TENNESSEE VALLEY AUTHORITY

OFFICE OF NUCLEAR POWER

REPORT OF SEQUOYAH READINESS REVIEW

Operational Readiness Review Team

January 5, 1988

TVA 64 (OS-9-65) (OP-WP-5-85)

UNITED STATES GOVERNMENT

Memorandum

TENNESSEE VALLEY AUTHORITY

TO: S. A. White, Manager of Nuclear Power, LP 6N 38A-C

FROM: Operational Readiness Review Team, ONP, Sequoyah Nuclear Plant (SQN)

DATE: January 5, 1988

SUBJECT: SEQUOYAH NUCLEAR PLANT (SQN) - OPERATIONAL READINESS REVIEW (ORR) - REPORT OF - FCF-1-88

The ORR team was formed at your direction on August 18, 1987 . The team proceeded to assess "the qualification and motivation of personnel at SQN unit 2 and the availability of necessary supporting resources for the safe and reliable testing, operation, and maintenance of the plant" prior to startup. The ORR Team considers that a thorough review of those activities that were included in your memorandum dated August 14, 1987 (A02 870814 001), has been conducted. The report of the ORR Team findings, from the review made at SQN, is forwarded herewith. At your direction the ORR Team will observe activities and personnel during the forthcoming plant heatup evaluation. A separate report will be forwarded to you on the results of that evaluation.

The ORR review at SQN was accomplished during the period from mid-August 1987 until January 1988. This afforded the team an opportunity to perform the review in the environment of the many activities being performed at the plant in preparation for criticality. The nine members of the team provided a broad base of nuclear plant operating and management experience. This led to examination of each review area from diverse viewpoints and is considered to have resulted in carefully considered findings.

A wide range of plant documentation was read to understand management direction and plant procedures. Many interviews were conducted with individuals, ranging from top management to working level. This was done informally and with assured confidentiality to elicit meaningful response. Significant team man-hours were spent in observing activities in process. This generally was done on an unannounced basis. The observations, however, involved prior ORR Team preparation efforts in reviewing background documentation and planning the observation. Each interview and plant observation was documented by a typed memorandum summarizing the information gained. These were circulated among the team and discussed during the regular team meetings, generally held three times each week. The memorandums and discussions thereof provided the basis for the attached ORR Team Report and for a Team consensus of the findings presented therein.

The report format provides a section (chapter) for each general review area. The sections are subdivided into topics, each of which reports a concern and the ORR Team basis for the concern.

The preliminary findings of the ORR Team were included in a draft interim report, entitled Phase A, which was given to you in early October 1987. This represented the initial findings of the ORR Team and presented its view of plant operations as of that time. The content of the report was given to top management in presentations at both the TVA Headquarters and SQN. The ORR Team's subsequent efforts focused more on support areas at the plant plus observing all six operating crews in action at the Power Operations Training Center SQN simulator. The ORR Team findings listed in the interim report have been reviewed, updated, and consolidated with the latter period efforts to provide this integrated report.

The Manager of Nuclear Power requested a separate review by the Institute of Nuclear Power Operations (INPO). This took place during October and November 1987. The ORR Team observed this review and was provided copies of the two INPO reports. These are appended to this report. The content of the INPO reports was reviewed by the ORR Team, and comments from that review are provided. The INPO findings are basically consistent with ORR Team findings given the differing review time spans, mission objectives, and vantage points of the two teams.

The concerns expressed in this report are based on the high standards that the ORR Team considers should apply to TVA nuclear plant operations. Accordingly, the following are concluded from the SQN Unit 2 Readiness Review.

- A February 23, 1988 startup objective provides adequate time for plant personnel to effect the corrective actions, which commenced in October 1987 pursuant to the ORR Team's interim report.

- Prior to startup, a verification of readiness should be accomplished by management. The planning, observation, and conduct of the readiness verification should involve management participation to ensure operational readiness in the following areas:

  - Evaluate each operating crew in the simulator using the upgraded procedures and INPO "topics."

- Evaluate each operating crew in the plant and in the control room, including watchstanding proficiency of AUOs.

- Assure that the desired performance standards are met in the areas of formality, communication, conservative plant operations, self-assessment, procedure compliance, diagnostics, and knowledge level.

- Assure that sufficient steps have been taken to demonstrate site and plant management commitment and progress in improving radiological controls.

o Prior to startup a formal plan should be developed regarding completion of actions on the remaining ORR team concerns. To assist in continued safe and reliable operation over the longer term, site and plant management commitment to this action plan should be demonstrated.

o Prior to startup the areas that need improvement as recommended by INPO should be completed.

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TENNESSEE VALLEY AUTHORITY

OFFICE OF NUCLEAR POWER

REPORT OF

SEQUOYAH READINESS REVIEW

Operational Readiness Review Team

January 5, 1988

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APPENDICES

Summary

The Operational Readiness Review (ORR) Team was formed by the Manager, Office of Nuclear Power, to assess "the qualification and motivation of personnel at SQN unit 2 and the availability of necessary supporting resources for the safe and reliable testing, operation, and maintenance of the plant "prior to startup.

A review of the scope and time represented by the ORR effort is bound to disclose matters not within the strict wording of the mission statement. These were documented and appended separately where the ORR Team considered them to be important to the greater responsibility perspective of the Manager of Nuclear Power.

The ORR Team Review findings are included in the report and reflect review of the plant activity areas listed in the table of contents, Sections I through XV. The Institute of Nuclear Power Operations (INPO) made a concurrent review. The two reports of their observations are appended to this report and commented on in Section XVI.

The ORR Team observed both positive areas of performance and areas of concern. These are summarized as follows. The concerns are detailed in the report under related topic headings. The most significant of these have been consolidated for this summary.

Positive Observations

- Most onwatch operations-personnel exhibited a willingness to learn and to correct performance deficiencies which could affect their operation of the plant.

- Users consider that procedures have been significantly improved. Working level personnel have provided input to procedure content.

- A system has been implemented to ensure that routine chemistry samples are taken.

- A procedure for the conduct of testing has been implemented. Test Directors are complying with the procedure.

- Operator entry to radiological contamination zones has been simplified for routine inspections.

- The restart testing program was well organized and its effort is nearly complete.

- The reorganization of System Engineering represents a positive step toward addressing existing system deficiencies.

Significant Concerns

- Deficiencies were noted in some Standards of Operation areas such as formality, communications, and self-assessment. The lack of a conservative and questioning approach to operations was evident.

- The number of procedural compliance and quality problems observed has the potential to lead to future operational problems.

- There was a lack of concern for abnormal chemistry situations with the resultant inadequate actions to maintain system chemistry and correct out-of-specification conditions in a timely fashion.

- The numerous Radioactive Waste System temporary alterations and operational deficiencies observed by the team increase the possibility of radiological problems associated with the processing of liquid waste.

- Watch station rotation and continuing training do not ensure maintenance of watchstanding proficiency by the Assistant Unit Operators.

- The practices employed for independent verification of valve and electrical alignment do not provide full assurance that they are correct. This could lead to a systems operation problem from improper system alignment or a personnel safety problem from an improper clearance.

- A thorough understanding and a clear working knowledge of reactivity control was not apparent.

- Technical knowledge of reactivity effects and Safety Parameter Display System use was below desired standards.

- Training deficiencies were noted in the team diagnostic capability of operating crews and in technical areas for maintenance personnel. Training methods weaknesses contribute to operator knowledge and performance standards deficiencies.

- The significant level of activity performed in the control room to support maintenance work authorization distracts from the operators primary responsiblity to control and monitor the plant. This also contributes to inefficiency and lack of timely authorization of maintenance work.

- The lack of management observation of and participation in both simulator exercises and plant shift operations inhibits the effective implementation of necessary changes in conduct of operations and performance standards.

- The lack of a designated single individual accountable for each unique plant system increases the probability that needed first-class material condition and operability will not be achieved.

- Many aspects of radiological control do not meet requisite standards. Deficient elements include items in both the radiological control organization and other site and plant organizations.

Acronyms and Abbreviations

AI	Administrative Instruction
ASE	Assistant Shift Engineer
AUO	Assistant Unit Operator
BOP	Balance of Plant
CAQR	Condition Adverse to Quality Report
CCW	Component Cooling Water
CDWE	Condensate Demineralizer Waste Evaporator
CS	Containment Spray
CSSC	Critical Systems, Structures and Components
DCN	Design Change Notice
DCR	Design Change Request
ECP	Estimated Critial Position
ERCW	Essential Raw Cooling Water
HVAC	Heating, Ventilating and Air Conditioning System
INPO	Institute for Nuclear Power Operations
LCO	Limiting Condition of Operation
LOCA	Loss of Coolant Accident
M&TE	Measurement and Test Equipment
NRC	Nuclear Regulatory Commission
ORR	Operational Readiness Review (team)
OSLA	Operation Section Letter, Administration
OSLT	Operation Section Letter, Training
POTC	Power Operations Training Center
RCS	Reactor Coolant System
RHR	Residual Heat Removal
RO	Reactor Operator
RWST	Refueling Water Storage Tank
RadWaste	Radioactive Waste
SE	Shift Engineer
SGTR	Steam Generator Tube Rupture
SI	Surveillance Instruction
SOI	System Operating Instruction
SPDS	Safety Parameter Display System
SQA	Sequoyah Nuclear Plant Standard Practice
SRO	Senior Reactor Operator
STA	Shift Technical Advisor
T_{av}	Average Temperature
TACF	Temporary Alteration Change Form
TDCT	Tritiated Drain Collection Tank
TVA	Tennessee Valley Authority
UO	Unit Operator
WR	Work Request

I. STANDARDS OF OPERATIONS

Improvement is needed to achieve the desired standards for excellence of operations in several areas.

A. Formality

1. Concern

Operations are not conducted with the degree of formality necessary for a proper businesslike approach.

2. Basis

Instances of informal operations were seen during in-plant and simulator training observation periods. Some examples of these are listed as follows.

a. Communications

(1) Orders were not acknowledged or repeated back.

(2) Orders were given by hand signals.

(3) Orders were not in clear, crisp language.

(4) Numerous incoming telephone calls provided distraction. Some incoming calls were of a nonbusiness nature and others were requests which should not have been directed to onwatch personnel.

(5) Excessive use of the public address system to page personnel created a distracting background noise-level.

(6) Transmissions from radios in use were difficult to hear. This detracted from control of the operation in progress.

(7) There was an almost complete lack of repeat back of orders or acknowledgement of information being passed in some simulator training sessions. Many communications went into a "black hole" and misunderstandings resulted.

- In one instance, failure of a Unit Operator (UO) to assure that the Assistant Shift Engineer (ASE) was aware of high charging pump flow (and corresponding high pump motor power) resulted in pump motor burnout.

- After an anticipated transient without scram, the Unit Operator (UO) did not get to full boration (pump speed) until later and the ASE was unaware of this because there was no repeat back.

- During a transient involving the loss of feedwater, the UO announced that he concluded it would be appropriate to blow down a steam generator. Nobody heard him or acknowledged his message. The UO proceeded to blow down the steam generator. The SE and ASE were discussing what to do and concluded about three minutes later that it would be appropriate to blow down a steam generator. The SE ordered the UO to do so. The UO ignored the SE.

(8) Imprecise orders were given in simulator training such as the following.

- "If you all feel comfortable, start reducing load."
- "Just give it a little bit of boron."
- "Pull the rods out a little bit if you start getting more boron than you want."
- "Make T_{av} a little lower."

Moreover, voices were too low. Operators did not speak up forcefully and precisely.

It is noted that items (1) through (3) above were the type of informality that had been pointed out within Executive Summary paragraph 1.2.2.12 of a report[1] dated October 3, 1986.

b. Control Room Access

(1) Permission from operators is required to enter the Control Room. Sometimes, however, more personnel are allowed in than would be prudent.

(2) Access often is not restricted when it should be, e.g., during watch relief.

c. Watch Relief

(1) There were instances of "watch-sharing" when both the offgoing and oncoming personnel performed onwatch duties.

(2) There were occasions when personnel did not make a clear announcement and acknowledgment of watch relief.

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1 Report to the Tennessee Valley Authority Office of Nuclear Power Regarding the Division of Training, Chattanooga, Tennessee; Westinghouse Electric Corporation; October 1986.

(3) The offgoing watchstander completed and signed the watch relief checksheet well in advance of watch relief.

(4) The oncoming watchstander did not sign the watch relief checksheet promptly or enter the time of relief in the logs.

(5) Shift turnover briefings were observed that were not as effective as they should have been. Deficiencies noted included the following.

(a) A Residual Heat Removal pump being out of commission was not stated. Technical specifications require maintenance of a current plant condition status.

(b) Significant operational problems were mentioned on occasions with little more than a one-sentence description. No training or lessons learned benefit was communicated.

(c) The fact that there was a bubble in the pressurizer was not stated. (Note related observation as the first item under "Knowledge of Plant Conditions" in Paragraph B following.)

(d) The limiting conditions for operation were sometimes referred to only by number without stating what they were.

(6) An offgoing Unit Operator (UO) (during a poorly conducted relief) left to go home five minutes before the oncoming RO returned to the control room. The latter returned from a visit to the toilet and assumed the watch. The time of relief entered in the check sheet and log was the time of return.

(7) Most Assistant Unit Operators (AUOs) were observed to leave their watch station without relief and without permission to go to lunch.

(8) An AUO was observed to relieve the watch without previously having reviewed the logs.

d. Logkeeping

(1) The daily journal, which is maintained by the lead Unit Operator (UO), varies significantly in detail among watchstanders, e.g. manual energization of pressurizer heaters was observed being logged by only some operators.

(2) A Shift Engineer (SE) prepared his log by reviewing the UO logs and making similar entries several hours after the actual event. Another SE advised that he also uses this practice.

(3) Instances of late entries based upon rough notes or memory were frequently observed in violation of plant Administrative Instruction (AI-6) requirements.

(4) Supervisory review of the logs is not effective; e.g.

(a) A shift supervisor was observed reviewing a log in which the time of relief had been omitted. The error was not detected.

(b) A plant Surveillance Instruction (SI-38) is required to be performed daily by the Shift Technical Advisor (STA) to verify shutdown margin and the minimum boron concentration required to maintain that margin. The September 14, 1987 verification was completed at 0930 but was not reviewed by an Assistant Shift Engineer (ASE) until 0730, September 15, 1987, and then only because the lack of review was questioned. SI-38 appeared to be deficient in that it had no time limit for ASE review.

(5) The importance of the AUO log as a record of auxiliary systems operations, did not seem to be properly recognized by Administrative Instruction (AI-6). This instruction stated that the AUO log was to be used for information only, not maintained for official record and not subject to audit.

(6) Numerous instances of failure to keep logs properly were noted during simulator training. These would have contributed to difficulties in reconstructing events in the case of actual casualties.

e. Alarms

(1) On occasion, alarms were simply silenced without audibly announcing the alarms. In some cases, the exact reason for the alarm did not appear to be verified.

(2) Alarms were sometimes relied on as the trigger for operator action, e.g., stopping a tank filling operation in the Radioactive Waste system.

(3) An AUO observed high- and/or low-alarms on heat trace circuits associated with boron systems and did not know if they were expected nor did he record the alarms or take any other action.

(4) The silencing and acknowledging of alarms were slow at times during simulator training sessions. Alarms generally were not called out by operators. Cases, involving more than one alarm at the same time, caused difficulties. In one of these, the main generator voltage regulator trip went unnoticed until discovered a few minutes later. In another (shortly after a pressurizer low-level alarm) a steam generator safety valve opened and went unnoticed for about two minutes until the SE pointed out the condition to the Unit Operator.

f. Respect for Reactivity

(1) Surveillance Instruction (SI-38) is performed daily by the Shift Technical Advisor (STA) to verify the shutdown margin and the minimum boron concentration required to maintain that margin. On September 14, 1987, this verification was completed at 0930 but was not reviewed by an ASE until 0730, September 15, 1987, and then only because it was questioned. SI-38 appears deficient in that it prescribes no time limit for Assistant Shift Engineer (ASE) review. (Also see Subsection 2.d.(4).(b) preceding).

(2) The RCS boron concentration was not updated on the status board in a timely manner. On two separate occasions, it was observed that an update had not been made for more than a week.

(3) The boron concentration meter in Unit 2 was not operating. When that fact was questioned, the response was that it had never worked.

(4) Operations conducted in the plant simulator demonstrated the lack of full appreciation and respect for reactivity considerations. Examples of these include the following.

(a) Calculations of Estimated Critical Position (ECP) were repeatedly done on scratch paper in a completely informal manner.

(b) Calculations of dilution rates/quantities were done informally on scratch paper.

(c) The only check made of the STA's calculations of boron dilution to go from 15 to 30 percent power was a comparison for reasonableness by the SE to the dilution required to reach 100%.

(d) The calculations for ECP were done independently in some crews and in other crews done by an informal review of a single calculation.

(e) Informality, in the calculation of the estimated Critical Position (ECP), contributed to an incorrect prediction of critical rod height and abnormally high boron concentration was not recognized. The plant simulator went critical (or very nearly so) below the lower rod insertion limit as a result of this error.

g. Personnel Conduct

(1) Operators frequently leaned against or sat on the front of panels. This practice offers the potential for inadvertent switch operation.

