U.S. NUCLEAR REGULATORY COMMISSION

REGION II

Docket Nos:	50-327, 50-328
License Nos:	DPR-77, DPR-79
Report Nos:	50-327/97-05, 50-328/97-05
Licensee:	Tennessee Valley Authority (TVA)
Facility:	Sequoyah Nuclear Plant, Units 1 and 2
Location:	Sequoyah Access Road Hamilton County, TN 37379
Dates:	March 24 through May 22, 1997
Inspectors:	M. Shannon, Senior Resident Inspector D. Seymour, Resident Inspector D. Starkey, Resident Inspector R. Eckenrode, Senior Human Factors Engineer
Approved by:	M. Lesser, Chief Projects Branch 6 Division of Reactor Projects

Enclosure

EXECUTIVE SUMMARY

Sequoyah Nuclear Plant, Units 1 and 2
NRC Inspection Report 50-327/97-05, 50-328/97-05

This special inspection was conducted to review the events associated with the Unit 1 inadvertent reactor coolant system (RCS) drain down on March 24, 1997. During an evolution to reduce pressurizer level to 25%, following plant shutdown, operators inadvertently drained the pressurizer and subsequently the reactor coolant system to a level approximately one to three feet below the top of the reactor head. The licensee determined that a voided reference leg (for the pressurizer level instrument being monitored), provided an erroneous indication of pressurizer level.

An apparent violation was identified for inadequate corrective actions for a 1993, Sequoyah Unit 1 inadvertent drain down event and other adverse conditions, which failed to preclude repetition of a similar event on March 24, 1997. Examples of this apparent violation included:

- The licensee did not correct the slope of the cold calibration pressurizer level indicator reference leg (Section D).
- Root cause evaluations were not performed for previous multiple backfills of the pressurizer level instrument reference legs (Section D).
- Redundant pressurizer level indications were not required to be used while draining down the pressurizer to 25% and the pressurizer level correction curve was not included in GO-7 (Section F).
- Positive inventory controls were not implemented while draining down the pressurizer to 25% (Section H).
- Operators did not limit the number of evolutions in progress while draining down the pressurizer to 25% (Section I).
- Reactor vessel level indication system (RVLIS) was removed from service while draining down the pressurizer prior to having additional level instruments available (Section J).

Instruction by the training organization on the correlation between the hot calibration and cold calibration level channels was lacking (Section K).

The 1993 loss of reference leg root cause evaluation noted that the evaluation was deficient in that it did not adequately identify the root cause. (Section M).

The licensee's IIT report identified various root causes for the event and the proposed corrective action recommendations in the report appeared to be comprehensive (Section J).

An apparent violation was identified for failure of the operators to follow SSP-12.1, Conduct of Operations. Examples of this apparent violation included:

- The shift manager did not maintain complete oversight of shift activities and the unit supervisor did not clearly inform the shift manager and outage shift manager of the decision to continue draining the RCS (Section L.1).

- The shift manager did not stabilize or limit plant conditions when a pressurizer level instrument malfunction was suspected (Section L.1).

- Operators did not promptly record accurate histories of the drain down evolutions and did not identify late log entries (Section L.2).

The lines of responsibility for the outage shift manager position were unclear (Section L.3).

I. Unit 1 Reactor Coolant System Partial Drain Down

A. Inspection Scope (40500, 71707)

The inspectors reviewed the March 23 and 24, 1997, sequence of events which resulted in an inadvertent Unit 1 reactor coolant system (RCS) partial drain down event. The inspectors also reviewed selected site procedures; Generic Letter (GL) 88-17, Loss of Decay Heat Removal, and the licensee's responses to the GL; the licensee's Incident Investigation Team (IIT) report and the corrective actions for the March 1997 event; and two related 1993 event reports for loss of inventory.

