitor key parameter steps; (5) move backward in flowpaths to monitor path specific parameter steps; and, (6) move within and between flowcharts and EPMs as directed by referencing and branching instructions.

(b) Excessive number of transition methods

Transitions are indicated through multiple methods. For example, EPM 4.40 includes seven different methods of directing transitions. No differentiation between the different methods is provided in the writer's guide nor are they clear from their use. Within flowcharts, movement is also indicated through the use of path-to-path arrows and directives within action steps.

(c) Unclear transition methods

Movement through flowcharts is directed through extremely long flowlines, running parallel with other flowlines that do not share the same destination. No direction indication is given, and the lines are so close that it is difficult to remain on the correct line. When different color flowlines run parallel, contrast is sometimes insufficient to aid in differentiating the two lines.

(2) Decisions

(a) Excessive number of decisions

Within the Plant Hatch EOPS, required decisions are indicated by two types of decision symbols, along with sequence sensitive action steps, sequence insensitive action steps, notes, cautions, and logic sequences within EPMs action steps and flowchart action steps. Within Path 4, approximately 40 percent of all steps require decisions. In addition, decision symbols on the flowcharts must be remembered and decision making repeated, should conditions change.

(b) Inconsistent decision formats

The decision directives within these steps and symbols are written in inconsistent formats. In decision symbols, sometimes the decision is worded as a question, other times it is worded as a statement. Logic terms such as IF, WHEN, and THEN, are used in the flowcharts in a manner inconsistent with that defined for use in the EPM (e.g., Path 4, area 7-D). Not only is this use of logic statements within action steps on the flowcharts inconsistent with that in the EPM, but it fails to utilize the decision symbols provided for use in the flowcharts.

(3) Memory Requirements

(a) Excessive memory requirements

The Plant Hatch EOPs contain many steps that require the operator to remember step content for all or part of the execution of the procedure. For example, all key parameter decision steps must be remembered while in the EOP system, that is, the flow chart and any EPMs referenced. In addition, all path specific parameters must be remembered throughout the path in which they are included. All sequence insensitive steps must be remembered after an initial scanning, so that they can be executed at any time prior to their location on the flowline. Cautions and notes are reported to often be used through memory alone.

(4) Cautions and Notes

(a) Inadequate format distinction between cautions and notes

Because of the critical nature of information contained in cautions, it is particularly important that they be (1) properly emphasized to catch the operators attention, and (2) distinguished from the non-critical information contained in notes. In the Plant Hatch EOPs, cautions and notes in the flowcharts are emphasized in exactly the same manner. Within the EPMS, cautions are bordered on top and bottom by a solid line, in contrast to a dotted line used to encircle notes. In neither case is the distinction between notes and cautions considered adequate. In the flowcharts, placement of some cautions along the perimeter of the flowchart with the notes could also lead to them being overlooked by the operator.

(b) Incorrect content

Cautions are intended to contain critical information relating to potential injury or equipment damage. Notes are intended to contain supplemental information that may be of use to the operator. Neither are to contain operator actions. Throughout the Plant Hatch EOPs, cautions and notes are found to (1) contain operator actions (e.g., Path 4, cautions 17 and 20; notes 23 and 24) and (2) be mislabeled (e.g., cautions as notes; notes as cautions. See Path 4, cautions 1, 2, and 20. In addition, most cautions or notes containing cautionary information did not identify the potential hazard.

Also, relative to the problem of excessive detail in the procedures, some information included in notes and cautions was so basic that it appeared unnecessary to include in the procedure.

(5) Graphics

Graphics methods employed in the production of the Plant Hatch flowcharts have contributed a number of problems. For example, print size on the mid-sized flowcharts is estimated to be approximately one-third of the minimum size required by application of human factors engineering principles. The use of color is not only reported to be of no use to operators, but entails colors which do not provide adequate contrast and, in fact, make the flowcharts more difficult to read. Use of all capital letters not only is more difficult to read, but eliminates the use of all caps for emphasis. The type of laminate used on the flowcharts causes glare, requiring operators to flex the flowcharts in order to read them. In addition as observed in the control room the reproduction quality of the EPMs was poor and in conflict with the Plant Hatch Writer's Guide and NUREG-0899, since the quality of the copies was not equal to the quality of the originals.