(2) Many operators were observed to wear dosimetry badges improperly, at or below waist height.

(3) Four AUOs and the ASE were observed sitting in the turbine building office conducting a nonbusiness related discussion. On another occasion, an AUO was observed to be working on personal business.

(4) There were periods during the simulator training of reactor startup when no one observed the panels. The source range nuclear instrumentation went unmonitored for 3 minutes, on one occasion, between control rod movements.

(5) The plant went solid on the pressurizer in one case during simulator training. This happened because the pressurizer level was not closely monitored after multiple casualties.

(6) The operators, at the simulator training sessions, generally were not checking to see if what they expected was what they actually got.

It should be noted that the lack of formality in communications, control room access, watch relief, logkeeping, alarms, and conduct of personnel have all been the direct or indirect cause of significant events in the nuclear industry. These events have negative impact on the efficiency, reliability, and/or safety of operations. Relating them to the foregoing example categories is an effective teaching technique.

B. Knowledge of Plant Conditions

1. Concern

The knowledge of plant conditions, on the part of onwatch operations personnel, appeared to be less than adequate.

2. Basis

During in-plant monitoring, the following examples of a lack of knowledge of plant conditions were observed.

(1) An onwatch Unit Operator (UO) was questioned about control of plant pressure. He stated that the primary plant was solid i.e. coolant totally liquid-phase. He was unaware that there was a bubble (steam) in the pressurizer. An onwatch Shift Technical Advisor believed that the pressurizer bubble was nitrogen gas and not steam.

(2) Several onwatch UOs did not know the volume of water in the pressurizer at the existing level and there was inconsistent knowledge of the volume-versus-level relationship.

(3) Two onwatch UOs did not know the maximum pressure allowed to avoid overpressure of the reactor vessel at the existing primary coolant temperature.

(4) The rate of secondary boundary valve leakage from the steam generators (a condition which had been under investigation for some time) was not known by a UO.

(5) The Shift Engineer Daily Orders from operations management incorrectly specified the required plant condition for Unit 2. A pressurizer level of 20 to 25 percent was specified. A UO advised that the pressurizer level must be maintained above 24 percent by Technical Specifications requirement because a Residual Heat Removal (RHR) pump was inoperative. The pump problem was known prior to the issuance of the orders that incorrectly specified the required plant condition.

(6) Several licensed operators stated that they did not know why 50-75 psi was the specified pressure band at that time for Unit 2.

C. Conservative Plant Operations With a Questioning Appr..ch

1. Concern

Personnel did not display conservatism and a questioning approach to essential operating information in plant operations.

2. Basis

The lack of conservatism and a questioning approach on the part of operations personnel was noted during both interviews and in-plant observations. Some examples of the deficiencies observed include the following.

a. Many watchstanders performed evolutions for which they were unable to explain the underlying reason for performance, e.g., a UO who started up and loaded a standby diesel generator did not know why it was being done.

b. Operators sometimes were unable to explain predicted response for their actions. An example of this was the rate of pressure increase caused by manually energizing the pressurizer heaters.

c. Double valve position verification by two persons working together is permitted by Administrative Instruction (AI-37). The method has the built-in possibility of one person influencing the other and thereby defeating the intended criterion. The ORR team noted several deficiencies resulting from this practice, including the failure to note an improperly positioned breaker. (See Section VII. E. of this report.)

d. Because plant pressure was being maintained between 50 and 75 psig, the wide-range pressure instruments did not show a reliable reading. When the one narrow-range meter was out of commission, the only remaining indication was a display on the P-250 computer. When questioned about maintaining pressure in a range such that only one indication was usable, one Unit Operator (UO) decided to consult a steam table, thus using pressurizer temperature as a backup indication.

Subsequently, another UO authorized work on the P-250 computer. This resulted in a loss of the direct pressure indication for about one hour. The UO questioned about this stated the following.

(1) The same work was authorized the previous day and only affected indication for 15 seconds. This day the worker took a break leaving the indication out for an hour.

(2) He could have had the indication restored, but he didn't want to disturb the test that the technician was performing.

(3) He knew that he had pressure because one meter was reading zero. It normally reads less than zero when the system is depressurized.

A conservative operator normally would have chosen plant conditions to allow proper monitoring of plant parameters in the control room by on-scale indications. He would not allow loss of pressure indication.

e. Section III of this report discusses several instances of untimely action on out-of-specification chemistry conditions. The lack of aggressive action to maintain or restore chemistry conditions in the various plant systems is an indication of nonconservative operation.

f. No instructions or criteria were found which require two boundary isolation (e.g., double valve isolation) for fluid systems/components removed from service for maintenance. There may be occasions when this criterion can not be met without affecting plant operation. For conservative operation in these instances, senior management concurrence should be required before proceeding with only one pressure boundary in high pressure systems.

g. Operations were not consistently conservative during simulator training. For example, a Shift Engineer did not contact his supervisor on shutting down the plant when the following conditions existed simultaneously: (1) a stuck rod, (2) manual water level control on one steam generator with a low-low level reactor protection function inoperative, (3) one diesel generator out of service, and (4) the main generator in manual Voltage control.

D. Employee Turnover and In-Plant Training

1. Concern

A long shutdown period and considerable employee turnover, has occurred during the last two years. This will have a decided impact on individual sensitivity to plant conditions and on the ability to respond correctly to them.

2. Basis

a. Difficulty may be encountered in evolutions which differ during power operation. This is because of the long shutdown and personnel with little or no operating plant experience,

(1) Thirty persons are in the onshift chemistry group and are organized into six shifts. Nine of the thirty have no operating plant experience, and three others have only six months operating experience. It was noted that there were four vacancies and two loaned employees from Watts Bar. The shifts were arranged so that on dayshift (0700-1500), three shift groups were on duty (15 people). Of the remaining three groups; one was on evening shift, one was on night shift, and one shift was off. The six shift groups allow the chemistry group to work with the same operations shift personnel. This has distinct advantages.

(2) After presently planned training is completed, there still will be nearly 50 percent of the chemistry shift staff who have had no operating plant experience.

(3) Training for the chemistry group has not emphasized obtaining results from analyses within realistic time restraints. Both primary and secondary chemistry analyses, as well as decay counting of radiological samples and smears, will be needed during hot operation, Reasonable concern exists as to the ability of the overall group to supply accurate results in a timely manner. A similar need appears to exist in the radiological control organization.

(4) Improvement is needed in the radiological control area for those training areas which are assumed to be covered by "on-the-job training." Examples of this include the following.

(a) Power Operations Training programs are understood to assume that radiological control technicians are obtaining the knowledge and proficiency to handle airborne radioactivity through on-the-job experience with actual airborne situations. However, several technicians advised that they had not had such experience.

(b) The Power Operations Training program appears to assume that radiological control training for operations personnel beyond General Employee Training (GET) is handled by the site. Operations personnel are in charge of the response to various plant radiological casualties (e.g., response to fire or medical emergency in a contaminated area). The ASE in charge at the scene of one such drill appeared not to recognize several significant radiological deficiencies which occurred during the drill. This may have been due to a lack of training.

b. No plans to conduct practice exercises were found for improving proficiency such as:

(1) Accurate completion of chemical analyses within the time constraints which will exist during power operation. Personnel have become accustomed to the extended periods for analysis completion which are normally acceptable in a shutdown plant.

(2) Radiological control casualties (e.g., spills, fires) which require coordination of several operational groups.

Consideration should be given to more in-plant training using techniques such as case studies, coaching, drills, etc., while simulating various plant modes.

E. Self-Evaluation

1. Concern

The concept of critical self-evaluation of performance appeared to be absent from normal operations functions.

2. Basis

The concern is based upon interviews, observations of in-plant operations, observation of simulator training and review of documents. Some examples supporting the concern are as follows.

a. The "big picture" reasons for and lessons learned regarding the plant shutdown seemed to be recognized by very few people onsite. Most people believed that the plant was previously safe and will not be significantly safer as a result of the shutdown. This misconception and failure to be realistic is considered to represent a significant obstacle toward recognizing the Tennessee Valley Authority's and the Sequoyah Nuclear Plant's public health and safety responsibilities.

b. Managers and supervisors reported, in interviews, that they do not use quantitative performance indicators to measure the effectiveness of their group's performance. It is noted that there are performance indicators listed in a Standard Practice (SQA 129) entitled Objectives in Plant Operation - Sequoyah Nuclear Plant. The status of four (of five of these relating to one specific manager's area) was reported in the Sequoyah Nuclear Plant, Plant Performance Report of July 1987. The specific manager stated, during an interview however, that he did not use any performance indicators.

c. Some of the lessons learned from recent abnormal events did not seem to be accepted as valid by some managers and supervisors. One example was the procedural compliance aspects of spill events.

d. Managers/supervisors frequently did not appear to have plans for corrective action. This was apparent during interviews when probing questions caused the managers and supervisors to discuss problem areas.

e. Very few managers and supervisors could give first-hand observations of performance when asked questions about the quality of workmanship and adequacy of training. Comments such as "I don't get out in the field as much as I would like to" and "the training department takes care of that" were typical.

f. A contaminated injury drill was considered to be unsatisfactory by the Operational Readiness Review Team observers. However, the onsite (Sequoyah personnel) critique came to a generally opposite conclusion. A comparison of the onsite critique and ORR Team observation is as follows.

ONSITE CRITIQUE	ORR TEAM OBSERVATION
1. "Drill was a success"	1. "Drill unsatisfactory"
2. "Medical care and health physics techniques were generally good"	2. "Treatment of two simulated injured persons was repeatedly delayed due to unnecessary radiological controls procedures
3. "Contamination control was good overall"	3. "Contamination control was inadequate, inconsistent and untimely"

The ORR Team noted that it was nearly an hour after the incident before the more seriously injured man was transported to the hospital. During most of that time, he was in a hot room with the temperature nearly 95°F while his removal was delayed due to application of unnecessary radiological controls procedures. It should be noted that, while plant management concurred in the critique findings, the management of the personnel involved in the drill was not represented at the critique.

g. Operations supervision and management did not monitor any of the drill periods during the time the six crews were at the simulator. Training and operations personnel both advised that management usually does not observe simulator exercises.

h. The above observations confirm the finding in the Executive Summary of a Report[2] dated October 3, 1986. This was that "Effective management and supervisory training to achieve clear understanding of top management's standards and priorities is not provided." The report also concluded that "Managers and supervisors appear reluctant to assess subordinates' performance in the field." The ORR Team's concern about the lack of critical self-evaluation reflects a corresponding assessment.

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2 Ibid.

II. PROCEDURES

Anomalies were found in the accuracy of and compliance with formal procedures. Other instances of operating with less than formally approved procedures also were noted.

A. Compliance

1. Concern

The failure to clearly define, implement, and enforce the requirements for procedural compliance could lead to operational problems.

2. Basis

a. Examples of the procedural compliance deficiencies that were observed include the following.

(1) A Shift Engineer (SE) changed a procedure step without a formal procedure change while drawing the pressurizer bubble. This was to delete the requirement to have a blank installed on an open-ended pipe downstream of a closed valve.

(2) An Assistant Shift Engineer (ASE) was making preparations to perform a test on the Essential Raw Cooling Water (ERCW) system based on a memorandum from the Mechanical Test Group. The memorandum requested that certain valves be opened, which were currently tagged for work, in order to establish flow in a portion of the system for 24 hours. The remainder of the tagout was to remain in effect. The ASE stated that a procedure was not necessary because a clearance could be used as a procedure.

(3) An Assistant Unit Operator (AUO) and an engineer were performing tests on a filter system associated with the Condensate Demineralizer system. No test or operating procedure was in use. The AUO advised that no procedures existed for this. As a result, a valve lineup error was made causing a relief valve to lift.

(4) An AUO was directed to align the tritiated water tank to the temporary radioactive waste demineralizer. The ASE prepared a handwritten procedure. However, the approval and format requirements of the Operation Section Letter, Administration (OSLA-58) were not followed. A System Operating Instruction (SOI) has existed for this evolution since May 1987. Another AUO, assigned to the Radioactive Waste system, also did not know that this SOI existed.

(5) An AUO secured recirculation of one Refueling Water Storage Tank (RWST) and started recirculation of the other tank without signing the steps in the required category A procedure. When asked if he had used the procedure, the AUO said nothing but was observed to take the following actions during the next 15 minutes.

(a) Amended his log entry to indicate that the SOI was used.

(b) Removed the first and third pages from an existing working copy of the SOI and added a new page two. This working copy was not verified per Administrative Instruction (AI-4). The reused first page contained initials of another AUO for meeting a required Condition of Operation.

(c) Signed for performance of a valve checklist on the new page two which, per the filed record copy, was last done May 7, 1987; signed for performance of a limited valve position check permitted in lieu of the formal checklist; marked one step "NA" (per AI-4, only an SE may "NA" a step); and signed a step which required system filter differential pressure to be less than 20 psid (both filters were greater than 40 psid and had been out of specification (high) since June 1987).

(d) Did not sign the steps, on page three, for securing recirculation of the first tank.

(6) Recirculation of a Refueling Water Storage Tank (RWST) was being performed in violation of the applicable category A procedure as follows.

(a) Two steps were marked "NA" by the AUO. Per AI-4, section 17.1.1, only the SE may "NA" a step in a category A SOI. Two other AUOs stated that a step may be marked "NA" by the person performing the procedure.

(b) One step required the RWST filter differential pressures to be less than 20 psid. Gauges for both filters read higher. The AUO performing the procedure had marked two Work Request (WR) numbers in the margin. These WRs had been issued on June 17, 1987, for filter changeout in order to secure lower differential pressure. Another AUO stated that, when he performs this procedure, he does not sign the step but obtains Unit Operator (UO) permission to continue.

(7) Water was being transferred between the Unit 1 and Unit 2 pure water tanks (an abnormal operation). The procedure was violated following the trip of a radiation monitor. The procedure permitted overriding the signal to a dump valve by manually holding the valve operator switch for five minutes, after which the transfer was to stop. The AUO taped the switch and left it in that position for 30 minutes. The AUO log showed that he had informed both UOs of the trip condition and the fact that he was overriding the dump valve. After 30 minutes, he was directed to stop the transfer.

(8) The transfer of water between the two pure water tanks took several shifts. The AUO completing the operation stated that he had to obtain a copy of the procedure because it had not been used by the previous shift.

(9) The AUO performed an evolution to check a boron evaporator pump set point without the use of a procedure. While this would be a category B procedure, he made no attempt to determine if a procedure existed. He explained that a less experienced operator would need to use a procedure, but the need to use a procedure for such an evolution was a matter of AUO judgment.

(10) A temporary change was not signed by the Shift Engineer as required by AI-4.

(11) A sieve was not installed during boric acid addition to a boric acid mixing tank, No apparent check of the eyewash equipment was made These were a violation of the applicable category B procedure.

(12) Some category A operations were observed where the AUOs used working copies of procedures which had not been verified against the originals as required by AI-4.

B. Quality

1. Concern

The necessary positive steps to correct specific operating procedure deficiencies sometimes were not taken.

2. Basis

a. Three examples were observed where the willingness of licensed operators to continue an evolution, with a known procedure deficiency, resulted in the failure to correct the error. These are outlined as follows.

(1) A Surveillance Instruction (SI) for sequencing containment isolation valves contained a requirement to enter data in a specific log. The verification signatures for these entries were being left with an "NA" written in. This log has not existed for about two years. An attempt by one Reactor Operator (RO) to resolve this by use of a Condition Adverse to Quality Report (CAQR) dated 6/17/87 had not provided the desired results.

(2) A SOI covered evolution was in progress without the two "Conditions for Operation" being signed for completion. The procedure was poorly written in that one condition could not be met until the procedure was partially completed and the other condition should have been a precaution. The SE did not know whether "Conditions for Operation" needed to be met prior to performance of the procedure and suggested that the head of the procedure preparation group be called by the observer.

(3) A change to a procedure recognized the addition of two valves which apparently had not been installed. The operators complained that the day shift people apparently took someone's word for the existence of the valves, without checking, and thus made problems for the operators. The problem was apparently going to be handled by declaring the new (uninstalled) valves inoperable and logging this condition in the abnormal equipment log so the required steps could be completed without a procedure change.

C. Management Approach

1. Concern

Management support for procedure compliance was not always evident where needed to effect necessary improvements in operator performance.

2. Basis

a. Operations supervision and management have used alternate means to avoid or delay a procedure revision as follows.

(1) An informal memorandum dated November 3, 1982, from an operations supervisor, was found posted which permitted operating a heater drain pump with a motor overload alarm if a given temperature limit is not exceeded. This should have been accomplished by a procedure change.

(2) Night orders were being used to supercede existing or create new operating procedures.

(a) Several night orders impose operating limits on pressurizer level changes, maximum flowrate to fill a steam generator, and removal of temporary shielding during heatups.

(b) Two night orders establish procedures for the ERCW backwash and the Condensate Demineralizer Waste Evaporator (CDWE) shutdown/recirculation.

(3) An operator aid was being used in lieu of a temporary procedure change (and in violation of Institute for Nuclear Power Operation (INPO) guidelines) to place a limit on the flow to heat exchangers.