B. Event Synopsis

Following the plant shutdown for the Unit 1 Cycle 8 (U1C8) refueling outage on March 22, the pressurizer was filled in order to collapse the steam bubble and to cool the upper casing of the pressurizer. Late on March 23, with the pressurizer in a water solid condition, operations began draining the pressurizer to 25%. Draining was stopped around 2:00 a.m. on March 24, due to planned surveillance testing. When the draining was subsequently restarted around 7:00 a.m., the licensee inadvertently drained the pressurizer to less than 0%. At approximately 8:30 a.m., control room personnel terminated the drain down and commenced refilling the RCS and pressurizer. The primary cause of the inadvertent drain down was the failure of the cold calibrated pressurizer level instrument which indicated 38% when actual pressurizer level was less than 0%. This adverse condition was due to voids (partial emptying of) in the reference leg.

C. Detailed Sequence of Events

The following is the sequence of events which led to the inadvertent drain down. This listing is primarily based on information derived from the plant computer, charts and alarm printouts. It should be noted that, prior to the start of the pressurizer drain down evolution, the calibration of the pressurizer (cold calibration) level channel instrument was checked and found to be operating satisfactory.

At approximately 11:00 p.m., on March 23, 1997, the Unit 1 operators initiated drain down of the pressurizer to 25%, using Procedure 0-GO-7, Unit Shutdown From Hot Standby To Cold Shutdown.

At approximately 2:00 a.m., on March 24, the drain down of the pressurizer was halted, with the pressurizer cold calibration level channel reading 57% (736 foot plant elevation), in order to perform 1-SI-OPS-062-026.A, Loss of Offsite Power with Safety Injection - D/G 1A-A Containment Isolation Test (SI-26). At this time, the pressurizer hot calibration level channels were reading approximately 25% (723 foot plant elevation).

At approximately 6:30 a.m., the oncoming shift arrived for shift turnover and began the turnover process by reviewing plant status, reviewing control room logs and walking down the main control panels with the off-going crew.

At approximately 6:58 a.m., the unit supervisor directed the operators to restart the drain down of the pressurizer to a 25% pressurizer (cold calibration) level (723 foot plant elevation).

At approximately 7:00 a.m., the oncoming shift went to the shift manager's office for the formal shift turnover.

At 7:10 a.m., the pressurizer low level alarm (<17%) actuated (this alarm was valid; the hot calibration level is the input source to the annunciator).

At 7:12 a.m., the second pressurizer low level alarm actuated (<17%) (this alarm was valid; the hot calibration level is the input source to the annunciator).

At approximately 7:30 a.m., after the shift turnover, the oncoming shift assumed the watch.

At 7:36 a.m., the three pressurizer level instruments (hot calibration) went off scale low.

At 7:44 a.m., operators increased the drain down rate from 36 gallons per minute (gpm) to 48 gpm.

At 7:51 a.m., the plant computer was taken off line for an upgrade, so subsequent plant data was not available from the computer.

At 8:16 a.m., charging flow was increased and drain down was continued at 37 gpm.

At 8:33 a.m., operator noticed that the pressurizer (cold calibration) level channel had stopped decreasing at approximately 38% and the hot calibration level channels had dropped offscale to below 0%. In addition, the operator noted that the reactor vessel level indication system (RVLIS) was indicating approximately 92%. Charging flow was again increased, and refill of the RCS was initiated at 88 gpm.

At 8:57 a.m., the three pressurizer level instruments (hot calibration) came back on scale.

At 9:06 a.m., the first pressurizer low level alarm (>17%) cleared.

At 9:08 a.m., the second pressurizer low level alarm (>17%) cleared.

At 9:15 a.m., pressurizer level (hot calibration) returned to approximately 24%.

Following the event, the licensee determined that RCS level had drained to approximately the 708 to 706 foot plant elevation (the top of reactor vessel head is at the 709 foot plant elevation and the reactor vessel flange is at the 702 foot plant elevation). Later, the licensee

initiated refilling of the cold calibration channel reference leg, which was subsequently determined to be low by approximately 15 feet of water.

