RAS 5892 50-390-CIVP, et al. — Licensee Exhibit 48 - Rec'd 4/24/02

INVESTIGATIVE INSERT

(X)

OIG File No. 2D135

The following investigation was conducted by Special Agent Beth B. Thomas on January 20, 1994, at Knoxville, Tennessee.

Attached are excerpts from the 1989, 1991 and 1992 Institute of Nuclear Power Operations (INPO) evaluation reports regarding findings against Sequoyah Nuclear Plant's Chemistry Program. These excerpts were furnished by Charles Kent, Radiological Control and Chemistry Manager, SQN.

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TVA Exh. 48

AJC00287

Template=SECY-028

2D-135-38 SECY-02

'CLEAR REGULATORY COMMISSION

Docket No. 50-390 Official Exh. No. TVA48

In the matter of TVA

Staff ____ IDENTIFIED ✓

Applicant ✓ RECEIVED ✓

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CHEMISTRY

RADIOACTIVE EFFLUENTS

PERFORMANCE OBJECTIVE: Radioactive effluent controls should minimize radioactivity released to the environment.

Finding (CY.6-1)

(Related to CY.6-1, 1988)

Increased efforts are needed to identify sources of liquid radioactive waste and minimize the amount produced, processed, and released to the environment. This problem was identified in 1988, but progress in reducing liquid radioactive waste has been minimal. Problems noted are as follows:

a. From October 1988 through September 1989, the station discharged over 8.2 million gallons of liquid radioactive waste. This volume is about twice the volume typically seen in other pressurized water plants. The volume discharged each month has been essentially constant.

b. Many sources of liquid radioactive waste have not been identified. Most known sources are not quantified. Radioactive liquid waste collector tanks and sump levels are not trended to identify changes in the input to the collection system.

c. Long-standing problems with the performance of the boron recovery evaporators have not been resolved. The station's inability to recover this relatively high purity water adds to the high volume of liquid radioactive waste processed and is a major source of radioactivity discharged by the station.

It is recognized that an engineering study to provide baseline information for water management has been conducted and a water processing manager has recently been assigned to develop and implement a program. However, additional efforts are needed to identify, quantify, and reduce the volume of radioactive waste and the amount of radioactivity released to the environment.

(See Appendix II, p. 8, for further details.)

Recommendation

Identify and quantify sources of liquid radioactive waste. Take action to control and minimize the volume produced, processed, and released to the environment.

identification numbers to ensure easy retrieval. Train maintenance personnel on the use of the maintenance history data base.

Response

The need to make the maintenance history data base more user friendly to properly support work planning is recognized. In 1985, the consistency and accuracy of data input was improved. Since then the loading of data has been done in a uniform manner.

In order to encourage use of historical data in maintenance planning, experienced personnel with the history and trending group are available and are now being used to support all plant staff in using the maintenance history data base. This function was established to minimize the difficulty in retrieving some of the data. Since the data entered prior to 1985 was not filed consistently and the present computer system does not support full-time use by the planning organization, the history and trending group will continue to support maintenance planners until long-term program changes are fully implemented.

The long-term program for the maintenance history data base is to acquire the automated maintenance management system (AMMS). AMMS is scheduled to be initially installed in January 1990 and available for use sometime after that date. The AMMS will incorporate into one data base the work control and maintenance history systems as well as information beneficial to scheduling and planning, such as special tools and actual man-hours.

The short-term actions already implemented and the long-term establishment of the AMMS address the examples as well as the root cause of the above finding.

Status

The new maintenance management standard was issued in October 1989 with implementation commencing on November 1, 1989. The training on retrieval of maintenance history by planners has been conducted. A computerized maintenance management system (MPAC) has been selected. The new system will begin implementation in June 1990.

CHEMISTRY

Finding (CY.1-1) (1988)

Some significant system problems that impact the chemistry program have not received sufficient management emphasis. Examples of these problems are as follows:

a. A test of unit 1 (which is in cold shutdown) post-accident sampling system (PASS) to sample reactor coolant and containment atmosphere demonstrated significant deficiencies in procedures, equipment, and technician knowledge. Because use of the PASS during normal plant operation places the unit in a limiting condition for operation, the unit 2 PASS was not tested. Current station plans include a two-year goal to modify the PASS so routine sampling and analyses can be performed without the necessity to enter a limiting condition for operation.

b. Main condenser air in-leakage in unit 2 is currently about 45 standard cubic foot per minute (SCFM), about six times the industry median value for pressurized water reactors. This problem was identified in 1984. Although work is in progress to identify and repair leaks, the unit action plan dated July 12, 1988 has no expected date for achievement of the less than 10 SCFM goal.

c. Longstanding problems with chlorination of the essential raw cooling water (ERCW) system have caused the residual chlorine to frequently be below the specified limit. Installation of a new chemical addition system has been delayed because the pipe necessary for installation has not been received. In addition, sample points are provided on only two of four system headers. Samples of all headers are needed to verify the proper distribution of the additive.

d. Oxygen levels in the unit 2 primary water storage tank (PWST) are 2000 to 3000 parts per billion (ppb). The plant's specification for oxygen in makeup water to the reactor coolant system is less than 100 ppb. This condition has existed since 1982. A design change request written July 8, 1988, to correct this problem lists a desired installation date of March 1989. Adding oxygenated makeup water increases general corrosion in the reactor coolant system.

e. Frequent additions of highly concentrated chemicals are made to the component cooling system because of an ineffective chemical addition system and excessive system leakage. Replacement heat exchangers needed to correct system leakage have been on site since the end of 1985, but have not been installed. Installation is scheduled to occur during the unit 2 outage (March 1989). The chemical addition problems will be corrected by installing a permanent addition system. This modification was initiated by Field Change Request (FCR) 6454 in October 1987. The scheduled design completion date of June 1988 has been delayed to September 1988 with installation scheduled for March 1989.

f. During operation, the auxiliary boiler pH, conductivity, and hydrazine values are frequently out of specification as a result of an inadequate chemical addition system. FCR 6562 was written to correct this problem. However, currently it is on indefinite hold.