(4) A caution tag has existed since January 1987 requiring two fire pumps to remain in automatic mode. The tag is needed because a Surveillance Instruction (SI) is deficient with respect to checking Technical Specification requirements.

b. It was apparent during interviews that most levels of management did not fully support the need for procedural compliance. Individual managers cited concerns for the procedures being too detailed, operator actions being unnecessarily restricted during unanticipated or abnormal situations, and the organization being forced to operate like the Navy. The prevailing management attitude appeared to support these concerns rather than to constructively address them. The result was confusion as to the plant policies on procedures and some lack of management credibility.

III. CHEMISTRY CONTROL

Significant problems were found in plant chemistry control.

A. Chemistry Out of Specification

1. Concern

The lack of adequate chemistry control results in undesirable periods of out-of-specification conditions.

2. Basis

The Institute for Nuclear Power Operations (INPO) documents, entitled Guidelines for the Conduct of Operations at Nuclear Power Stations (INPO 85-017) and Performance Objectives and Criteria for Operating and Near-Term Operating License Plants (INPO 85-001), state that out-of-specification chemistry conditions should be corrected promptly. INPO 85-001 further states, where feasible, corrective actions should be taken before specifications are exceeded. These INPO guidelines were not being observed in the following examples.

a. An INPO evaluation conducted at Sequoyah in February 1984 found that chemistry specifications were not being adhered to in some auxiliary systems. A continuing lack of specification adherence was noted.

(1) The Essential Raw Cooling Water (ERCW) System was out of specification (low) on chlorine at least 10 days in the 30-day period from August 22 to September 22, 1987.

(2) The Component Cooling Water (CCW) System was out of specification (high on chloride) during most of July 1987, was out of specification on Molybdate most of August, was out of specification (low) on tolytriazole during most of July and August, and was out of specification (low on pH) most of August and the first half of September.

b. A Nuclear Regulatory Commission (NRC) audit of Unit 1 chemistry data from March 1986 to March 1987 showed that control of hotwell condensate-feedwater chemistry had not been maintained in some instances. A continuing lack of control was noted.

(1) Condensate Storage Tank B exceeded dissolved oxygen limits by as much as a factor of 20 during two weeks in July and two weeks in August 1987. The tank also was out of specification in silica and specific conductivity approximately two weeks in July 1987.

(2) Unit 2 hotwells had low pH some eight days in June, five days in July, and at least five days in August 1987. The pH was high in the hot wells approximately two weeks both in July and in August 1987. Hydrazine was low for about one week in August 1987.

c. Chemistry data for June, July, and August 1987 for Unit 2 showed the following.

(1) Residual Heat Removal System coolant was out of specification (high in chlorides) by a factor of 10 one week in August.

(2) Unit 2 steam generator chemistry sometimes was out of specification during these months in the following categories.

- Hydrazine exceeded limits in steam generator #3 about one-half of August and in #4 approximately one week in August.
- Sulfates were out of specification (high) in steam generator #3 some two weeks in July, in #2 about one week in August, and in #1 some two weeks in August.
- pH was below the acceptable level in three steam generators during some two weeks in June, in one generator all of July, in the other three a week or more in July, and in one generator two weeks in August.

There are circumstances, such as system conditions for modifications and repairs, that can make it difficult to maintain chemistry within specification at all times. However, increasing concern and effort are needed to eliminate or minimize such circumstances.

B. Action on Out-of-Specification Conditions

1. Concern

Actions to correct out of specification chemistry conditions are not always timely. In some circumstances, planning of operations was not adequate to assure proper control of chemistry.

2. Basis

Correction of out-of-specification conditions should be made promptly per the guidelines in INPO 85-001. Examples where this has not been done include the following.

a. The 2-B containment spray heat exchanger in wet layup was found out of specification on 16 July 1987. It was (low on pH (7.58 vs minimum of 9.5) and hydrazine (38 ppm vs. minimum of 100 ppm). The chemistry group did not recommend correction of this problem until 18 August 1987 and operations did not correct the situation until 15 September 1987.

b. A Limiting Condition for Operation (LCO) was issued on unit 2 on 10 July 1987, because of a failed surveillance test of the Control Building Emergency Ventilation System. This LCO allowed no actions that would add reactivity. By 30 August 1987, a bubble had been drawn in the pressurizer. This condition requires oxygen to be below 0.1 ppm. However, hydrazine could not be added because of the LCO. Finally, on 18 September 1987, a method was approved for adding hydrazine while meeting the LCO. (Note: The Mechanical Test Engineering Group estimated that it might be November 1987 before the LCO will be lifted.)

c. A bubble was drawn in the unit 2 pressurizer prior to 30 August 1987, but the pressurizer was not sampled until 8 September 1987. Dissolved oxygen was found to be high at 1 ppm. Dissolved oxygen remained high (out of specification) until after hydrazine was added to the Reactor Coolant System on 18 September 1987. Good practice supported by a specific procedure could have dictated sampling prior to drawing a bubble.

d. The chemistry group did attempt to take a pressurizer sample on 3 September 1987, but could not do so because of a hold order placed 2 September. This hold order was to allow replacement of RayChem splices in power cables for the pressurizer solenoid-operated sample valves. This was poor work sequencing. The splices should have been replaced before a pressurizer bubble was drawn. The hold order was released on 7 September and a sample was finally obtained on 8 September as noted above.

C. Attitude Toward Chemistry Conditions

1. Concern

Abnormal chemistry conditions do not receive adequate management attention.

2. Basis

Guidelines in INPO 85-001 clearly state that corrective action should be taken, when feasible, before specifications are exceeded and that plant staffs should strive to maintain chemistry parameters at optimum points within the specified bands. Moreover, INPO 85-001 states that managers should be aware of chemistry trends. Although chemistry data is available to management, the frequent and extended periods of out-of-specification chemistry indicate a lack of commitment to effective corrective actions.

A lack of concern was demonstrated by the following.

a. Chemistry limits were frequently exceeded despite concern expressed by both INPO and NRC in their respective reports of 1984 and 1987.

b. Some chemistry analysis equipment in the titration room was found to be not operable and not being maintained properly. The room was dirty. Inconsistent, informal labels were on a number of gauges and recorders. The new DIONEX sample analysis system was installed in a temporary fashion in a crowded corner of the room. This was pending action on a Design Change Request (DCR) being processed to get it installed permanently.)

c. The chemistry laboratory needed housecleaning. Additional attention to equipment was needed such as a support for the phenylarsene oxide standard bottle used in the analysis for chlorine.

d. The boric acid sampling station originally installed in the plant did not work. It was plugged with solidified boric acid. This condition resulted in chemists having to enter contaminated radiation areas in order to obtain routine samples.

e. Operating personnel should have given more attention to chemistry. During the week of 14 September, the weekly chemistry report available in the Control Room was dated 5 September. The latest report should have been for 12 September 1987. Licensed operators often expressed the view that fluid chemistry was the responsibility of the chemistry group. One reactor operator questioned did not know the approximate activity of the primary coolant. His knowledge of chemistry limits and the reasons for these limits was sketchy.

f. Chemistry personnel did not appear to respond rapidly enough to out-of-specification conditions. On 10 September 1987, high pressurizer dissolved oxygen was not reported to the Control Room for six hours after the analysis results were available.

g. The document, entitled Objectives in Plant Operation - Sequoyah Nuclear Plant (compiled pursuant to SQA129 Rev. 7 dated 11 July 1987) did not contain any chemistry goals or objectives.

IV. RADIOLOGICAL WASTE SYSTEM

Concerns exist for the design, temporary configuration and operation of systems for radioactive liquid waste handling.

A. System Configuration

1. Concern

The Radioactive Waste System (Rad Waste) is in a temporary configuration which makes operating the system difficult and error prone.

2. Basis

The Institute for Nuclear Power Operations (INPO) document entitled Performance Objectives and Criteria for Operations and Near-Term Operating License Plants (INPO 85-001) lists performance criteria for control of radioactive liquid effluents. One criterion is that the effectiveness of radioactive waste processing equipment should be evaluated routinely. Observation confirmed that the "routine" evolutions are being performed, e.g. to determine when to replace or flush a filter. However, the overall condition of the Rad Waste System appears to require review directed at improving operability and reducing the risk of an incident. Specifics include the following.

a. Both the original liquid waste evaporators, the Coolant Waste Evaporator and the Auxiliary Waste Evaporator are decommissioned. In fact, these units never operated for any length of time due to design deficiencies. Management is understood to have concluded, at the time of the startup of the plants, that these deficiencies did not warrant correction. The equipment was not removed or disconnected from the remainder of the Rad Waste system, but was valved off.

b. The Condensate Demineralizer Waste Evaporator (CDWE) installed to handle radioactive condensate-demineralizer flush water has been the only permanently installed means to process radioactive liquid. As a backup, and for periods when the CDWE must be shut down for maintenance, a temporary radioactive liquid demineralizer (RAD DI) system supplied by the ChemNuclear Company has been located in the railroad bay. An 80 foot temporary hose has been installed from the Tritiated and Floor Drain Collection Systems to this Rad DI system.

c. Originally, the CDWE fluid (referred to as a slurry) could be recycled to the Floor Drain Collection System via the floor drain in the room where it is located. Also, the distillate, when not meeting conductivity specifications, was directed to this drain. The drain became plugged on at least one occasion which caused backup of the slurry on to the floor of the Spent Resin Collection Tank Room. Subsequently, a Temporary Alteration Control Form (TACF), was issued which provided for a 200 foot hose to be installed to carry these drains directly to the Floor Drain Collecting Tank.

d. The drain from the Spent Resin Collection Tank became plugged during operation. A TACF then was issued to tap into a portion of the primary water system to allow partial draining of the tank which is required prior to resin discharge.

e. Shipment of solidified waste requires knowledge of its pH, boron concentration, and radio-isotope content. Sampling the waste for this knowledge is difficult during the solidification process. The problem is twofold: (1) having to obtain the sample during solidification and (2) then diluting it to keep it from solidifying.

f. A total of thirteen RadWaste System temporary changes (as documented by TACF's) are in effect. Four have existed since 1981; four since 1982, one each in 1983, 1984, and 1985; and two in 1987. A plan is inplace to take actions to resolve these but, by this plan, some of the TACF's will still be outstanding at startup. A review should be made to assure that those TACFs left at startup do not degrade system operability.

g. Aspects of the system should be reviewed other than outstanding TACFs. For example, the single valve protection (provided, in some instances, between portions of the system and between the system and other plant systems) could result in an adverse condition. An independent engineering evaluation of the system should be able to define any actions required now (including needed changes in drawings, hardware, procedures and training), in advance of the longer range plan referred to in subparagraph f. above.

B. Operational Control

1. Concern

The temporary changes in effect and the quantity of radioactive liquids involved are not providing the degree of careful and formal operations routinely needed for the RadWaste System.

2. Basis

INPO 85-001 guidelines state that operators should be knowledgeable of radioactive waste systems and operations. The following examples, and the concerns expressed in Section VI of this report concerning Assistant Unit Operator (AUO) proficiency, form the basis for this concern.

a. The accuracy of the system status sometimes has not been maintained as required by Sequoyah Nuclear Operations Section Letter, Administrative (OSLA-58).

(1) Two TACFs were not properly indicated on the system flow diagram used for system status control in the Auxiliary Building operator office. Both involved removal of check valve internals. One TACF was not indicated on the diagram, the other was marked on the wrong valve. (Note: System Operating Instruction, SOI-77.1, properly reflected the TACFs.)

(2) An Assistant Unit Operator (AUO) was not able to provide evidence in the operator shack as to when the system had last been status checked or validated. There were numerous marks and entries on the clear plastic cover over the diagrams without signature or initials for control purposes.

b. An operation to align the Tritiated Drain Collection Tank to the temporary ChemNuclear provided Rad DI System was observed. The AUO obtained a handwritten procedure from an Assistant Shift Engineer (ASE). The approval and format requirements of OSLA-58 were not followed in this. Moreover, an approved written procedure for this evaluation existed although the personnel involved were not aware of its existance.

c. Day Shift AUOs assigned to the RadWaste System received direction from two separate sources. The first was the RadWaste supervisor and the second was the Control Room licensed operators. Examples of this include the following:

(1) An AUO performed an evolution to check a boron evaporator pump setpoint without the use of a procedure. This was performed at the request of a Radwaste supervisor without permission from the ASE. The AUO explained that his direct supervisor was the ASE, but the Radwaste supvervisor didn't go through the ASE when requesting operations. The AUO made the

judgment as to whether other systems would be affected and whether ASE permission was needed. He pointed out a Component Cooling Water (CCW) valve which he knew would affect other systems. He learned this by once operating it without permission, and receiving an immediate phone call from a Unit Operator.

(2) A System Operation Instruction (SOI) for transferring radioactive water from the Tritiated Drain Collecting Tank to the temporary Rad DI system, permitted performance by an AUO with the permission of either the Shift Engineer (SE) or a RadWaste supervisor. This evolution, which include operating plant valves and pumps, could therefore be performed without the knowledge of the licensed operators.

d. An AUO was observed using the system alarms as operational control means. In this system and in others, alarms should not be used to control operations. RadWaste System liquid and resin transfer operations should be monitored continuously and secured if the AUO will be absent (e.g., for a lunch break).

V. SHIFT TECHNICAL ADVISOR

The role and use of Shift Technical Advisors was found to differ from the objectives sought by Nuclear Regulatory Commission Publication NUREG-0737.

1. Concern

The Shift Technical Advisor (STA) is not being effectively utilized to accomplish the intended function of providing technical advice pertaining to assuring safe operation of the plant.

2. Basis

Improvements in STA effectiveness were shown to be desirable based upon observation related to relationships, technical knowledge and performance in simulator exercises, all as discussed below.

a. Relationships

(1) STAs typically are only assigned to plant watchstanding duties for limited periods (10 weeks per year). The Shift Engineers expressed a lack of confidence in individuals who may have been out of the plant for over six months. Even when on watch, STAs are in a different shift rotation from the operations crews. As a result, they do not become well integrated with any specific shift group.

(2) The first generation of Sequoyah STAs has been promoted to other jobs. Turnover of subsequent STAs has been high, as large numbers of younger (inexperienced) engineers need to be trained to compensate for the general dislike of shift work.

(3) Many STAs are perceived by the SEs to have qualified only to make their employment history look good for potential promotion.

(4) SEs believe STAs are useful but not necessary. The STAs presence is perceived as only necessary to meet Technical Specification requirements.

(5) The STA is not required by the Technical Specifications to be present during cold shutdown conditions (Mode 5). Thus, STAs are currently being assigned for one 9-hour shift each weekday and 4-hour shifts on weekends. One SE considered the assistance of a STA to be more critical during an outage because of the abnormal systems configurations which then exist.

(6) Some STAs have been assigned administrative duties (e.g., maintenance of paint permit log) which appears inconsistent with their intended function and professional training.

(7) Site procedures require the STA to request permission to enter the control room. Other control room personnel can enter at will.

(8) STAs feel they serve and survive at the pleasure of the SE and their success on shift is significantly personality dependent.

b. Knowledge

(1) STA knowledge of plant conditions was inadequate in some instances. Some individuals questioned did not know:

(a) the current core burnup
(b) that the pressurizer had a steam bubble (thought it was nitrogen).

(2) STA qualification did not involve demonstration of significant plant hands-on knowledge of components and systems. As individuals, they were usually qualified in the plant by another STA instead of an SE, ASE, or UO. Their perceived effectiveness in performing their intended function was lessened as a result of their limited in-plant training and their relative inexperience in nuclear plant operation.

c. Simulator Exercise Performance

(1) Most STAs appeared very knowledgeable of the technical specifications.

(2) Most STA calculations for reactivity changes were correct although done very informally. One error was detected by the SE.

(3) The STAs provided correct, timely, and conservative guidance in several cases. This was not the case, however, in the scenario of the criticality (or near criticality) with rods below the lower rod insertion limit.

(4) Knowledge deficiencies relating to use of the Safety Parameter Display System (SPDS) are discussed in Section VIII.

VI. ASSISTANT UNIT OPERATOR QUALIFICATION MAINTENANCE

The current operator rotation practice and training certification system allows personnel assignment to plant stations without assurance of the individual's up-to-date station familiarity.

1. Concern

The current rotation schedule for the Assistant Unit Operators (AUOs) does not assure that an AUO assigned to a specific station has maintained watchstanding proficiency for that station from an operational familiarity standpoint.

2. Basis

The concern regarding AUO watchstanding proficiency resulted from interviews and observations of AUOs along with discussions with operations and training personnel with regard to how AUOs are assigned to various stations as noted below.

a. Comments by Line Management

(1) One Assistant Shift Engineer (ASE) stated that he had refused to accept a certified AUO for a specific station because he knew the employee was not sufficiently experienced.

(2) An operations manager expressed concern that he had some certified AUOs assigned to support specific station operations whom he considered to be insufficiently experienced.

b. Comments of AUOs

(1) One AUO advised that he had been off of the shift rotation for a number of months and was quite concerned that, when the plant went back into operation, he would be directed to man a station which he felt he was not qualified to man due to the lack of recent operating time at that station.

(2) An AUO assigned to the day-shift glycol station stated that, on Mondays and Tuesdays, one AUO had the duty. On Wednesdays, Thursdays, and Fridays, a second AUO had the same station. According to the AUO interviewed, it took at least two days to become familiar enough with the system to be able to note trends. Thus, the Friday monitoring of the system was performed in the most proficient manner.