The senior resident and a resident inspector were in the control room on March 24, between 11:45 a.m. and 12:15 p.m., reviewing a different issue. Although they held discussions with shift management, the drain down event was not mentioned. Around 12:30 p.m., another resident inspector reviewed the Unit 1 control room logs and noted a late entry concerning a drain down between 7:15 and 7:45 a.m., and subsequently discussed the drain down with the control room staff. At approximately 4:00 p.m., senior licensee management briefed the inspectors on the reactor coolant system drain down and noted that an IIT would review the event in detail and provide a final report.

D. Cause of Reference Leg Voiding

Following the event, the licensee established an IIT to determine root cause(s) for the event and to recommend appropriate corrective actions. The inspectors reviewed an initial IIT report on April 11, 1997, and a final IIT Report on April 22, 1997. The report appeared appropriate, in that it detailed the root causes for the event and documented detailed recommendations for corrective actions.

The IIT identified various root causes of the March 24th event as follows: noncondensibles expanding during rapid RCS depressurization (approximately 320 psi in 30 minutes), causing displacement of approximately 182 inches of liquid in the reference leg (the licensee concluded this occurred after taking the RCS solid at approximately 325 psig and before starting the drain down from solid water conditions at approximately 30 psig); and the lack of a questioning attitude by the operating crews with respect to pressurizer level (primarily, the operating crews failed to verify the pressurizer level by using other indications while performing a critical evolution). The licensee also listed six contributing factors to this event in the areas of operator training, procedures, pre-job briefings, management oversight, misjudgment by operations, and communications.

The licensee's corrective actions included: enhancing training; revising procedures to include backfill of the cold calibration level channel reference leg post-depressurization and pre-drain down, using multiple level indications during drain down, positive inventory controls; and developing inspection plans for the instrument sensing lines.

As part of the IIT investigation, the licensee walked down the cold calibration level channel reference leg. During this walkdown, two bowed portions of tubing were identified. An approximate two inch bow was found in a five foot horizontal run between two supports. A second approximately two inch bow was found at a bent flex connection from the condensate pot to the $^{3}/_{8}$ inch reference leg sensing line tubing. The licensee subsequently repaired the bowed sensing lines. The licensee believed the bowing was caused by outage related work prior to 1988.

The licensee's IIT report stated, "It has been determined that this bowed area has existed since 1988 by reviewing 1988 sense line walkdown documentation."

The inspectors reviewed Mechanical Instruments & Controls drawing 47W600-24, Revision 13, which listed the design criteria for the cold calibration reference leg at the time of installation (when the unit was built). This drawing specified a slope of $\frac{1}{8}$ inch per foot of tubing run. The current engineering specifications for $\frac{3}{8}$ inch tubing is a slope of one inch per foot of tubing run.

The bowed horizontal runs of tubing did not meet the design slope requirements for reference leg tubing, and provided high points which could cause gas entrapment; this entrapped gas could then migrate under pressure changes and displace water from the reference leg. In 1988, the licensee inappropriately evaluated the bent piping as acceptable, therefore, the damaged piping was not corrected to meet the design requirements.

The inspectors concluded that the damaged cold calibration reference leg did not meet the original design criteria specified on Mechanical Instruments & Controls Drawing 47W600-24, Revision 13. The licensee's failure to correct the slope of the cold calibration level instrument reference leg is considered to be a failure to correct an adverse condition and is an example of an apparent violation of the requirements of 10 CFR 50, Appendix B, Criterion XVI, Corrective Action, (EEI 50-327/97-05-01).

In addition, the licensee performed numerous (greater than 10) backfills of the hot and cold calibration level indicator reference legs since the 1993 event, with some of these backfills during power operations. The inspectors noted that the licensee had not performed thorough root cause evaluation for these backfills. Inspection report 50-327, 328/96-09, Section O2.2, documented an at power backfill of the hot calibration pressurizer level reference leg on August 29, 1996. This report states, "The inspectors questioned the licensee on the necessity of backfilling the level transmitters since the reference leg is designed with a condensing pot which should ensure that the reference leg remains full." The failure of the licensee to perform adequate root cause evaluations for the multiple backfills of the reference legs is considered to be a failure to identify and correct a significant adverse condition and is an example of an apparent violation of the requirements of 10 CFR 50, Appendix B, Criterion XVI, Corrective Action, (EEI 50-327/97-05-01).