(6) Sentence Structure

Structure of steps within the Plant Hatch EOPS include a number of problems which contribute to difficulty in understandability, useability, and the excessive level of detail. In addition, these problems are generally in conflict with guidance provided in NUREG-0899. For example, many steps are written in an overly complex structure, including supplemental phrases that are unnecessary for the execution of the action (e.g., Path 4, section L-1, K-5, K-9, caution 17). Related to this issue, many Plant Hatch staff indicated that complete sequences of steps within the procedures were unnecessary for execution of the actions required.

In conflict with the Plant Hatch Writer's Guide, imprecise adverbs (e.g., slowly, rapidly) and terms (e.g., as required, if installed) are used within the procedures (e.g., Path 1, sections K-16, B-14). Sentence structure is also used inconsistently throughout the EOPs. For example, logic terminology is sometimes used incorrectly (e.g., Path 4, sections N-2, N-3). Sentences sometimes begin with the action verb, but in other cases the action verb is buried within the sentence or completely missing (e.g., Path 4, section K-2, Path 5, sections D-1, D-3).

(7) Writer's Guide

The Plant Hatch Writer's Guide does not provide sufficient nor adequately restrictive guidance to result in consistently prepared and revised, high-quality EOPs. For example, the guidance provided in Section 8.3 for preparation of the EPMs and cover procedures contains guidance on general writing techniques. However, Section 8.2, Organization of Flow Charts, does not include guidance on the writing of individual steps. As noted above, this is a problem area within the EOPs. In addition, the guidance that is provided is in some places is vague and non-restrictive. For example, writers are directed to use language "such as," (go to), to indicate branching within an EPM. This lack of restriction has led to inconsistent use of multiple indications to the operator that a transition is to be made. Related to writer's guide inadequacies, the acronyms and abbreviations provided in the PSTG are not consistently applied within the EOPS.

The nature of the Plant Hatch EOP system requires that ARPs, AOPs, and EPIPs be used during execution of EOPs. The writer's guide does not provide guidance for consistent formatting, structure, and control of the entire family of EOPs and related procedures. As currently managed, these procedures are not maintained properly for use during emergencies. Torn pages, missing tabs, and insufficiently emphasized binders make the ARPs, AOPs, and EPIS inadequate for easy access and use by operators.

(8) Miscellaneous

A number of miscellaneous inadequacies were identified in the Plant Hatch EOP system. Some are:

(a) Physical aspects of the control room and EPMs

Current physical structure of the control room does not provide adequate desktop space for use of the flowcharts and EPMs, along with the satellite procedures required during their use. During simulator exercises, binders were piled upon each other and flowcharts were propped against the tabletop, promptly falling to the floor. This condition could lead to delay and error during execution of the EOP.

The binder used for the EPM is designed in a manner that results in part of the book sitting on top of a telephone in the control room, which is awkward and could lead to problems in using the procedures. In addition, the EPM binder in its current form includes two sections which open backwards and include sections that are numbered backwards. This is in conflict with common Western use and experience and could lead to delay and error.

(b) Acronyms and abbreviations, in addition to deviating from those listed in the PSTG, were used inconsistently throughout the EOPS.

(c) References to the flowcharts were inconsistent, ranging from "the flowcharts" to "31EO-EOP-001-OS."

(d) Placekeeping spaces provided in the EPMs were placed on the right side of the steps, rather than at the step number. When a step is longer than one line, this method could lead to confusion about exactly which step had been performed.

(e) The writer's guide lacked a sufficiently complete list of approved action verbs.

(f) Yes/no exits from decision symbols on the flowcharts were inconsistently placed.