(3) An AUO expressed concern about the lack of adequate on-the-job training for equipment operation. While he considered the classroom training to be excellent, he noted that he had received only two days of operational training on the boron evaporators. This had been 16 months prior to standing watch.

(4) An AUO stated that he did not know which station he will be assigned to the following week. He noted, that at Browns Ferry, the AUOs are scheduled at least a month in advance. In addition, he stated that he will not receive training during the following week regardless of the time since he last had been assigned to that system.

(5) The following statements were heard during a group discussion among the AUOs. "Agree with AUO rotation but a clerk runs the rotation and it's a shambles." "There are not guidelines such as maximum days away before standing a re-training shift or recognition of the wide variation as far as difficulty of the position". "Once on the 'qualified' list an AUO can be assigned anytime. It's left up to the individual to say he 'doesn't feel comfortable' and request another station."

(6) A day shift AUO admitted that he did not know how to fill the loop seals with glycol if he found the level low. This is required by the unit 2 auxiliary building routine notes, page 1.

c. Direct Observations

(1) An AUO was unable to locate the Refueling Water Storage Tank's (RWST'S) recirculation system filter gauges immediately after arriving in the vicinity of the RWST recirculation pumps. This was after being informed of a potential problem.

(2) It was found that an AUO had used a handwritten procedure issued by an Assistant Shift Engineer (ASE) for transferring water from the Tritiated Drain Collection Tank (TDCT) to the temporary ChemNuclear demineralization system because no formal procedure existed. A System Operating Instruction (SOI 77.1A9), issued in May 1987, covers this evolution. Another AUO, when questioned, also did not know that this SOI existed.

d. The AUO Station Assignment Procedure

The following subparagraphs discuss the current practice for assigning certified AUOs to specific stations. These illustrate the basis for the concerns and observations listed above.

(1) There are currently 11 AUO stations specified in Operations Section Letter, Administrative (OSLA 99) as noted below:

New Makeup Water Treatment Plant
Auxiliary Building - Unit 1
Auxiliary Building - Unit 2
Rad Waste
Outside Plant Routine
Turbine Building - Unit 1
Turbine Building - Unit 2
Condensate Demineralizer
Unit Control Room
Glycol Routine for Containment Ice Machines
Condensate Demineralizer Waste Evaporator.

(2) Each station has its own specific requirements for on-the-job training which the AUO must satisfy to obtain certification for that station. This certification is achieved when the AUO meets the initial training requirements (including on-the-job training) and passes the oral exam. These requirements are specified in Operations Section Letter, Training (OSLT-1).

(3) To maintain certification at a specific station. There is a requirement that the AUO man that station at least once in a six-month period, however there is no requirement for the number of hours that must be spent at that station (See OSLT-1). No formal system is presently in place which keeps track of the frequency or number of hours that an AUO actually mans a specific station. Hence, it is probable that the six-month maximum period will be exceeded.

(4) Some stations require more training and involve more intricate operations than others. Consequently, it is necessary for the AUOs to have more opportunities to actually man these stations to maintain the necessary watchstanding proficiency than is required for the less demanding station assignments. This difference in station complexity is recognized in the varying times specified for training a new operator for specific stations (See OSLT-1). The difference is not recognized in the operational control of shift assignments, however.

(5) The current practice for AUO station rotation can result in an AUO being assigned to a specific station for six to seven days. These assignments can be separated by periods of three to four months for a normal shift rotation. This practice means that an AUO normally can expect an

assignment total of approximately 28 days to a specific station throughout a calendar year. Changes to the normal shift assignments due to special daytime assignments for outages can result in decreasing the time spent on specific stations.

(6) Records of AUO certifications at various stations are kept in the Shift Engineer's office and maintained by the shift clerk. The shift clerk has no record of actual manning time at the stations for which the AUOs are identified as being certified.

VII. PLANT ADMINISTRATIVE CONTROL

Certain plant administrative controls, for plant functions requiring careful control, were found to be less than adequate.

A. Control of Temporary Alterations

1. Concern

The lack of complete and accurate information available to the operators, because of plant and/or drawing changes associated with temporary alterations, increases the possibility of operator errors.

2. Basis

The August 31, 1987 status of Temporary Alteration Control Forms (TACFs) for TACFs written prior to November 1, 1986 indicated that 102 of the 124 total were in some stage of resolution by being incorporated as permanent modifications. The March 12, 1987 revision to the governing Administrative Instruction (AI-9) was issued to prevent TACFs from being used for permanent modifications to plant equipment. Some of the old TACFs date back to 1980 and have been incorporated in the plant documentation. Problems, however, were noted as follows.

a. Two TACFs in effect since 1981 (as noted in Section IV preceding) were not properly indicated on the system flow diagram used for system status control in the Auxiliary Building Office. Both involved removal of check valve internals. One was not indicated on the diagram, the other was marked on the wrong valve. (Note: System Operating Instruction (SOI-77.1) properly reflected the TACFs.)

b. An excessive number of TACFs associated with permanent modifications remain open. It is noted that Sequoyah Nuclear Plant Standard Practice (SQA-129) entitled Objectives in Plant Operation included "Our goal for 1987 will be to reduce the number of outstanding long-term TACFs by at least 50 percent, resulting in approximately 75 outstanding long-term TACFs at the end of fiscal year 1987." Nothing within this goal appears to address the potential that some of the 75 to be carried over might involve items necessary for safety. The latest available compilation shows the following examples of long-term open items.

(1) --81-2298 2-FSV-14-3E. Wired operator to valve 2-14-3E such that valve would not reopen on high delta P ... 05/20/81

(2) --82-2050 Disable auto trip for "C" backup pressurizer heaters ... 02/23/82

(3) --82-2039 3 Relay trip circuit. To maintain hotwell pumps running at all times during SI signal and high steam generator level to minimize damage during restart ... 02/15/82

(4) --81-2442 Check valve 0-77-680. Remove internals to allow flow from CDWE distillate tanks to the cask washdown tank ... 07/29/81.

Consideration could be given to amplifying the current prestart check of TACFs to insure that all supporting operating documentation (e.g., drawings, procedures, tags, etc.) support the existing TACF configurations.

B. Use of Night Orders

1. Concern

The night orders are being employed as a substitute for preparing or changing both operating and administrative procedures.

2. Basis

a. Examples of night orders apparently being used to supercede existing or create new operating/administrative procedures include the following.

(1) One permitted the shift engineer to authorize nonoperations personnel to manipulate switches, etc., even though contrary to current plant policy.

(2) One superceded an administrative requirement of Operations Section Letter, Administration (OSLA-58) relative to the configuration log.

(3) Several imposed operating limits on pressurizer level changes, on maximum flow rate to fill a steam generator, and on removal of temporary shielding during heatups.

(4) Two established procedures for Essential Raw Cooling Water (ERCW) backwash and Condensate Demineralizer Waste Evaporator (CWDE) shutdown/recirculation.

(5) One noted that required pressurizer sampling could cause plant trip if any level instruments are out of

commission. Plant modifications to correct this condition have been deferred to the next refueling.

b. Copies of the night orders were not up-to-date relative to the Shift Engineer's copy. For example, the turbine building Assistant Shift Engineer (ASE) copy was found to have over 20 outdated night orders going back four years which were not in the Shift Engineer's copy.

C. Operator Aid Postings

1. Concern

Operator aid postings are being used in lieu of Caution or Hold Tags and procedure revisions. Deficiencies previously identified by the Institute for Nuclear Power Operations (INPO) had not been corrected.

2. Basis

a. The INPO document entitled Guidelines for the Conduct of Operations at Nuclear Power Stations states the following concerning operator aid postings.

"Operator aids that alter procedures should not be approved. Instead, appropriate procedures should be changed to incorporate the necessary information. Operator aids should not be used in lieu of danger or caution tags.

Operator aids should be viewed as a convenience to the individual using them, not a requirement. In most cases, operator aids remind users of information that might otherwise be overlooked and provide guidance that is not procedural in nature. Operator aids may supplement approved procedures, but they should not be used in lieu of approved procedures."

Sequoyah Nuclear Plant Standard Practice SQA-142 prescribes controls for the use of operator aids.

Some uses of operator aids found to be inconsistent with both the INPO guidelines and SQA-142 were noted. These were as follows.

(1) An operator aid placed a flow limit on a heat exchanger to avoid tube vibration. The aid stated that the applicable System Operating Instruction (SOI) would be revised in the future. A temporary procedure change should have been issued pending revision of the SOI.

It is noted that INPO identified the use of operator aids in lieu of procedure revisions as a deficiency in their December 1986 evaluation.

(2) An operator aid indicated the need to provide cooling water to a pump prior to operation. The cooling water had been isolated due to valve leakage problems. A caution tag should have been used.

(3) Red grease pencil marks were found on many meters for various reasons. SQA-142 restricts the use of red grease pencil marks to designation of trip points.

(4) An operator aid required checking a pump oil-level prior to operation because of an excessive oil leak which has existed since July 1987. A caution tag should have been used.

(5) Three operator aids on motor operated valves stated "Do not operate - see ICF and USQD". A hold tag should have been used to prevent operation of a component.

(6) An operator aid required opening a by-pass valve prior to putting the 1A charging pump in service. It appears that a procedure change was warranted for this.

(7) An informal memorandum dated November 3, 1982, from an operations supervisor, was posted permitting operation of a heater drain pump with a motor overload alarm if a temperature limit is met. It is noted that in December 1986, INPO had found similar uncontrolled operating information and recommended an inspection of the plant for such information as part of the periodic operator aid audits.

b. The following deficiencies were noted with respect to SQA-142 and compliance with its administrative requirements.

(a) SQA-142 does not implement the INPO guidelines for use of operator aids. SQA-142 states that an aid is used to "remind personnel of an abnormal situation." This definition more closely meets the INPO guidance for use of caution tags.

(b) SQA-142 requires a monthly audit, by the Shift Engineer, of the operator aid log for correctness and continued need of the aid. In many cases, the reason for the aid was inadequately entered in the log (e.g., only the name of the affected equipment is given) making the effectiveness of this audit questionable. The audit does not include a check for uncontrolled operating information.

(c) The control room operator aid log contained two different versions of SQA-142. One was revision 4 with a few minor handwritten changes. The other also was revision 4 but with much more extensive handwritten changes. These included the addition of requirements for maintenance of a log for recording, approval, and verification of tape markings used for setpoint identification on annunciation windows. There was no indication of plant management approval of the handwritten changes. It is noted that, a December 1986 INPO report noted deficiencies in the control of annunciator window setpoint labeling with incorrect setpoints.

(d) Shift Engineer approval had not been obtained for the setpoint markings on instruments, as required by the handwritten revision to SQA-142.

D. Clearance Control (Tagouts)

1. Concern

The safety of personnel and protection of equipment is not fully assured by the current use of tagouts.

2. Basis

The ORR team observed cases where detailed execution of the tagout requirements was lacking.

a. An Assistant Shift Engineer (ASE) initialed a tagout indicating that two tags had been hung which actually had not been. Another ASE found the problem but took no action other than hanging the tags. While hanging the tags, the ASE assigned to do the second verification signed the tag sheet without independently verifying the action. He observed the tagging and positioning of one valve, but did not observe the second. He stated that he had checked the valve position a few minutes earlier (prior to tagging).

b. An ASE signed for the second verification of a hold tag placement prior to the initial positioner signing the tagout sheet. For two of the switches involved, the ASE hanging the tag incorrectly signed in the second verification column. He explained that he did not correct this because the required line out, initials and date would make the tagout sheet messy.

c. During removal of a hold tag by an ASE on a valve in a Contamination Zone (C-zone), an Assistant Unit Operator (AUO) signed for the second verification of the valve position based only on observation of the ASE. The AUO remained outside the C-zone, within three feet of the valve.

d. A clearance was being used as a substitute for a valve lineup sheet to position nine valves without actually hanging the hold tags. It would have been appropriate to install the tags for proper control since the clearance also included many tagged valves. Discussion with the ASE indicated that clearances are sometimes used as procedures.

e. One hold order had been reissued for a different reason after all tags were cleared. The old information still existed on the clearance sheet. As a result, the purpose of the tags, along with the components affected, i.e, Reactor Coolant Pumps, could not be determined readily from the clearance sheet. It was noted that the involved ASE was familiar with the tagout and explained its purpose.

f. When removing tags in the diesel generator building, an ASE failed to reposition one breaker. The tagout sheet was incorrectly initialed both by the ASE and a second checker verifying that it had been repositioned.

g. An ASE in the turbine building was given the valve numbers to be tagged over the phone from the Unit Operator (UO). There was no repeat back and the numbers were written directly on the tags. The ASE asked the purpose of the clearance. Before hanging the tags, the ASE became concerned and checked the diagram. He found the UO had given him the wrong numbers. The error thus was corrected before the tags were hung.

h. There are three areas of concern in Administrative Instruction AI-3, Clearance Procedure.

   (1) A recent revision to Paragraph 3.1.8 allows the use of a caution order for protecting equipment and personnel. The use of a caution tag in this application is inconsistent with INPO guidelines which recommend the use of hold tags for equipment and personnel protection.

   (2) Paragraph 5.2 delineates extensive requirements for establishing a safe working clearance from an electrical safety perspective. The subject of mechanical safety is not addressed in comparable detail. Precautions for isolating high energy systems are not included, e.g., criteria for a two valve boundary.

(3) During interviews, some operators stated that their only real safety concern for starting up was the complexity and administration of the clearance procedure.

E. Independent Verification - Valve and Electrical Lineups

1. Concern

Current independent verification practice doesn't fully assure that the valve and electrical lineups are correct for the intended operations.

2. Basis

This concern is based upon observation of in-plant monitoring and review of documentation. Some examples of deficient practices are as follows.

a. An AUO reported that there were valves in systems which were not addressed in valve lineup check sheets.

b. It was noted that there was a valve in the gland seal steam system that was not shown on the system drawing being used by operations personnel to align the system.

c. Administrative Instruction (AI-37), entitled Independent Verification, allows two individuals to verify an action at the same time. Industry experience, as documented in event reports, demonstrates that simultaneous verification leads to shortcuts and errors. Specific examples are provided in paragraph D.2 preceding.

Complete separation of independent verifiers should be considered as plant policy. Exceptions should be on a case-by-case basis with appropriate controls. Also, a specific action plan will be needed to ensure that all valves in critical systems have designation numbers along with appearing on the operations working drawings, on the valve lineup check lists, and in the appropriate procedures.

VIII. TECHNICAL KNOWLEDGE

Core Reactivity and Safety Parameter Display System were areas where individuals displayed weak knowledge.

A. Core Reactivity

1. Concern

An understanding and working knowledge of core reactivity changes resulting from various activities were lacking.

2. Basis

Interviews and simulator observations both disclosed deficiencies on the part of some individuals. These were in what is normally expected to be a ready part of their technical knowledge base. Examples noted during plant interviews include the following.

(1) One Unit Operator (UO) had no sense of the magnitude of core reactivity change which would result from dilution of boron by injecting fresh water. The individual did not exhibit the ability to calculate the reactivity change.

(2) Two Shift Engineers (SEs) and two Assistant Shift Engineers (ASEs) lacked familiarity with basic core and plant design parameters which impact core reactivity and which are the basis for accident recovery actions. They exhibited a "leave that to the STAs" attitude.

(3) A chemist had no conception of what boron is used for in the plant.

(4) A chemistry supervisor displayed a very limited knowledge of boron reactivity-impact and boron-system knowledge.

(5) Four chemists did not know if the reactor could go critical with control rods on the bottom and Reactor Coolant System diluted to zero boron content.

Additional examples of deficiencies noted during the simulator exercise include the following.

(6) One crew did not recognize an abnormally high boron concentration provided for the Estimated Critical

Position (ECP) calculation. This contributed to going critical (as announced by the operator), or very nearly so, below the lower rod insertion limit.

(7) STA calculations were not accurate in one case when using the doubling method for the approach to criticality. This was because he delta'd from step to step, thus building up error, instead of going back to the initial position/count rate.

(8) Immediate boration was not initiated when criticality occurred below the rod insertion limit although rods were inserted.

(9) A delay in recognizing and reporting the cause of a reactivity change was noted during a decreasing Tavg condition.

B. Safety Parameter Display System.

1. Concern

A lack of complete familiarity and appreciation for the capability of the Safety Parameter Display System (SPDS) was evident.

2. Basis

Plant personnel did not demonstrate the effectiveness of the SPDS as a working tool to enhance operations. Examples of this include the following.

(1) Several ASEs struggled with the concept of critical safety functions and with the purpose and use of the SPDS as noted above.

(2) Discussions with training personnel indicated that training for use of the system is not extensive.

(3) The use of SPDS, during the simulator training, was minimal for the most of the crews.

(4) One STA specifically reported he was not familiar with SPDS. He stated that changes had been made to the system, with which he was not familiar.

(5) There did not appear to be any uniform or consistent approach by operators, STAs or training instructors regarding the use of the SPDS during the simulator exercises.

IX. TRAINING

Training was evaluated by performance of personnel in their normal work environment, by interviews and by observations at the TVA Power Operations Training Center (POTC) Sequoyah simulator. All six plant operating crews were observed during the two INPO Assistance-visit one week training-exercises conducted in October and November 1987. Concerns exist relative to both performance and methods.