The inspectors concluded the root causes and the corrective action recommendations identified in the licensee's IIT report were good.

E. April 1993 Inadvertent RCS Drain Down and December 1993 Formation of Gas in the Reactor Head

A similar inadvertent drain down event occurred on Unit 1 at Sequoyah in 1993. The licensee established an IIT to determine the root causes for the event and to recommend appropriate corrective actions. A synopsis of the April 1993 event, and the recommended corrective actions are detailed in Section M of this report. In December 1993, an accumulation of gas in the Unit 1 reactor head and steam generator tubes resulted in erroneous RCS level indication. This event is synopsized in Section N of this report.

F. Use of Multiple Independent Level Indications

The licensee's 1997 investigation team noted that the procedure in effect, 0-GO-07, only required use of a single cold calibrated pressurizer level instrument, did not require comparisons of pressurizer hot and cold level instruments, and was considered to be deficient. A corrective action for the 1993 event was to ensure that operators were provided multiple independent level channels during drain downs. However, 0-GO-07 did not require the operators to use the redundant pressurizer level indications while draining down from 100% to 25% pressurizer level. The licensee's failure to revise the appropriate operating procedures to incorporate corrective actions from the 1993 event is an example of an apparent violation of the requirements of 10 CFR 50, Appendix B, Criterion XVI, Corrective Action, (EEI 50-327/97-05-01).

G. Pressurizer Level Correction Curve

The inspectors noted that a corrective action (pressurizer level correction curve) for the 1993 inadvertent drain down event was incorporated into 0-GO-13, Reactor Coolant System Drain and Fill Operations, but was not incorporated into 0-GO-7, Unit Shutdown From Hot Standby To Cold Shutdown, the procedure in use at the time of the March 24, 1997, inadvertent drain down.

During the 1997 event review, the inspectors noted that Appendix E, Pressurizer Level Correction Curve, was only applicable in 0-GO-13 for about the first 15 minutes of a drain down evolution. After 15 minutes, the pressurizer level instruments would be off scale low due to the drain down evolution, and the curve would have no further use. The inspectors noted that Appendix E would be applicable for days and possibly weeks while operating in accordance with 0-GO-07, Unit Shutdown From Hot Standby To Cold Shutdown. However, the curve was not included in 0-GO-07 as part of the corrective action for the 1993 event and this contributed to the March 24, 1997 drain down event. The licensee's failure to revise the appropriate operating procedures to incorporate corrective actions from the 1993 event is an example of an apparent violation of the requirements of 10 CFR 50, Appendix B, Criterion XVI, Corrective Action, (EEI 50-327/97-05-01).

H. Positive Inventory Control

The inspectors also noted that the control room operators did not implement actions for positive inventory control prior to starting the 1997 drain down evolution. A corrective action for the 1993 event was to develop and implement procedural guidance for positive inventory control. However, positive inventory control was not included in 0-GO-7, the procedure in use for draining the pressurizer. The licensee's failure to implement positive inventory controls while draining down from 100% to 25% pressurizer level is an example of an apparent violation of the requirements of 10 CFR 50, Appendix B, Criterion XVI, Corrective Action, (EEI 50-327/97-05-01).

I. Limit on Number of Ongoing Evolutions

The 1997 drain down evolution was initiated during the middle of the turnover process. Subsequent statements from the operators noted that they were focused on the performance of 1-SI-OPS-082-026.A and that there was a high level of activity in the control room. A corrective action from the 1993 IIT report was to ensure that only one significant evolution was underway at a time. However, in this case, the drain down evolution was initiated during turnover, with the operators focused on 1-SI-OPS-082-026.A, and with high activity in the control room. The licensee's failure to control the number of evolutions while draining down from 100% to 25% pressurizer level is an example of an apparent violation of the requirements of 10 CFR 50, Appendix B, Criterion XVI, Corrective Action, (EEI 50-327/97-05-01).