A. Diagnostic Capability of Operation Crews

1. Concern

The operating crews did not show uniformly good skills in diagnosing plant problems.

2. Basis

There were a number of cases during simulator training where the diagnostic evaluation of plant problems was less than excellent and led to incorrect responses. Examples of these include the following.

a. Observations

(1) An incorrect ECP (based on an erroneous boron concentration) was not diagnosed until the plant simulated an inadvertent criticality (or nearly so).

(2) A Loss of Coolant Accident (LOCA) was treated as more severe than actually simulated.

(3) A simulated combination of a Steam Generator Tube Rupture (SGTR) and a small LOCA was diagnosed late and as more severe than actually simulated.

(4) A case of simulated decreasing T_{av} was diagnosed late.

(5) Crews sometimes concentrated on one problem to the extent that other indications of concurrent problems were not adequately diagnosed.

(6) The Shift Engineer (SE) was observed in several cases, becoming involved in the details of one aspect of routine corrective action. This diverted his ability to maintain overall cognizance of both plant conditions and required corrective actions.

B. Maintenance Personnel Training

1. Concern

Insufficient time is being allocated each year for maintenance personnel retraining. The lack of sufficient numbers of skilled craftsmen to perform maintenance in some specialized areas is of special concern.

2. Basis

The Institute of Nuclear Power Operations (INPO) document entitled Guidelines for Training and Qualification of Maintenance Personnel INPO 86-018 (July 1986) covers continuing training in Section 16. TVA received accreditation for the instrument maintenance training programs in 1984 and for the electrical and mechanical craft training programs in April 1987. Section letters for the three craft disciplines, discuss the type of continuing training programs to be administered. These programs need management attention, however, based on the following observations of and discussions with Sequoyah personnel.

a. Interviews

(1) Most of the maintenance planners interviewed evidenced a lack of schooling in their current jobs beyond on-the-job training in Sequoyah-evolved techniques. No formal training program has been provided in the past for new maintenance planners. Some are not former craftsmen and lack craft knowledge. Others were craftsmen but lack planning skills. Periodic training is not given to provide or update these specialized skills.

(2) Planners indicated that no special training was planned for post startup needs and indicated that "we need some."

(3) A maintenance manager expressed concern that time was being taken from necessary technical training to devote to administrative training. Although the administrative training was recognized as being necessary, it cut into the available technical training time. According to the manager interviewed, only one week a year was allotted for retraining of personnel.

(4) More specialized training is required in the electrical maintenance group on the diesel generator and on the alarm-panel annunciator solid state circuitry.

(5) Priority work for restart items has preempted sending personnel for training.

(6) A lot of the administrative training (that has been done in the past two years) was required to meet restart commitments.

b. Observations of Lack of Training

(1) Two instrumentation mechanics disagreed on the proper valve sequencing to be followed in removing a differential pressure (d/p) cell from service. Removing and returning d/p cells to service is considered to be a skill-of-the-craft.

(2) An instrumentation mechanic improperly hooked up the low-pressure side of a water column to the high-pressure side of a differential pressure cell that was being calibrated.

(3) A lack of understanding of the reasons for common mode failure concerns in calibrating instrument channels is not well understood by some craft personnel. A mechanic was allowed to perform calibration work but was told by his foreman not to initial the surveillance procedure since the individual was not a member of the dedicated instrumentation crew for that channel. The lead mechanic initialed the form instead.

(4) The INPO team observed problems with electricians not being able to read the drawings needed for work on alarm annunciator problems.

The ORR Team discussions with both training and maintenance staff indicated that necessary training can be provided but has not been as effective as desirable due to the extensive plant workload. Plant management did not appear to have initiated a review of the maintenance training program to assure that defense in depth is provided in trained personnel to accomplish all maintenance tasks necessary for plant safety and availability.

C. Operations Requalification Training

1. Concern

Certain key features appear to be missing from the program used to assure that requalification training is focused toward areas of greater need.

2. Basis

a. Followup discussions concerning the apparent need for additional training in selected areas raised questions relative to determining retraining/refresher training needs. The following were specifically noted.

(1) Supervisors are asked to provide input for the continuing training program. However, knowledge deficiencies associated with other than normal operations may not come to the supervisors' attention or be remembered when providing training program input.

(2) There is no mechanism for examining crews at the beginning of requalification periods to ferret out knowledge weaknesses, identify training needs and conduct training to meet these needs.

(3) Training examinations do not have a requirement for certain questions to be answered correctly. That is, the passing criteria of 70 percent is not accompanied by a requirement to demonstrate understanding of all key knowledge areas.

(4) There is no training procedure to collect the questions not answered correctly and to reteach and retest for the areas encompassed or make a determination that coverage is not needed.

(5) Training instructors routinely do not followup in the plant to establish that trainees have had adequate retention of needed knowledge weeks/months down the line.

(6) Industry operating experience is not well incorporated into the formal training programs for operations personnel. Pertinent information about a steam generator tube rupture at a non-TVA nuclear plant had not been disseminated at the operating level two months after the event. Industry experience was not included in some simulator training exercise critiques.

b. Knowledge retention and operational application ability should be considered to be more important than grades on examinations given in a training environment. It is noted that the executive summary of a report[3] dated October 3, 1986, contained a finding that seemed pertinent to the foregoing. This was 1.2.2.8 pointing out that training efforts seemed to be directed at preparing operators to pass the NRC licensing examinations rather than demonstrating proficiency in plant operations. The same executive summary also stated that more effective line management involvement and assessment of performance is necessary to ensure that the investment in training produces the desired improvement in plant performance.

D. Monitoring and Evaluation of Standards of Operation

1. Concern

The conduct and evaluation of simulator exercises do not take full advantage of the training environment opportunity to instill proper standards of operation.

2. Basis

Many of the weaknesses in formality, communications, knowledge of plant conditions, etc. (outlined in Section I of this report) also were noted during the simulator sessions. These did not receive adequate attention during the post-drill critiques.

a. Contributing Factors

Contributing factors to the observed weaknesses may have resulted from the following.

(1) There was only one simulator instructor assigned. Much of his time was spent at the simulator console where he was unable to observe the trainees' actions.

(2) Operations supervision and management did not monitor the drill periods. Training and operations personnel both advised that management usually does not observe simulator exercises.

(3) In briefings and debriefings, particularly of the first three crews, the instructor did not adequately relate event, actions, and recovery to industry and

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3 Report to the Tennessee Valley Authority Office of Nuclear Power Regarding the Division of Training, Chattanooga, Tennessee, Westinghouse Electric Corporation, October 1986.

first-hand experiences. The opportunity was missed to have operators understand and retain important training knowledge.

b. Examples of performance weakness noted are as follows.

(1) Communications difficulties contributed or potentially contributed to operational problems, and these were not emphasized in some of the simulator session evaluations.

(2) Several cases of imprecise orders were noted. These were not always emphasized in the evaluations.

(3) Cases of informality in handling reactivity calculations were not discussed in the exercise critiques.

(4) Incidents of inattention to the panels, resulting from diversions to less important tasks, were not covered in all cases.

More precise details of the foregoing are provided in Section I of this report entitled Standards of Operations.

E. Accuracy of Simulation

1. Concern

The simulator training situation did not always correspond to a real plant situation.

2. Basis

There were some physical and procedural areas which did not accurately replicate the in-plant situation. Examples of these include the following.

(1) All five crew members were always inside the "horseshoe" control area at the simulator. In the plant control room; the SE, ASE, and STA have desks outside the "horseshoe" where they spend most of their time.

(2) The instructor allowed an STA to simulate a whole series of phone calls by simply stating once what the message would be and who would be called. The STA then took an active part in the ongoing drill. This allowed more time for him to assist the operating crew than would have been the case in a real plant situation.

(3) The estimated critical position calculations were done in a rough, back of the envelope, form without formal review

or signoff. Similar calculations made to determine an increase in boron concentration for a shutdown and cool down also were made in the same informal manner.

(4) The steam generator high-low level variance alarm band is 5 percent in the simulator. This has been reset to 7.5 percent in the plant.

(5) The plant computer program, for predicting Xenon and Samarium transients, is not available in the simulator.

(6) The times to obtain results from calls to AUOs or chemists are often shorter than they would be in practice. This occurs by the Instructor making statements such as "I just took a boron sample and obtained 1130 ppm" rather than stating that a sample would be taken and waiting a normal amount of time for the sample and titration. The temptation to compress the exercise timeframe is recognized but the simulation should remain realistic.

(7) Plant administrative requirements, using orange stickers, to label out-of-calibration or inoperative instruments, are not followed in the simulator.

F. Design and Procedure Change Requirements

1. Concern

Simulator training is not being used to the maximum potential to document the need for design or procedure changes in the plant.

2. Basis

Situations during simulator exercises were noted where there were clear signs that plant design or operating procedure changes would have been required. Examples of these include the following.

(1) One activity required subsequent to a LOCA is to switch the Residual Heat Removal (RHR) and the Containment Spray (CS) pump suctions from the Refueling Water Storage Tank (RWST) to the containment sump. The procedure for this required stopping the CS pumps while the suction line valves were repositioned. This appeared unnecessary and potentially detrimental if a pressure buildup was occurring in the containment.

(2) There was no adequate procedure available for a steam generator tube rupture casualty combined with a LOCA. The Westinghouse Owners Group has published one, but the Sequoyah plant has not incorporated it.

(3) One crew appeared to be confused about the correct sequence for opening the spray valve and energizing the heaters in order to establish flow through the pressurizer after a dilution of the plant primary coolant. The procedure was not clear.

(4) Steam dump valves cycled repeatedly during a simulated reactor startup. This continued for more than 30 minutes until enough steam was generated to keep the valves open. In the real plant, the rapid cycling of these valves would cause premature failure and need for repairs. If this is not a simulator modeling problem, there is a need for a design or procedure change.

X. RADIOLOGICAL CONTROL

A. The Radiological Control Program exhibited areas of weakness that requires continuing managerial attention.

1. Concern

Many aspects of radiological control are not at the requisite level of excellence. If radiological control management fails to continue the recent high level of attention, and if the other site and plant organizations fail to take on the radiological responsibilities that go with their jobs, then the radiological control program will not improve sufficiently to support power operations.

2. Basis

a. The attitude of radiological control technicians does not support good control of radiological work. They are reluctant to stop poor work practices. They tend to wait for outsiders to identify radiological problems. They are not fixing problems promptly and are not reacting aggressively to near misses. They have been accepting status as second-class personnel.

b. The attitude of the work force appears to be that radiological control is a necessary evil, not an integral part of their job, and is basically the responsibility of the radiological control organization.

c. Training of radiological control technicians and their foremen does not impart sufficient technical knowledge and does not ensure these personnel can handle unusual situations. For example, they do not understand the fixed radiation monitors. The extra training time available in a six-shift rotation is not planned as is done for others who need large amounts of training. Oral examinations do not address the ability to handle unusual situations, they are not given to foremen, and they are not repeated periodically for requalification.

d. Radiation workers have not received sufficient training in the practical aspects of their radiological work. Numerous examples of poor work practices have been observed.

e. Radiological control personnel are not sufficiently sensitive to their responsibilities to minimize unwarranted injury claims in such basic areas as keeping good logs.

f. Poor cooperation among radiological control, chemistry, and radioactive waste organizations contributes to radiological problems going unresolved.

g. Support of the radiological control program is particularly weak in the nuclear engineering and the modifications organizations.

h. There is no organized program to control the radiation source term which causes the bulk of the radiation exposure to workers.

. The radiological assessor position under the site director is vacant. Without this key person, management attention has not focused on the parts of the radiological control program outside the radiological control organization.

j. Contamination control practices are sloppy. Radioactive leaks are not identified and repaired promptly. Temporary hoses continue to be used for long-term service, increasing the risk of leaks. Equipment to control radioactivity widely used in good contamination control programs elsewhere is not in use.

k. Personnel leaving the plant are not required to pass through an operating portal radiation monitor. The purpose of a portal monitor is to increase the assurance of successful control of radioactive contamination within the plant.

l. Most radiological control personnel lack recent experience in an operating plant. Extra efforts to compensate for this situation have not been planned.

m. Over 3000 personnel are being monitored for radiation at the station. Efforts to make major reductions in this number are not apparent, although such reductions have been successful elsewhere. Where used, these allowed better training, supervision and radiological control coverage of the smaller radiation work force.

XI. MAINTENANCE ACTIVITIES

Review of the maintenance activities disclosed significant weaknesses in overall maintenance program efficiency. The primary cause is the lack of a defined and implemented modern maintenance management system. Dedication of significant additional resources, one time management tools (war room and concentrated management attention) along with the emphasis of special experts, review groups and corporate presence are presently precluding any significant reduction in effectiveness that could lead to operational risks.

A. Maintenance Program

1. Concern

Dedication of extra resources to compensate for existing maintenance program inadequacies may not be maintained after startup or be adequate for the new plant modes. This could adversely impact safe and reliable operations.

2. Basis

A review of maintenance documentation, interviews with maintenance personnel (from craftsman through management), observations of "war room" activities, and inplant surveillance of work approval and execution revealed many inadequacies in the basic maintenance program. Key parts of a modern maintenance program are missing or inadequately addressed (see Appendix A, Other Observations, Item 3. Thus, the program which would take over to support an ongoing plant maintenance function is known to have significant inadequacies which are outlined for the major issues as follows:

a. Inspections

There is no broad based program to conduct periodic material condition inspections. Start-up reviews are presently covering this deficiency on a system-by-system basis.

b. Planning

Instances were noted where packages were incorrectly or incompletely planned. These required the foremen or individual craftsmen to correct or to obtain the necessary corrections from others. This often involves maintenance engineers and/or planners along with impacting important war room and management startup activities.

c. Schedule

Maintenance work is scheduled on a day-to-day basis. There is no wholly integrated schedule which contains all identified work. The lack of a standards-based estimating system precludes consistent and reliable critical path scheduling and accountability. This is recognized and compensated for in the startup program.

d. Work Flow and Control

The present WR generation, review, approval, prioritization, release, implementation, and post completion testing practices are cumbersome, and time consuming. This increases the after-startup operational-risk that needed work will not be identified, will be identified but get lost/downgraded in the system, will be delayed to the point of challenging the plant's engineered safety systems, and/or frustrating operations and/or maintenance personnel. In the latter case it could result in bypassing necessary control requirements in an attempt to get work done and result in unacceptable incidents.

e. Performance Measurement

There is a lack of meaningful maintenance performance measurement and reporting practices which are needed to provide the quantitative information for raising the standards of performance. This reinforces the attitude that what is being done is good enough. The priorities for startup work and resource limitation make this acceptable in only the short term.

B. Maintenance - Operations Interface in the Control Room

1. Concern

The need for the operations control room staff to support maintenance activities, by the approval and control of work, is causing excessive distraction to the control room operators. This could cause a plant safety risk if continued during critical operations.

2. Basis

There may be several points, in processing a maintenance work request, which require the approval and/or actions to be taken by the onshift operations staff. The demands on the control room staff, during periods of extensive maintenance and modification work, reduce the effectiveness of the operators in monitoring plant operations. Major work still will be in progress on unit 1 after unit 2 restart and there will be a backlog of unit 2 post startup work. In many situations, the maintenance group is delayed, on a minute-by-minute basis, when the control room staff (for whatever reason) cannot act in a timely fashion. Other nuclear plants perform this function outside the control room.

a. Interview Data

(1) Operations personnel stated that there was general agreement that too much (maintenance support) has to be cleared by the control room for it to be fully productive.

(2) Delays in both setting hold orders and obtaining work clearances both are frustrating work accomplishment. Access delays (to the control room) are part of holdup.

(3) A maintenance manager indicated that the sign-on time for getting work started is excessive.

(4) One electrical craftsman advised that he and two other craft personnel wasted three hours in the control room area (outside the restricted area). They were waiting for the operations staff to approve a work request for job start.

b. Observation Data

(1) The plant lacks an effective method for coordinating maintenance support activities. This is needed to enhance craft productivity, maintain plant configuration control and avoid excessive distraction of the onshift operations staff.

(2) Numerous observations in the control room indicated a line of maintenance people waiting for their turn to consult with the control room operators.

(3) Considerable delays were encountered during the course of one observed job when the crew had to make frequent trips into the control room. This was to get an Assistant Shift Engineer (ASE) to sign for a change in configuration control and to come to the work site to rack out or rack in a circuit breaker. After a lunch break, it was observed that two crews were delayed 40 minutes waiting for the Unit 2 ASE to return from a plant tour to sign documents necessary to continue the

work. These observations support the frustrations expressed in the interviews.

C. Instrument Test Equipment Storage Facilities

1. Concern

The existing facilities for storing test meters and equipment in the Instrument Shop is inadequate. It does not assure that test equipment remains in a satisfactory condition to perform properly when required.

2. Basis

The Institute of Nuclear Power Operation (INPO) document (entitled Guidelines for the Conduct of Maintenance at Nuclear Power Stations) INPO 85-038 describes, in (Chapter XI), the requirements for providing proper facilities. This is to ensure that test equipment is protected from damage in storage and is properly maintained. Discussions with an instrument maintenance foreman elicited a statement that the Measuring and Test Equipment (M&TE) storage and issue room was not adequate. An inspection of the room resulted in the following observations.

a. The room is crowded and some sensitive equipment was stored on the floor reducing the walkway space.

b. There is no test bench which can be utilized to test instruments before they go out to be sure they are working properly.

c. Some equipment is out on semipermanent loan as the storage facility will not hold the present inventory.

d. Several wire mold receptacles are attached to storage shelf edges so that instrument internal batteries can be kept on charge. The profusion of cords could be considered to be a fire hazard and a significant risk to the M&TE needed to support plant operation.

D. Maintenance Training

The topic of maintenance training is covered in Section IX of this report entitled Training.

XII. SYSTEM ALIGNMENT

Effective control of the alignment of plant systems is essential for safe and reliable operations and personnel safety.

1. Concern

The practices employed for system alignment did not provide full assurance that valve and electrical lineups are correct.

2. Basis

The methodology was unnecessarily complex and did not incorporate appropriate human engineering considerations to minimize error probability. This particularly was apparent in the area of independent verification. Some observations which illustrate this basis are described below.

a. The method of splitting the systems into packages for alignment was based upon system functions rather than physical location or complete systems. Disjointed work efforts resulted. The checklists themselves had deficiencies. Difficulty was experienced in valve/switch location because the lineup sheets did not contain locations. Lineup checks, were held up to correct technical errors, e.g., the System Operation Instruction (SOI-30.7-1) Power Availability checklists for the air-conditioning compressors.

b. Multiple data entries were made to transfer results from a working copy, deviation log, configuration log, clearance logs, etc. During an interview with plant management it was stated that one of the reasons for the complexity of the system is that it has evolved over the years.

c. Valve alignments were being controlled by specially assigned Unit Operators (in a separate location) with little involvement from the Shift Engineer. In fact, the Shift Engineer and other onwatch personnel were busy with a large volume of other outage activities.

d. More than half of the discrepant items on the alignment log sheets reviewed by the ORR Team were noted as being resolved by determining that a Work Request was not entered or was improperly entered into the configuration control system.

e. The ORR team observed personnel performing the system alignments work in two-man teams doing the independent verifications by working together. The degree of independence varied between teams. Generally, a conscious attempt was being made to be independent. In some cases, it could not be established positively (by the ORR Team) that the second checker independently verified the correctness of the component. Industry experience shows that having physically separate independent verifications results in fewer misalignments. The importance of physical separation was observed by the ORR team at Sequoyah when the existing procedure resulted in a mispositioned breaker not being detected by the checker who was with the positioner.

XIII. RESTART TESTING

A Restart Testing Program was directed within Section III-11.0 of the Revised Sequoyah Nuclear performance Plan. A dedicated organization was created, staffed and operated to develop, manage and execute the Restart Test program at Sequoyah. This was intended "... to ensure that the plant has been comprehensively tested to develop management, operator, public and regulatory confidence in the operation of Unit 2."

The Restart Test Program has been in operation some time. The general activity delays at Unit 2 have allowed the Restart Test program to be virtually complete at the time of the review made by the ORR Team. It is noted that the Restart Test Program was done in conjunction and integrated with the regularly scheduled testing program.

The few remaining restart tests are subject to actual Mode 4 and Mode 3 operations. The limited field observation of actual tests did not disclose information that would indicate concern about the adequacy or accuracy of Sequoyah test activities.

XIV. PLANT RESPONSIBILITIES

The ORR Team is concerned that responsibilities for the proper material condition of plant systems, components, and structures have not been clearly delineated below upper management level personnel.

A. Lack of Accountability

1. Concern

Evidence exists that responsibility and accountability for plant systems is lacking.

2. Basis

a. Radioactive Liquid Waste System - Section IV of this report discusses numerous longstanding temporary configurations in the Radioactive Liquid Waste System. While there were "plans" to correct some of these no one below upper management could be held responsible for their continuing existence. The general comment was that only modifications required for restart are allowed and action had not been pressed further.

b. An NRC Integrated Design Inspection of the ERCW System showed that a number of system deficiencies had existed, some since initial plant operation, yet no one below upper management could be held accountable.

c. Two members of the ORR Team made a plan-in-hand inspection of the Auxiliary Feed Water System using the applicable piping and instrumentation schematic drawing. The system was traced through, component by component, looking at its externally visible condition. Some significant and numerous minor deficiencies were found. No existing WRs were found for most deficiencies identified. The conclusion reached is that no one is clearly responsible, or being held accountable, for accomplishment of inspections that reveal such deficiencies.

d. Most plant operations personnel interviewed expressed a lack of confidence that deficiencies they identify would be corrected at any time in the near future. It was apparent that these shift operators have no means to readily pursue correction of a deficiency unless it was of an emergent nature.

e. The "Daily Management Involvement in Onshift Operational Activities" program announced in early September 1987 is only an operational activities program. Team review of actual reports by managers who have performed walkthroughs, in accordance with this program, show they are not emphasizing system conditions.

f. A program for System Engineers was initiated in January 1986 with the promulgation of SQA-168. This subdivided the plant into some 92 separate systems. The responsibility for individual Systems Engineers was assigned to eight different plant organizational units. Approximately one half of the 92 systems were assigned to three sections within the Technical Support Services Group. It is apparent that this program was not effective.

g. The ORR Team understands that there are plans to strengthen the Systems Engineering function by the assignment of sufficient technical personnel and the consolidation of some functions. However, the individual systems engineers would continue in their current role as coordinators to facilitate resolution of issues affecting that system, rather than being held clearly responsible and accountable for system performance. If such a clear definition is not made, then no one will be really responsible. (See B.2.c below.)

B. Plant Ownership

1. Concern

Actions taken to implement the concept of plant "ownership" by Operations could lead to confusion as to the responsibilities of various support organizations.

2. Basis

a. Plant Ownership is intended to indicate control and a directing or restraining influence on all activities occurring in or affecting the plant. Accordingly, this is a role which correctly resides with the operators.

b. A draft revision of the Administrative Instruction (AI-30) reviewed by the ORR Team, unfortunately confuses ownership and responsibility. This revision indicates that various organizations "own" specific duties, implying the confusing concept of multiple "owners." In fact, the various organizations are responsible for specific duties, and they should be held accountable for proper performance of these duties.

c. No document (that the Team was able to find) clearly delineates functions, assignments, and responsibilities in a concise and understandable manner.

XV. INPO REPORT

A. Introduction

The TVA requested a special assistance visit from the Institute of Nuclear Power Operations (INPO) as part of the overall preparations for the startup of Sequoyah Nuclear Plant unit 2. The visit took place during October 26-30 and November 18-20, 1987. The purpose of the visit was to review activities in the operations, maintenance, and radiological protection areas with emphasis on readiness of the plant to start up. The visit included observation of simulator training, and evaluation thereof, for each of the six shift crews. The INPO report has been included as Appendices B and C to this Operational Readiness Review (ORR) Team report. The ORR Team review of the INPO report is presented herein.

The observations of the ORR and INPO teams were performed independently. In general, the INPO observations are consistent with those of the ORR Team. The ORR Team's comments on the INPO observations are discussed below and arranged according to the ORR report section topics.

B. Standards of Operation (Section I)

The INPO observations of Standards of Operation were based primarily upon the six shifts of simulator training. These reinforced the ORR team's conclusion that significant improvement is needed in this area. Specific INPO observations which support the ORR positions include (1) many instances of communications deficiencies, (2) deficiencies in handling alarms, (3) weaknesses in knowledge of plant conditions which are considered by the ORR Team to have contributed to many of the noted operational problems. The ORR Team noted weaknesses in shift turnover, control room activities, and operator rounds that were not similarly reported by the INPO Team. It should be recognized that the ORR team observations are more extensive as they extended over a substantially longer time period.

C. Procedures (Section II)

The ORR Team review of procedures focused primarily on procedural compliance, procedure quality, and plant management support in these areas. The INPO findings support and supplement the ORR Team findings. The INPO observations included a number of instances of noncompliance with both operating and maintenance procedures. Both the ORR and INPO Teams recognized that added attention is needed to ensure procedural adequacy and compliance. The INPO report highlighted concerns with the human factor aspects of various operations and maintenance procedures. INPO personnel found that many Westinghouse Owners group Emergency Response Procedures were not included in the plant emergency operating procedures. The lack of a sound technical basis for the omission is of particular significance. This finding supports the generic concern by the ORR Team that plant management does not take full advantage of the nuclear industry experience available to them for improving operations at Sequoyah.

D. Plant Administrative Control (Section VII)

Both INPO Team, and the ORR Team, were concerned about the station clearance-tagging program. The ORR team previously had identified concerns regarding physical separation of the personnel performing independent verification. The ORR Team strongly endorses the INPO recommendations in that area.

E. Technical Knowledge (Section VIII)

The INPO observations noted weaknesses in technical knowledge similar to those found by the ORR Team. This was particularly evident for shutdown margin, reactivity effects, rod control, use of doubling and plant response during normal loading and unloading of the generator. The ORR team believes that the specific training recommendations contained in the INPO report should be considered within the context of a broader approach as discussed in the ORR Report, Section IX entitled Tr ning.

F. Radiological Control (Section X)

The weaknesses noted in radiological protection by the INPO team were similar to those found by the ORR team. The lack of critical assessment of performance by supervisory personnel was clearly evident to both the INPO and ORR observers.

G. Maintenance (Section XI)

The INPO findings reinforce the ORR Team's concerns in the areas of maintenance planning, scheduling and operations support. INPO personnel listed a specific finding regarding the absence of administrative controls for nuclear instrumentation alignment data prior to restart. This has generic implications regarding other safety and critical system data availability and quality. Another INPO finding (which has generic implications) is the apparent lack of backup maintenance support in the troubleshooting of alarm annunciators. Similar problems could exist in other specialized maintenance areas.

H. Valve Alignment (Section XII)

The INPO finding that the configuration status control program is unnecessarily complicated is the same as the ORR team's conclusion.

I. Simulator (Sections I, V, VIII, IX)

There is a limited opportunity to observe simulator drills when all members of a shift are evaluated as a team. Therefore, the ORR team chose to observe the simulator training with the INPO team. The two sets of observations are consistent although independent and sometimes different in emphasis. Because of the importance of those observations in assessing readiness, the ORR team has reported its observations separately and in detail in Section I, V, VIII and IX of this report.

J. Conclusion

The INPO observations are consistent with those of the ORR team and provide additional support for the conclusions reached by the ORR team.

APPENDIX A

OTHER OBSERVATIONS

Appendix A

OTHER OBSERVATIONS

The review activities disclosed items not within a strict interpretation of the assessment charter but considered to deserve attention. These are reported as follows.

1. Several instances of gauge indicator and valve locations were noted where they were not readily accessible by personnel for routine operations. This risks personnel injury, errors, and potential operation avoidance due to the difficulty of climbing to difficult to reach locations. Consideration should be given to identifying all of these, assessing risks and taking corrective action.

2. Industry operating experience is not incorporated effectively into initial and requalification formal training programs for operations personnel. The same situation was observed in ongoing operations and simulator training. One example was the steam generator tube rupture at a non-TVA nuclear plant. This was found not to be disseminated at the operating level two months afterwards. A quick communications means should be initiated to identify and promulgate this character of information.

3. The present maintenance management system appears to be locally evolved and far behind state-of-the art. Numerous aspects of the management structure should be upgraded and people trained in the associated modern methods. Areas requiring improvement include (1) work generation, (2) work input control, (3) estimating, (4) material staging, (5) backlog management, (6) work load planning, (7) shop scheduling, (8) Productivity management, (9) work sampling, (10) job acceptance, and (11) closeout procedures. For example, the work generation system, listed as (1) above, appears to lack on effective periodic inspection system to find and collect hardware deficiencies. The general practice is to depend on operations personnel to find and tag these items. The team's review noticed several items not tagged but clearly deficient indicating that dependence on operations to do this may not not working well.

4. The condensate demineralizers have been contaminated in the past, thus any spill of resin or water from these and associated systems should be treated as potentially radioactive. A spill that occurred from a relief valve in the high crud filter system was not so treated by Operations and Chemistry personnel. Radiological Control should determine the proper radiological status of the Condensate DI building.

5. The auxiliary unit operators do not have ready access to computer terminals. They must leave their work station in order to obtain computer displayed information. As a long-range upgrade of the plant management information system, computer terminals should be considered for the major

AUO stations, e.g., Auxiliary Building, Condensate DI station, Makeup Water Treatment Building and Turbine Building.

6. The large backlog of secondary drawings awaiting updating to reflect modification or other drawing changes should be reduced as expeditiously as possible. Although the drawings maintained in the main control room (primary drawings) for operator use are redlined to reflect changes prior to distribution of the drawing revision, the secondary drawings are not. Since many maintenance activities require updated secondary-type drawings, it would be prudent to expedite the updating of these drawings.

7. The extensive number of equipment labeling problems (>650) identifed during the verification walkdown of the SOI checklists indicates that plant mangement should address the root cause of this problem and develop a corrective action plan consistent with the importance of various system to plant safety.

APPENDIX B

INPO REPORT (Forwarded Nov. 13, 1987)

INPO

President's Office
ES Dept.

Institute of
Nuclear Power
Operations

Suite 1500
1100 Circle 75 Parkway
Atlanta, Georgia 30339
Telephone 404 953-3600

November 13, 1987

Mr. Steven A. White
Manager of Nuclear Power
Tennessee Valley Authority
6N 38A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Dear ~~Mr. White~~ Steve:

This letter documents the results of INPO's special assistance visit conducted at Sequoyah Nuclear Plant during the week of October 26, 1987. The purpose of the visit was to review activities in the operations, maintenance, and radiological protection areas with emphasis on readiness of the plant to start up. Additionally, three of the six operating shift crews were observed on the simulator conducting routine operations as well as responding to emergency situations. Observation of the remaining three operating shift crews is scheduled for the week of November 16, 1987. A supplemental report addressing these activities will be forwarded at the conclusion of the observations.

The results of the visit were discussed with appropriate members of the plant staff on Friday, October 30, 1987; however, written material was not provided by the team at this briefing. In accordance with our policy, the team returned to INPO and discussed their thoughts with other experienced personnel and department management before providing recommendations in writing.

Enclosed is a copy of our team's trip report that includes recommendations for improvement. It is provided to you independent of INPO's evaluation program and is intended for assistance in enhancing nuclear plant operations.

Although our team did not identify any significant weaknesses that would preclude plant start up, key items that should be addressed prior to start up are identified in the "SUMMARY" section of the report. In addition, as recommended in the report, INPO will plan, with your support, to return for the next full evaluation of Sequoyah within three months after start up.

I hope you find the information useful. Please do not hesitate to contact me, or have your staff contact Bob Link at 404-953-5452.

Sincerely,

P. M. Beard, Jr.
Group Vice President
Evaluation & Assistance

PMBJr:mm
Enclosures (as stated)

cc/w: J. B. Waters
C. C. Mason, Jr.
D. E. McCloud
H. L. Abercrombie
L. M. Nobles
Z. T. Pate
C. K. McCoy

INPO

Institute of Nuclear Power Operations

Date: November 11, 1987

To: P. M. Beard, Jr.

From: R. W. Link

Subject: TRIP REPORT - SPECIAL ASSISTANCE VISIT TO SEQUOYAH NUCLEAR PLANT

Memorandum

Prepared by:

Reviewed by:

Approved by:

I. BACKGROUND AND PURPOSE

Mr. C. H. Fox Jr., Deputy Manager of Nuclear Power requested a special assistance visit to the Sequoyah Nuclear Plant during the week of October 26, 1987. The purpose of the visit was to review activities in the operations, maintenance, and radiological protection areas, and provide recommendations for improvement. Additionally, three of the six operating shift crews were observed on the simulator conducting routine operations, such as reactor startup, as well as responding to emergency situations. Observation of the remaining three operating shift crews is scheduled for the week of November 16, 1987. A supplemental report addressing these activities will be forwarded at the conclusion of the observations.

The team focused on unit 2 because that unit is scheduled for restart in early 1988. A list of team members is provided in Attachment A.

II. ON-SITE ACTIVITIES

An entrance meeting was held on Monday, October 26, 1987 at 10:30 a.m. to introduce team members to their plant counterparts, to identify specific areas the counterparts wanted reviewed, and to establish daily debrief times. Team members were then given plant tours and completed the day's activities by conducting material condition inspections in designated areas of unit 2.

The next three days consisted of observing ongoing plant activities, conducting interviews with plant personnel, and observing three operating shift crews in the simulator. Each crew was observed in the simulator for over five hours performing routine operations as well as responding to emergency conditions.

Counterparts were briefed by team members on a daily basis on the observations and recommendations. The observations, used as a basis for many of the recommendations, are included as Attachment B. Plant personnel contacted while conducting the observations and interviews are shown in Attachment C. A final briefing was held on Friday, October 31, 1987 where team members presented verbal recommendations to plant management.

The information used by team members in preparing for the special assistance visit is shown on Attachment D. In addition, the SRO peer evaluator was at INPO the week before the visit to review Sequoyah emergency procedures, operating procedures, and become familiar with plant administrative requirements with the other team members. Additionally, the SRO peer evaluator received observation training. TVA provided team members general employee training (GET) for unescorted access at the INPO office the week before the visit.