J. Maintaining RVLIS Operable

While the 1997 drain down evolution was in progress, operations valved RVLIS out of service, as an independent task, prior to establishing the additional shutdown level instruments. As noted in paragraph C, the operator observed RVLIS reading 92% and acted appropriately however it apparently had just been isolated. Recommendations from the 1993 IIT report were to provide multiple independent channels of reactor coolant system level instruments and to provide correlations between the cold calibrated, hot calibrated, liquid level and RVLIS instruments. Although the level instrumentation correlation was developed, it became useless when the instruments were not available. During the drain down, the liquid level gauge was not available, the pressurizer hot calibration level gauges were off scale low, the pressurizer cold calibration level gauge was indicating erroneously and was actually off scale low, and the operators valved out RVLIS, the only working reactor coolant system level gauge.

The licensee could not provide any requirement for having disabled RVLIS at this point in the shutdown. The inspectors concluded that valving RVLIS out of service, when it was the only functioning reactor coolant system level instrument, was contrary to 1993 IIT report corrective actions to provide multiple independent pressurizer level channels during drain down evolutions.

The inspectors also reviewed the corrective actions for the December 1993 accumulation of nitrogen gas in the reactor vessel event. One of the actions to prevent recurrence stated, "The utilization of RVLIS in areas other than post-accident and midloop condition will be evaluated." The inspectors reviewed the licensee's evaluation for this action. The evaluation stated that RVLIS "may be used as backups for monitoring of RCS level during drain and fill activities when the RCS level is above elevation 699,.. " and, "the relative inaccuracy of these indicators (+ or - 5 inches) restricts their usefulness during drain/fill below elevation 699 (reduced inventory). Also RVLIS is often out of service for calibration and maintenance during drain/fill activities. For these reasons, utilization of RVLIS for drain/fill activities is limited." The evaluation also stated, "RVLIS is useful (when in service) to monitor for gas buildup when the head is not vented to atmosphere." The inspectors noted that, during the inadvertent drain down on March 24, that although the head was not vented to atmosphere, RVLIS was not left in service.

Incident Investigation Report 93083311 for the December 1993 event, Section IV, Operations Performance, stated in part, "RVLIS was back in service and would have indicated the extent of the problem if observed. However, there appeared to be a lack of sensitivity both procedurally and in training to the need for RVLIS with the unit in mode 5 and depressurized. The operators depended on maintaining the pressurizer level to ensure adequate inventory."

The inspectors concluded that removing RVLIS from service during the drain down, is an example of an apparent violation of the requirements of 10 CFR 50, Appendix B, Criterion XVI, Corrective Action, (EEI 50-327/97-05-01).

K. Operator Training

The inspectors noted that the appropriate operations personnel had received training the week before this event. This training included bringing the RCS water solid and draining the pressurizer from 25% to midloop. The training did not include draining the pressurizer from solid operations to 25%; however, it did provide the graphs which correlated pressurizer hot and cold calibration level instruments.

Personnel statements indicated that several operations personnel had observed and discussed the differences between the hot calibration and cold calibration level channels prior to restarting the drain down. However, the operators concluded that the differences observed were expected (actually, hot calibration level should always read higher than the cold calibration level from 100% to 25%).

The statements indicated that some operators were confused about the correlation between the cold calibration and hot calibration level channels with the unit at cold conditions. Procedure 0-GO-13, Reactor Coolant System Drain and Fill Operations, Revision 4, included graphs

which clarified the correlation of the various pressurizer level instruments. The inspectors noted that the operators had been provided special copies of this graph prior to the inadvertent drain down. Based on the graphs provided in 0-GO-13, the inspectors noted that the pressurizer hot calibration level channels should always read higher than the cold calibration level channel until an actual pressurizer level of 21% is reached. The inspectors concluded that the operators lacked a sufficient understanding of how the pressurizer hot calibration and cold calibration level channels correlated during cold operations.