III. SUMMARY

The following beneficial practices and accomplishments were noted:

- The performance of each of the three operating shift crews in the simulator was above average. Additionally, the assignment of individuals to the shift crews has resulted in well balanced teams.
- Steady progress in the reduction of contaminated areas has resulted in improved equipment accessibility.
- The coating of floor surfaces has upgraded the general plant appearance and contributes to good housekeeping practices.
- Several activities, such as shift turnover, control room activities, and operator rounds, observed in the plant were performed in a generally satisfactory manner.

Key areas that need improvement prior to start up include the following:

- o Upgrade the plant start up procedures to provide clear written guidance on the use of the count rate "doubling" method and when shutdown margin needs to be calculated. Provide operator training on any changes to the procedure.
- o Review and implement contingency actions identified in the Westinghouse Owners Group emergency response guidelines that are not included in the plant emergency operating procedures unless a sound technical basis exists for exclusion. Provide licensed operator training, including simulator training, on the upgraded procedures.
- o Establish administrative controls for nuclear instrumentation alignment data used during functional checks.
- o Ensure the licensed operator special training sessions address topics such as rod control, reactivity effects, shutdown margin, use of count rate doubling, plant response during normal loading and unloading of the generator and communications in adequate depth and scope.

In summary, improvements were noted in several areas however, with the plant shutdown, the team was not able to effectively evaluate plant material condition and complex control room activities, such as diesel surveillance testing. It is recommended that a complete plant evaluation of Sequoyah be conducted shortly after the Unit 2 startup to evaluate these and other areas.

IV. DISCUSSION AND RECOMMENDATIONS FOR IMPROVEMENT

A. Operations

1. Discussion: A lack of adequate training and procedural direction on the use of the source range count rate doubling method to predict critical rod position resulted in one crew not predicting early in the startup (on

the simulator) that the reactor would go critical below the rod insertion limits. The reactor closely approached criticality before an estimated critical position (ECP) error was detected by the crew. The operators utilized source range count rate trend and startup rate indications for the decision that the ECP was in error, based on the fact that the reactor was or very near critical.

During the withdrawal of control rods, the operators stopped pulling rods only after each doubling of source range count rate and then logged the source range counts and the rod height. During the rod withdrawal, the operators were observing only the number of doublings of count rate and believed the reactor would not go critical until five to seven doublings had passed, regardless of the count rate. In addition, the continuous withdrawal of the control rods did not allow for subcritical multiplication to increase count rate and so resulted in an incorrect determination of the actual rod height where doubling occurred. This adversely affects the accuracy of the method.

Recommendation: Prior to Unit 2 startup, plant procedures for reactor startup should be revised to provide guidance on the utilization of source range counts and rod height data as a tool for predicting criticality. Additionally training should be provided for each licensed operator, senior operator and shift technical advisor to ensure correct utilization and understanding of the doubling method for reactor startup.

2. Discussion: Procedural guidance to ensure adequate shutdown margin (SDM) is not directly provided. Currently, the operator is referenced through several technical specification action requirements to locate the requirement to verify or calculate the SDM.

   Recommendation: Prior to Unit 2 startup, provide clear direction in applicable procedures that define when it is appropriate to calculate or verify SDM. Procedures should direct the operator to calculate or verify SDM whenever required by technical specifications or when the SDM is in doubt due to abnormal indications or count rate.

3. Discussion: Technical specifications requires that Mode 2 be declared when Keff is less than or equal to 0.99. Interviews with plant staff revealed that actual practice is to wait until the reactor is critical or actually supercritical to declare entry into Mode 2. At the declaration of Mode 2, the technical specification requirement for ensuring adequate SDM changes from a calculation that includes many factors, to a verification of the control rods being above the rod insertion limits (RIL). In an exercise on the simulator, operators did not take required action to immediately borate the primary system with the reactor near critical and the control rods inserted below the RIL.

   Recommendation: Redefine the administrative definition for entering Mode 2 as being when the control banks are first withdrawn. This method is utilized by many other plants to eliminate interpreting when entrance into Mode 2 occurs, and provides conservative shutdown margin determinations. In addition, clear guidance should be provided in the applicable plant procedures on the required actions to ensure safe reactivity control and adequate shutdown margin, if the reactor does go critical below the rod insertion limits.

4. Discussion: Many Westinghouse Owner's Group (WOG) emergency response guidelines (ERG) have not been implemented by the plant. For some of the ERGs, this decision was based on a determination of a low probability of occurrence. Some difficulty in writing the procedures and operator unacceptability were given as reasons for not including some of the other ERGs. In one simulator exercise, the crew was given a loss of coolant accident (LOCA) combined with a steam generator tube rupture (SGTR). Since a plant procedure for this condition does not exist, the operator tranferred directly from the SGTR emergency operating procedure (E-3) to the LOCA emergency operating procedure (E-1) without direction by the procedure. This action has been plant policy and is taught by training. During performance of E-1, the referenced procedure to cooldown the plant (post-LOCA cooldown) does not provide adequate guidance to cooldown and depressurize a plant with a LOCA and SGTR. This guidance is provided in one of the WOG ERGs that was not included by the plant.

Recommendation: Prior to Unit 2 startup, all WOG ERGs that are not included in the station emergency operating procedure (EOP) base should be carefully reviewed for implementation, unless a sound technical basis exists for exclusion. Verification, validation, and training needs to be conducted on any new EOPs resulting from this review.

5. Discussion: The configuration status control program is unnecessarily complicated. This results in performance errors in maintenance of status records. The following are program aspects that are more complicated than observed at other stations:

   a. The system alignment checklists used during an outage corresponded to equipment configurations that are more appropriate for station operation at full power. For example, when an operator closed the reactor coolant pump seal return valves to the correct shutdown alignment, he produced a deviation from the alignment checklist but did not realize he had to document the deviation.

   b. Some frequently operated valves do not have a single correct alignment. Depending on the conditions at the time, the more appropriate position may change from open to closed. However, for some of these valves, the checklist specifies a required position. The required configuration log entry is sometimes forgotten when the valve is operated. For example, the cooling water return valve for the excess letdown heat exchanger was found in a position that deviated from its checklist position without a corresponding entry in the configuration log.

   c. When a component is operated under the clearance tagging program, an entry is currently required in the configuration log. This duplication of status control information increases the probability of errors.

Recommendation: Simplify the status control program to reduce the probability of errors in status records.

6. Discussion: Several station operating procedures contain human factors deficiencies that have caused performance errors in the industry. An operating procedure writers guide, that is currently being finalized, could assist in correction of the deficiencies.

   Recommendation: Expedite the implementation of the writers guide and initiate a program for upgrading the plant operating procedures. In addition, biennial review of procedures prior to the implementation of the writers guide should include correction of the most significant human factors deficiencies.

7. Discussion: Some practices in the station clearance tagging program have led to performance errors in the industry. For example, when second person verification is required at the plant, it is normally performed by a person accompanying the person performing the manipulation. Industry experience has shown that verification by a person not accompanying the original operator is more effective in detecting performance errors. Additionally, clearance boundaries are normally defined by the assistant shift engineer. The boundaries are not normally checked by another qualified person to verify them as adequate to provide safe working conditions. Such a verification has been helpful in reducing errors in the industry.

   Recommendation: Whenever practical, require second person verification to be performed by a person not accompanying the person performing the manipulation. In addition, require a check of clearance boundaries for adequacy by a qualified person.

B. **Maintenance**

1. Discussion: Lack of control over alignment data required to perform nuclear instrumentation functional checks increases the possibility that superseded data could be used during such checks. For example, data from previous alignments and tests is needed to perform the functional check of the high level trip bistable. Data used was obtained from an uncontrolled loose leaf binder maintained in the instrumentation and control shop. This data generally consists of copies of data

sheets completed during previous tests. The plant has no requirements to ensure that the data available is the most current. Best industry practice is to maintain this data in a controlled document with administrative requirements to enter the new data immediately after it is generated.

Recommendation: Prior to the startup of Unit 2, establish administrative controls over alignment data that will ensure the data used is the most current.

2. Discussion: Nuclear instrumentation maintenance procedures contain human factor problems that can lead to performance errors. For example, the nuclear instrumentation system intermediate range functional check procedure, Step 5.3, requires the technician to select various test currents on the Operations Selector switch. A caution statement at the beginning of the step states, "If the Level Trip switch must be moved from Bypass (see note 2), do not exceed 10^{-9} range." Note 2, which is at the end of the step, provides directions on positioning the level trip switch to the normal position to allow accurate current measurements when the Operations Selector switch is in the 10^{-11} and 10^{-10} position. The note continues by directing the technician to return the selector switch to bypass after the two current readings are obtained. Several other current readings are required after the first two, and if the switch is not placed in bypass, the plant will scram. Placing action steps in a note, and having a note follow the applicable step instead of preceding the step has resulted in industry performance problems.

   Additionally, several steps that check the alignment of bistables are performed as follows:

   - Measure and record the actual bistable setpoint.

   - From previous test data, obtain the setpoint that the bistable was aligned to. (This is not recorded)

   - Calculate an allowable setpoint band by adding and subtracting the specified tolerance to the previous test data. (This is not recorded, and in practice was performed on a scratch sheet of paper by one technician and is not checked.)

The result is that the only recorded data is the "as found" setpoint of the bistable. The practice of manipulating data as done in these steps has led to human errors in the industry. Also, it is difficult to verify the acceptability of the "as found" setpoints without the previous data being present.

Recommendation: Review the maintenance department procedures for human factors problems such a those noted above. Place additional emphasis on those procedures that require the use of previous alignment data in calculations or have the possibility of causing inadvertent plant system actuation. Record all needed data, such as previous alignment data, in the procedure and require critical calculations be second-checked by another qualified technician. Place notes prior to the step in which they apply; remove action statements from notes and place them in the body of the procedure.

3. Discussion: Enhancements can be made in the craftman's sensitivity to procedural compliance. Additionally, some maintenance is performed on equipment without the knowledge or authorization of operations personnel. Problems noted included the following:

   a. During performance of a nuclear instrumentation functional check, one step of the procedure states, "Have the operator remove the following computer points from scan." The computer points were removed from scan by the instrumentation and control (I&C) technicians instead of the operators. The reactor operator was aware they were performing this step and when questioned, the technicians stated this is normal practice. One of the points, located on the technical support center (TCS) computer, was not removed from scan as required by the procedure. When questioned, the technicians stated the TSC people did not want it removed and it takes a password to access the TSC computer. The same problem occurred at the end of the procedure. Prior to the start of the check the I&C foreman mentioned to the observer that this step would not be performed. Neither the foreman nor the technician initiated a change to update the procedure.

b. Electricians were observed performing corrective maintenance on a malfunctioning annunciator. Before they could obtain operations permission to commence work, the electricians were required to wait one-half hour while shift change was completed. During this time, the electricians opened the relay cabinets and took voltage measurements and moved cables in an attempt to identify the correct inputs. The operating crew was not aware of these activities.

Recommendation: Ensure all maintenance craftsman and supervision understand plant requirements regarding procedure compliance and operator authorization prior to starting work on equipment.

4. Discussion: Craftsman knowledge in the area of annunciator circuitry and related drawings needs improvement. Examples of the problems noted during annunciator maintenance include the following:

   a. The electricians were not familiar with the drawings needed to determine the location of the potentially faulty relay cards. They stated only one person in the department was proficient in determining card location. The location of the cards in question had been determined previously and was informally noted on a 5x7 card attached to the work document. An attempt was make to verify the data, however the electricians stopped after several minutes due to their lack of knowledge and the difficulty in using the prints.

   b. The contact points to obtain the initial voltage measurements were informally noted in the work document, as a result of previous entries made by another electrician. The initial voltage measurements were taken without first verifying the correct contact points. After some uncertainty about the correctness of the contact points, the electricians obtained the prints but had great difficulty in determining the required information.

c. The shop foreman indicated that only one individual was proficient on the annunciator circuitry and that training was needed in this area.

Recommendation: Provide training to the plant electrical maintenance personnel on annunciator circuits and related drawings.

5. Discussion: Improvements are needed in the station planning and scheduling efforts. Based on interviews with selected station management and supervision, the following problems were noted:

   a. All work necessary for establishing mode 4 and beyond has not been identified. Examples of unidentified work include:

      - setpoint changes to the HVAC system
      - some support work needed for tests and surveillances
      - work resulting from remaining system walkdowns
      - resolution and potential impact of some Condition Adverse to Quality Reports (CAQR)

   b. A comprehensive schedule including all identified work has not been developed. Needed parts, tools, impact on other work, and available manpower have not been considered in determining critical path and milestone dates.

   c. Maintenance work requests are scheduled by the first line supervisors rather than by an organization that has the ability to see the overall needs and direction of the station.

   d. Duties, responsibilities, and authority are not clearly defined for all individuals and organizations. For example, the duties, responsibilities, and reporting chain of the system coordinators has not been formally issued and is not clearly understood by all involved in the process. The authority of the scheduling organization management over these individuals is not clear.

Recommendation: Upgrade the station planning and scheduling effort as follows:

a. Require each TVA organization involved in restart to identify all remaining work. Require these organizations to provide a realistic schedule for the completion of the work including assumptions used for determining the timing of needed support such as technical resolution and off-site concurrences.

b. Develop a comprehensive, credible startup schedule that includes all required work and takes into consideration manpower, parts, and other needed support.

c. Clearly define in writing, the duties, responsibilities, and authority of all individuals and organizations involved in scheduling activities.

d. Provide senior management support and oversight in the development of the schedule to ensure all organizations efforts are directed toward a common goal.

6. Discussion: Coordination between maintenance groups and operations in the execution or maintenance work request needs improvement. Examples of problems noted include the following:

   a. Delays are routinely encountered when operation authorization is needed. (Coordination efforts with other site organizations was not observed.) Examples of problems noted include the following:

      1. It took approximately one-half hour for the work on a flow control valve to be approved by the shift engineer and the unit operator. During this time period, at least six other individuals were waiting to have their work authorized.

      2. Although a nuclear instrumentation functional check was scheduled on the daily work list, and was promptly authorized by the reactor operator, a one hour delay was encountered when the assistant shift engineer was not available to authorize starting the check.

b. Coordination is hampered by a general lack of communication between groups. For example, neither the planner, the electrical foreman, nor the electricians had discussed work on an annunciator with the initiator (I&C) of a work request. As a result of the lack of communication, the sequence of events related to the work was not understood, and the task could not be completed because needed I&C support was not identified.

c. Coordination capabilities are reduced by the scheduling of maintenance work requests only one day in advance. The schedule for the day is published at 8 p.m. on the previous day and results in the performing and support groups not being fully aware of their work until they arrive. Coordination is hampered since little time is available to plan ahead. Also, much of the scheduling is performed by first level supervisors who do not have the overall perspective of what station is trying to accomplish.

Recommendation: Upgrade the coordination of work activities as follows:

a. Provide for the next day's documents to operations a minimum of 24 hours in advance. Establish a method that allows operations authorization prior to the scheduled performance and permits prompt initiation on the shift the work is to be performed.

b. Assign each task to an individual shop (and foreman if possible). Have that shop maintain responsibility for the task from beginning to end and discontinue the practice of writing multiple work requests for the same task. If support work is required, write the necessary steps into a single document, with the "owning" shop maintaining coordinating responsibilities.

c. Schedule several days in advance and provide this information to the first line supervisors. The scheduling should be performed by a group with knowledge of overall plant direction.

7. Discussion: The overhead lighting in some areas of the auxiliary building needs additional attention. Examples of inoperable lighting include the following:

   a. seven of nine lights were inoperable in charging pump room 2A-A
   b. all of the lights are inoperable at the entrance to a residual heat removal pump room
   c. three of five lights are inoperable in the valve gallery for the gas decay tanks

   It is acknowledged that higher than normal voltage is maintained at the station for unrelated reasons and may cause an unusually high failure rate of station lighting.

   Recommendation: Place additional emphasis on the replacement of overhead lighting in critical areas to ensure that adequate lighting is maintained. Review the need for maintaining the higher that normal voltage on station electrical buses.

C. Training

1. Discussion: Simulator instructor performance was observed and evaluated during 18 hours of simulator training. The content of the simulator instructor course was also evaluated. The current simulator instructor course is technically oriented. That is it is a course for teaching someone how to operate the simulator rather than how to conduct training using the simulator tool. For example, the following topics are not included in the course:

   - pre-brief/post-exercise critique techniques
   - observation/evaluation skills
   - exercise guide development

   The instructors observed demonstrated effective training techniques that should be captured in a formal instructor skills and knowledge course so new instructors can benefit from their experience.

   Recommendation: Complete development of the simulator instructor program. Establish and implement a plan with achievable completion dates to ensure the items identified above are corrected.

INPO 86-026, Guideline for Simulator Training, should be of assistance in this effort. The guideline also has sections applicable to some of the recommendations that follow.