The inspectors identified that the licensee's training program did not adequately train the operators on the 1993 drain down event and the correlation of the hot and cold calibrated pressurizer level instruments.

L. Operator Performance

1. Oversight of Control Room Activities

The inspectors noted that the decision to restart the drain down evolution during the shift turnover was made by the unit supervisor. The off-going shift manager and outage shift manager were not informed that the drain down had been restarted and this information was apparently not passed along to the oncoming shift manager during their turnover. The unit supervisor stated that he informed the shift during the 7:00 o'clock shift turnover meeting that the drain down had restarted, however, the shift manager and outage shift manager were not aware of the restarted drain down evolution, and later stated that they had not been notified that the drain down had been restarted.

SSP-12.1, Conduct of Operations, Revision 16, Section 2.1 A.1. states that Operations personnel on each shift must "Be knowledgeable of those aspects of plant status relevant to their responsibilities." Section 3.1.4 B. and C. state respectively that the shift manager responsibilities include "on-shift management and oversight of all Plant Group activities to ensure safe and reliable plant operation...," and to "maintain a broad perspective of operation conditions affecting the safety of the plant as a matter of highest priority at all times." Section 3.17.2 B. states, "The shift manager, as the senior manager and resource manager, is in complete charge of shift activities." Section 3.1.5 F. lists one responsibility of the unit supervisor as "Coordinate the activities of the unit operators with other Operations and plant personnel to achieve safe, reliable, and efficient operation of the unit." The failure of the unit supervisor to inform the shift manager and outage shift manager of the decision to continue draining the RCS, and the failure of the shift manager to maintain complete oversight of shift activities is considered to be an example of an apparent violation for failure to follow SSP-12.1, Conduct of Operations, Revision 16, (EEI 50-327/97-05-02).

In addition, the oncoming shift manager noted the difference between the hot and cold calibration pressurizer level instruments, but did not take immediate action to investigate and resolve the concern. SSP-12.1, Section 3.2.7, Responses to Indications, states, in part, "When an instrument failure is suspected the following actions shall be taken to determine the true condition and to implement compensatory actions: A. Stabilize or limit plant conditions until all aspects of the instrument failure are understood and compensatory actions taken." The shift manager did not stabilize or limit plant conditions when he suspected a problem with the pressurizer level indicators. This is identified as an example of an apparent violation for failure to follow SSP-12.1, Conduct of Operations, Revision 16, (EEI 50-327/97-05-02).

2. Control Room Logs

The inspectors reviewed the control room logs and noted that the control room operators had not accurately documented the start or stop times of the two drain down evolutions. The log entries for the first part of the drain down stated, "Shutdown loop 2 RCP per 0-GO-7" and did not document the appropriate start or stop times of the first drain down evolution. At 8:25 a.m., during the subsequent recovery of pressurizer level, two log entries for the second part of the drain down were documented as follows: "Approximately at 0715 started draining RCS to 25% cold cal per 0-GO-7 based on trend recorders," and, "At 0745, noticed during drain down of PZR to 25% that the cold cal level indication at 30% stopped dropping level. Hot cal was already at 0% and indications of RVLIS appeared that they didn't coincide with cold cal indications." Based on the computer and alarm printer data, the logged drain down start time of 7:15 was determined to be in error. In addition, although the logs stated that the drain down evolution was stopped at 7:45 a.m., control room data indicated that the drain down was in progress until at least 8:16 a.m. and possibly as late as 8:33 a.m.

SSP-12.1, Conduct of Operations, Revision 16, Section 3.8.1 C., states, "An operator's narrative log should contain a narrative (story) of the plant's status as required to provide an accurate history of plant operations." Section 3.8.2 states, "Information should be promptly recorded in the logs. Delaying the recording of activities or events often leads to incomplete or inaccurate entries." Section 3.8.3 C.3. states the following information shall be recorded in at least one narrative log, "Relevant information reflecting static or changing plant conditions..." Section 3.8.5 D. states, "Late entries shall be annotated by placing the current time and the words "LATE ENTRY", followed by the time the entry should have been made, and then the entry."

The inspectors noted that the licensee's subsequent investigation of the drain down identified uncertainties with the log entry "start" and "stop" times of 7:15 a.m. and 7:45 a.m. The inspectors noted that the logged times did not correlate to the computer data, control room charts or the alarm printer. This resulted in uncertainties in the amount of

water that was drained and the minimum vessel level reached during the drain down. In addition, the inspectors noted that the entries made at 8:25 a.m. did not identify the entry as a "LATE ENTRY."

The inspectors concluded that the licensee's failure to (1) promptly record an accurate history of the two drain down evolutions in the control room logs, and (2) correctly annotate the late entries, are examples of an apparent violation for failure to follow SSP-12.1, Conduct of Operations, Revision 16, (EEI 50-327/97-05-02).

3. Human Performance Deficiencies

The inspectors also reviewed portions of the U1C8 outage schedule related to drain down, and changes to Appendix E of 0-GO-13 to be added to 0-GO-7. In addition, the inspectors performed a walkdown of the event in the control room, conducted interviews with members of both control room operations shift crews involved with the event, observed part of a drain down evolution on the control room simulator, and discussed the event with training department personnel.

The inspectors determined that two shift managers are used simultaneously during refueling outages. One is the shift manager (SM) of operations for both units. The second, the outage shift manager (OSM) is responsible for outage activities on the shutdown unit. At 7:00 a.m., on March 24, 1997, the night crew OSM had completed his personal turnover to the day crew OSM and had left the control room. When the drain down was re-initiated, the unit supervisor did not report the activity to the SM. In his interview statement, the unit supervisor indicated that he didn't think the SM would necessarily be interested in knowing about that particular outage evolution. According to another interviewee, an outage "standdown" of all groups to discuss expectations is usually held prior to each outage but did not occur this time because of time pressure. In addition, a hard copy of operations personnel duties, responsibilities and reporting requirements is usually disseminated prior to the start of an outage. This time it was received by the operations staff on March 27, 1997, five days into the outage and three days after the event.

The inspectors concluded that management expectations regarding reporting requirements for content, detail and lines of communication and authority were not clearly communicated to the staff by management or were not clearly understood by staff personnel. The lines of responsibility for the outage shift manager position were unclear.

This is the first outage in which operators were on a 12-hour shift rotation. Although the event occurred at the end of the night shift, fatigue did not appear to be a contributing factor, based on the information from interviews.

In addition, the Unit Shutdown for Hot Standby to Cold Shutdown procedure (0-GO-7) specified that pressurizer level should be decreased "--- to between 80% and 25% cold cal indication." However, this procedural requirement may become confusing in that the various pressurizer level instruments indicate in percentages but are indicating different actual pressurizer levels. The cold calibration level indication is 0% at 711 feet, RVLIS is 104% at 710 feet, cold calibration level indication is 59% when hot calibration level indication is 100%, and cold and hot calibration level indications are equal at 21%. The cold calibration level indication, hot calibration level indication and RVLIS all read in percents, but all have different level ranges between 0% and 100%, making direct comparison very difficult and may promote operator error.

M. April 1993 Inadvertent RCS Drain Down Event

NRC Inspection Report 50-327, 328/93-13 detailed an earlier inadvertent drain down event at Sequoyah. In 1993, Unit 1 was drained down in preparation for reactor vessel disassembly. This drain down event was caused by an unidentified loss of 15 feet of water from the pressurizer cold calibration level channel reference leg. In this event, the reactor vessel was drained to approximately the 701 foot plant elevation. The operators were relying on the cold calibration level channel which erroneously indicated 9% (716 foot plant elevation). At that time, the failure of the cold calibration level channel was determined to be caused by leakage past an instrument vent valve on the cold calibration level channel reference leg.