2. Discussion: The teamwork and diagnostic skills of three operating crews were observed and evaluated on the simulator. Training personnel were interviewed and training materials for teamwork and diagnostics training were evaluated. The following items resulted from these efforts:

   a. Current plans call for a week of teamwork and diagnostics training for all crews during the 1988 requalification cycle. Based on crew performance, such a generic course of study may not be necessary. The observed crews would benefit from a focused course on communications and attention-to-detail.

   b. Teamwork and diagnostic related learning objectives are not included in simulator exercise guides although the simulator instructors did evaluate the crews in these areas. There was some inconsistency between instructors on emphasizing these skills; while one instructor stressed attention-to-detail, two other instructors did not.

   c. The diagnostic model taught to the operating crews does not include the concept of feedback. That is, the crews are not taught the concept of tracking the results of corrective or preventative actions. For example, an operator may position a switch to open a valve, and seeing the valve's red open indicating light, report that the valve is open when, in fact, the valve may still be stroking open. Feedback training would help the operator to remember to check that the valve had actually opened.

   d. The teamwork skills course does not include personnel outside the control room with the exception of the auxiliary unit operators. The concept that all plant personnel, from maintenance to personnel in the technical support center, are part of an operating team, is not discussed during the course. For example, operators are not taught to ensure that the communications loop is closed when talking to plant personnel on the telephone.

e. During requalification simulator training, a complete crew (including a shift technical advisor) is not routinely used. The observed crews and instructors all stated that using a complete crew during simulator training was beneficial.

Recommendation: Implement the following items to improve teamwork and diagnostic skills of the operating crews:

a. At the beginning of each requalification cycle, evaluate each operating crew. Use these evaluations to identify teamwork and diagnostic training needs. Conduct training tailored to these needs.

b. Incorporate teamwork and diagnostic related learning objectives, with appropriate performance standards in the simulator exercise guides and performance evaluation sheets.

c. Incorporate the feedback concept into diagnostic training.

d. Expand the scope of teamwork to include personnel outside the control room.

e. Use complete crews during all requalification simulator training.

3. Discussion: During the simulator sessions, the following crew knowledge weaknesses were noted:

a. One crew did not know why a rod control urgent alarm annunciated during efforts to align a stuck rod. The procedures did not provide guidance in this area either.

b. One crew did not associate a decreasing reactor coolant system average temperature with a build up of xenon after a down power operation.

c. One crew and the instructor did not understand the impact on shutdown margin if the reactor achieves criticality below the rod insertion limit.

d. One crew did not use count rate doubling information effectively during a reactor startup to anticipate critical rod height.

e. One crew did not account for the drop in pressurizer level that occurs when generator load is rapidly reduced due to the corresponding drop in programmed reactor coolant system average temperature.

f. All crews had some problems with communications.

Recommendation: During the special training that will be conducted prior to Unit 2 startup, include the following topics:

a. rod control
b. reactivity effects
c. shutdown margin
d. use of doubling
e. plant response during normal loading and unloading of the generator
f. communications

If the topics are already included, review the training materials for adequate depth and scope.

4. Discussion: One way to ensure that operating crews perform consistently and follow operation management's standards is for management to periodically observe and evaluate the crews during simulator requalification training. An added benefit is that operations management can assure themselves that their crews are being trained in accordance with those standards. At Sequoyah, plant management involvement has been scheduled but has not been regularly or effectively executed.

Recommendation: Improve plant management involvement in simulator training. Operating crews, including the shift technical advisor, should be periodically evaluated during each requalification cycle. The evaluation should include an assessment of crew performance and training effectiveness. Evaluation standards should be used to ensure consistent and meaningful assessments are conducted.

5. Discussion: Industry operating experience should be used to ensure that plant personnel can prevent or mitigate similar events at their plant. The simulator exercise guides used for requalification simulator training do not contain references to industry operating events. Two of the three simulator instructors did discuss an appropriate operating event during reactor startup scenarios but they did not cover the lessons learned from that event. The third instructor did not discuss any industry operating events.

   Recommendation: Incorporate industry operating events into simulator training. Consider using generic lesson plans that outline the key items the instructor should cover.

6. Discussion: Based on operator comments, the simulator configuration may not correctly reflect the reference plant configuration. For example, at the referenced plant, a pressurizer backup heater has been modified so the operators can operate it in the same manner as a control heater. Also, some operator aids are not installed on the simulator.

   Recommendation: Evaluate the simulator configuration management program to ensure that the simulator is maintained current to the reference plant. Temporary modifications that are more than six months old should be considered for implementation on the simulator. INPO 87-016, Simulator Configuration Management System, could be cf assistance in this effort.

D. Radiological Protection

1. Discussion: Radiological controls technicians at times did not provide sufficient coverage of radiological work activities to ensure radiological conditions were fully evaluated and necessary precautions adequately communicated to workers. A radiological controls technician performing a routine survey did not smear boron crystal

buildup from a leaking valve on an accessible floor area. The floor area was not in a posted contaminated zone and was found to have a contamination level of 35,000 dpm/100 cm^2. A readily accessible area was not posted as an airborne radioactivity area although personnel were working in the area in respirators and an air sample indicated airborne radioactivity conditions above station limits. Protective clothing requirements for some tasks should have been upgraded to better protect workers from possible contamination. Radiological controls technicians observing these tasks did not take action to strengthen the requirements.

Recommendation: Provide radiological controls technicians specific guidance on their responsibilities when monitoring radiological work activities. Additionally, radiological control supervisors should periodically observe such activities and critically assess the adequacy of radiological controls coverage. Incidents resulting from deficient radiological control coverage of jobs should be fully evaluated and the practices contributing to the incident promptly upgraded and communicated to all radiological control technicians.

2. Discussion: Improvements are needed in the monitoring and control of radiation exposure in high radiation areas. Five mechanical maintenance workers were performing repairs to a valve in a high radiation area with non-uniform radiation fields. Radiological controls instructions allow entry to the area by a group if they are provided with a radiation monitoring device that continuously integrates the radiation dose rate in the area and alarms when a preset integrated dose is received. The radiation monitoring device became separated from the individual performing maintenance in the area of highest dose rate for an extended time period. The location of the device would not have accurately reflected the dose to the individual working in the highest radiation field and thus would not have adequately warned him or the group that a limit was being approached. No individual in the group maintained responsibility for the monitoring device. Additionally, the radiological controls technician providing continuous coverage of the work was not aware of the location of the device, nor did he monitor the exposure workers were receiving.

Recommendation: Discontinue the practice of allowing a group to enter a non-uniform high radiation area using just one dose rate integrating device to monitor exposure. Assign a device to each individual to prevent problems such as those noted above. Additionally, require periodic monitoring of these devices and self reading pocket dosimeters.

3. Discussion: Air samples are often not taken in a manner that would accurately reflect the airborne radioactivity concentration in a worker's breathing zone. In one instance, an air sample was located too far from a worker to be considered a breathing zone air sample and the air sampler nozzle was pointed away from the work area. In another instance the air sampler was located outside the partially enclosed space where the work creating the airborne radioactivity condition was being performed.

   Recommendation: Provide radiological controls technicians with specific criteria on what constitutes a breathing zone air sample. Supervisors should monitor radiological work activities to ensure air samples are sufficient and accurately reflect airborne radioactivity conditions.

4. Discussion: The station has yet to implement formal procedures for handling hot particle contamination. Nine hot particles have been detected since June 1987 through surveys or as a result of personnel contaminations.

   Recommendation: Develop a program that addresses the control of hot particle contamination at the station. Procedures should address particle detection, dose calculations and decontamination techniques. INPO SER 18-87, Rev. 2, Radiation Exposure from Small Particles provides guidance in this area and should prove helpful in developing the program.

5. Discussion: The isotopic analysis of hot particles on the chemistry laboratory multi-channel analysis equipment could be improved. The analysis equipment has not been calibrated for a point source geometry that a hot particle would display when being counted.

Recommendation: Calibrate the multi-channel analysis equipment for a point source geometry. Implement that geometry in the system software and utilize it for isotopic analysis of all detected hot particles.

6. Discussion: Solid radioactive waste volume could be further minimized. Yellow radioactive waste bags which were destined for the waste compactor frequently contained full green poly bags inside them. Green poly bags are used throughout the radiologically controlled area for depositing uncontaminated waste. The presence of the full green bags inside the yellow radioactive waste bags indicates either radioactive waste material is erroneously placed in green poly bags or uncontaminated green poly bags are mistakenly placed in yellow radioactive waste bags.

   Recommendation: Prevent the frequent inclusion of green, radioactive waste bags in yellow radioactive waste bags. Identify the work groups contributing to the problem and take appropriate corrective action.

RWL:pr

Attachments:
A. Team Members
B. Observations
C. Plant Personnel Contacted
D. Preparations

APPENDIX C

INPO REPORT (Forwarded December 18, 1987)

A02 871221 027.

Appendix C

Institute of
Nuclear Power
Operations

Suite 1500
1100 Circle 75 Parkway
Atlanta, Georgia 30339
Telephone 404 953-3600

December 18, 1987

Mr. Steven A. White
Manager of Nuclear Power
Tennessee Valley Authority
6N 38A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Dear Mr. White:

My letter dated November 13, 1987 forwarded a trip report for the INPO visit conducted at Sequoyah Nuclear Plant during the week of October 26, 1987 that included observing control room crew performance in the simulator. The report included recommendations for improvement, and noted that the observation of the remaining three control room crews was scheduled for the week of November 16, 1987.

This letter forwards the trip report of INPO's observation of simulator training and control room crew performance of the remaining three operating shift crews on November 18, 19, and 20, 1987.

The results of the visit were discussed with appropriate members of the plant staff on Friday, November 20, 1987; however, written material was not provided by the team at this briefing. In accordance with our policy, the team returned to INPO and discussed their thoughts with other experienced personnel and department management before providing recommendations in writing.

Although our team did not identify any significant weaknesses that would preclude plant startup, key items that should be addressed prior to startup are identified in the "SUMMARY" section of the report.

If there are any questions please do not hesitate to contact me, or have your staff contact Hugo Marxer at 404-953-7593 or Bob Link at 404-953-5452.

Sincerely,

Pat

P. M. Beard, Jr.
Group Vice President
Evaluation & Assistance

PMBJr:mm
Enclosure (as stated)

cc/w: J. B. Waters
C. C. Mason, Jr.
D. E. McCloud
H. L. Abercrombie
S. J. Smith
Z. T. Pate

INPO

Institute of Nuclear Power Operations

C-3

Memorandum

Date: December 2, 1987

To: P. M. Beard, Jr.

From: R. W. Link

Subject: SUPPLEMENTAL TRIP REPORT - SPECIAL ASSISTANCE VISIT TO SEQUOYAH NUCLEAR PLANT

Prepared by:

Reviewed by:

Approved by:

I. BACKGROUND AND PURPOSE

Mr. C. H. Fox, Jr., deputy manager of Nuclear Power requested a special assistance visit to the Sequoyah Nuclear Plant during the week of October 26, 1987. The purpose of the visit was to review activities in the operations, maintenance, and radiological protection areas, and provide recommendations for improvement. During the visit three of the six control room crews were observed on the simulator conducting routine operations, as well as responding to emergency situations. A trip report documenting this week of the assistance visit was forwarded to the utility on November 13, 1987. The observation of the remaining three control room crews was conducted during the week of November 16, 1987. This supplemental report includes the simulator observation of the three control room crews and additional recommendations for improvement.

This visit focused on operating crew performance on the simulator. Team members included the following individuals:

R. W. Link	Team Manager (on-site 11/20/87 only)
L. E. Thibault	Training Evaluator
W. S. Craighill	Operations Evaluator
B. C. Williams	SRO peer evaluator (V. C. Summer, operations superintendent)

II. ON-SITE ACTIVITIES

Three control room crews were observed in the simulator over a three-day period. Each crew was observed on the simulator for over five hours performing routine operations as well as responding to emergency situations.

The supervisor, Sequoyah simulator section, the operating crew shift engineer, and the simulator instructor were briefed by team members on a daily basis. Plant personnel contacted while conducting the observation and briefings are shown on Attachment A. A final briefing was held on Friday, November 20, 1987, where team members presented verbal recommendations to plant management.

III. SUMMARY

Observation of the additional three control room crews confirmed the need for improvement in the key areas identified in the initial trip report. The performance of two control room crews observed during this trip was satisfactory. However, the performance of one crew indicated the need for improvements in the following areas prior to start-up:

- o emergency procedure use and bases
- o crew communications, with emphasis on acknowledgement of receipt of directions
- o attention-to-detail, such as verification of steam generator water level before inserting a manual scram because of a misinterpretation of bistable lights
- o providing positive leadership and direction by crew supervision

As identified in the initial trip report, plant management needs to periodically observe simulator training to identify and correct problems, and to ensure adherence to station policies and procedures.

IV. DISCUSSION AND RECOMMENDATIONS FOR IMPROVEMENT

A. Discussion: The three operating crews did not effectively use the emergency instruction foldout page and the simulator instructors did not critique the use of the foldout page. Also, two crews had difficulty using step 14 of E-1, Loss of Reactor or Secondary Coolant.

Recommendation: Review the bases of the foldout page and the appropriate sections of E-1 with all licensed personnel and instructors. Review the use of these procedures, practice them on the simulator, and ensure all personnel can use E-1 and the emergency instruction foldout page.

B. Discussion: One of the six crews observed was noticeably weaker than the other five crews in several areas. The following are examples of weaknesses noted:

1. Procedure use and procedure bases: The crew violated emergency instruction rules of usage by utilizing two emergency instructions (E-0 and E-3) concurrently. The crew also blocked a low pressurizer pressure safety injection during a small break loss of coolant exercise, although the emergency instruction did not require the block.

2. Communications: Crew members habitually did not request or provide acknowledgement of communications. Many actions were taken by the board operators without keeping the shift engineer (SE) and assistant shift engineer (ASE) informed. For example, a manual safety injection was activated and the ASE did not know it had been activated until the reactor operator (RO) started reporting equipment status.

3. Attention-to-detail: The balance-of-plant (BOP) operator did not notice a low steam generator level until the low level alarm had actuated. The shift technical advisor (STA), SE, ASE, and RO then misinterpreted the low level alarm bistable lights as the low-low level reactor trip bistable lights. After the RO mistakenly stated that they had an anticipated transient without scram (ATWS), the ASE, based on advice from the STA, directed that a manual reactor trip be inserted without verifying steam generator levels.

4. Leadership: The SE was not assertive during several situations. During a low steam generator level scenario he did not make any comments on the crew actions although the BOP operator was trying to tell the crew that he had turned the level decrease around. In another case, he let the ASE and STA spend 20-minutes determining that they were in a one hour action statement although he had told them initially that he thought they were in a one hour action statement.

Recommendation: Provide the crew training to correct the problems noted above. The training should address the following topics:

a. emergency instruction bases
b. emergency instruction rules of usage
c. conduct of operations
d. communication techniques
e. fundamentals of diagnostics, with emphasis on attention-to-detail, control panel monitoring, as well as analyzing, predicting, and tracking of plant parameters and response
f. simulator practice sessions that enforce teamwork, diagnostic fundamentals, and use of procedures

In addition, provide the SE and ASE with supervisory skills training, and include coaching and guidance from operations management on expected control room command behavior.

RWL:mm
Attachment: A. Supervisory Personnel Contacted

TRIP REPORT - SPECIAL ASSISTANCE VISIT

SEQUOYAH NUCLEAR PLANT

Supervisory Personnel Contacted

Training Management	Title
C. H. Noe	Chief, Operator Training Branch
C. T. Benton	Supervisor, Sequoyah Simulator Section
Operations Management	
J. M. Anthony	Operations Group Supervisor
Simulator Instructors	
B. C. Lake	
W. G. Payne	
P. H. Gass	
Operational Readiness Review Team	
F. Fogarty	
T. McGrath	
G. Rogers	

Operator Crews

Shift Engineers	3
Assistant Shift Engineers	3
Unit Operators	6
Shift Technical Advisors	3

ATTACHMENT A

APPENDIX D

ORR TEAM DIRECTIVE

UNITED STATES GOVERNMENT

Memorandum

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Appendix D

TENNESSEE VALLEY AUTHORITY

TO : Those listed

FROM : S. A. White, Manager of Nuclear Power, LP 6N 38A-C

DATE : August 14, 1987

SUBJECT: SEQUOYAH NUCLEAR PLANT (SQN) - OPERATIONAL READINESS REVIEW (ORR)

As discussed with you by members of my staff, you have been selected to be a member of the ORR team for SQN. The objective of the ORR team is to review for me the qualification and motivation of personnel at SQN unit 2 and the availability of necessary supporting resources for the safe and reliable testing, operation, and maintenance of the plant.

An organizational meeting will be held at 8:30 a.m. on Tuesday, August 18, 1987, in the sixth floor conference room of Lookout Place in Chattanooga. This meeting, which is to review the mission and scope of the ORR team, is intended for team members only.

S. A. White

G. Bu~~rke~~rech, EG&G, ONP, Watts Bar
F. Fogarty, EG&G, ONP, Watts Bar
P. Judd, LP 6N 38A-C
T. McGrath, ONP, Sequoyah
G. Mullee, BR 5S 168A-C
G. Rogers, LP 6N 38A-C
W. Spencer, LP 6N 38A-C
G. Toto, ONP, Watts Bar

CHF:RFH:CLB
cc: RIMS, MR 4N 72A-C
H. L. Abercrombie, ONP, Sequoyah
C. C. Mason, LP 6N 38A-C