The inspectors reviewed the licensee's IIT Report for this event. The report identified the root causes for the 1993 event as follows:

- air entrapment in the cold calibration level channel reference leg (equivalent to approximately 15 feet of water, same as the 1997 event),
- comparison with other level indications was not required by the procedure to assure that instrumentation was indicating as expected,
- and the operator performed the drain down without relating the inventory transferred to an appropriate level response (positive inventory control).

The 1993 IIT Report provided corrective action recommendations listed under "Recurrence Controls and Actions," which included the following:

- provide multiple independent channels of level indication,
- ensure that only one evolution (i.e. pressurizer drain down or eduction) is underway at a time,

- have technical support provide level correlations between cold calibrated, hot calibrated, liquid level gauge and RVLIS,
- and develop provisions for positive inventory control.

The instrument vent valve which was suspected of leaking and causing the 1993 partial drain down was replaced in August 1993. One month later the licensee had to backfill the reference leg. Based on this, the licensee concluded, in the 1997 IIT Report, that the root cause of the 1993 loss of reference leg had not been adequately determined.

N. December 1993 Accumulation of Gas in Reactor Head and Steam Generator Tubes

NRC Inspection Report 50-327, 328/94-04 detailed an event where there was an accumulation of gas in the Unit 1 reactor head and steam generator tubes. Unit 1 was in Mode 5, in a refueling outage with fuel in the vessel. RCS temperature was approximately 120 °F and RCS pressure was at atmospheric. When containment pressure was increased to perform a containment integrated leak rate test, pressurizer level decreased and subsequently the licensee was required to add approximately 7000 gallons of water to the RCS. When containment pressure was decreased at the end of the test, pressurizer level increased and approximately 8000 gallons of water was drained from the RCS.

The licensee subsequently determined that nitrogen from the volume control tank had slowly come out of solution in the reactor vessel and had collected in the reactor head. The licensee determined that reactor vessel water level had been reduced to the top of the RCS hot legs, although pressurizer level indications remained steady at 60%. RVLIS had been reading accurately during this event, but had not been used. The root causes of this event were listed as insufficient knowledge of the pressurizer level instrument correlation and the lack of a questioning attitude by the operators. See Section J for a discussion of the corrective actions for this event.

II. Exit Meeting Summary

The inspectors presented the inspection results to members of licensee management at the conclusion of the inspection on May 22, 1997. The licensee acknowledged the findings presented.

The inspectors asked the licensee whether any materials would be considered proprietary. No proprietary information was identified.

PARTIAL LIST OF PERSONS CONTACTED

Licensee

Adney, R., Site Vice President
*Beasley, J., Acting Site Quality Manager
Bryant, L., Outage Manager
Fecht, M., Nuclear Assurance & Licensing Manager
Flippo, T., Site Support Manager
Herron, J., Plant Manager
*Lagergren, B., Operations Manager
*O'Brian, B., Maintenance Manager
Rausch, R. Maintenance and Modifications Manager
Reynolds, J., Operations Superintendent
*Rupert, J., Engineering and Support Services Manager
*Shell, R., Manager of Licensing and Industry Affairs
Skarzinski, M., Technical Support Manager
*Smith, J., Licensing Supervisor
*Summy, J., Assistant Plant Manager
Valente, J., Engineering & Materials Manager
*Walker, J., Operations Support Supervisor

*Attended exit interview

INSPECTION PROCEDURES USED

IP 37551: Onsite Engineering
IP 40500: Effectiveness of Licensee Controls In Identifying, Resolving, & Preventing Problems
IP 71707: Plant Operations

ITEMS OPENED

Type	Item Number	Status	Description and Reference
EEI	50-327/97-05-01	Open	Inadequate Corrective Actions for the 1993 Drain Down Event (Sections D, F, G, H, and I)
EEI	50-327/97-05-02	Open	Failure to Follow SSP-12.1, Conduct of Operations (Sections L.1 and L.2)