Recommendation

Increase management emphasis to correct long-term chemistry problems such as those described above. Periodically follow up to verify that the implementation of corrective action is progressing satisfactorily and that corrective action produces lasting results.

Response

Increased management emphasis is being placed on the Sequoyah chemistry program to ensure correction of significant system problems. The increased emphasis is documented in the Chemistry Improvement Program (CIP), which was presented to the plant manager and approved in August 1988. The CIP defines actions necessary to correct the concerns identified above as well as other TVA concerns. Implementation of the CIP requires periodic follow-up by the plant chemistry organization and reports to the plant manager to ensure satisfactory progress and lasting results.

The specific examples cited above are being addressed as follows:

a. Action to correct problems in the post-accident sampling system (PASS) in the areas of equipment, procedures, and technical knowledge have been identified and scheduled as part of the CIP. Equipment upgrades are projected to be complete by April 1989 for unit 2 and March 1990 for unit 1. Applicable PASS procedures have been reviewed and necessary changes will be incorporated by October 1988. Necessary training to upgrade technician knowledge has been determined and will be incorporated in the required training program by April 1989. Periodic follow-up of efforts to establish and maintain an effective PASS program will be conducted.

b. Testing and maintenance efforts as of September 1988 have reduced condenser in-leakage to less than 10 standard cubic feet per minute (SCFM) requiring only one of three condenser vacuum pumps to be in service. Condenser exhaust flows are being trended via recorders to correlate measured flow rates to any plant transient or equipment operation. In-leakage values are being reported and discussed daily in the plant manager's morning meeting. Work is continuing to seal all identified in-leakage paths that can be sealed with unit 2 in operation and to quantify exhaust flow rates that are measured but are not part of condenser in-leakage (e.g., vacuum pump seal leakage). Other identified leak paths will be sealed during the unit 2, cycle 3 refueling outage or during a forced outage of sufficient duration. Lessons learned during unit 2 startup and operation are being applied to unit 1 to minimize condenser air in-leakage and improve the accuracy of the in-leakage measurement.

c. The Essential Raw Cooling Water (ERCW) chemical addition skids and sample points were installed in August 1988.

d. Design change request (DCR) 2701 (submitted July 8, 1988) to install a nitrogen blanket system on each primary water storage tank (PWST) remains on schedule to be completed by April 1989. This modification is expected to reduce PWST oxygen levels to less than 100 parts per billion (ppb). Water from the PWST is normally sprayed into the volume control tank, which is pressurized with hydrogen, before it enters the reactor coolant system. As a result, oxygen levels in the reactor coolant system are normally below detectable levels of 10 ppb.

e. Field change request (FCR) 6454 to install the new chemical feed system for the component cooling system (CCS) heat exchangers is scheduled to be completed by April 1989.

f. FCR 6562 to install a new chemical feed system for the auxiliary boilers is scheduled for completion by September 1989.

Status

Design change request 3250 has been initiated to resolve PASS design deficiencies and improve system reliability. The design change request is scheduled to be worked and completed after refueling outages on both units.

Design change request 2701 to install a nitrogen blanket on each primary water storage tank is scheduled for completion as a part of the 1991 budget process.

Replacement of the two remaining component cooling water system heat exchangers is scheduled for unit 1 cycle 4 and unit 2 cycle 4 refueling outages.

All other items are complete.

Finding (CY.3-1) (1988)

The post-accident sampling system is not reliable due to equipment deficiencies, procedure deficiencies, and the lack of proficiency of some chemistry technicians. Also, plant personnel indicated that having to enter a limiting condition of operation to operate the system hampers the ability to train personnel on the system.

a. The following are examples of equipment deficiency problems:

   1. The position indication for the reactor coolant supply flush valve (FSV-43-311) was inoperable. Verification that this valve is shut is a prerequisite for initiating a post-accident sample.

   2. Ventilation damper FCO-31-480 did not operate, preventing adequate ventilation at the post-accident sample panel. The indication used to verify ventilation effectiveness has been out of service since December 1, 1987.

   3. Chloride analysis was not performed because the in-line instrument used for this analysis did not produce a stable baseline.

   4. The remote tool used to install the degassed sample collection vial was missing a guide pin required for proper positioning of the sample vial on the needle.

   5. Leaks in the gas samplers caused 1/2-hour delays to replace the samples on each of two attempts to sample containment gases.

   6. The gas analyzer chart recorder was moving erratically which could cause difficulty in evaluating sample data.

b. Technicians were not familiar with equipment arrangement nor with requirements of the procedures. The following problems were noted:

   1. The technicians had to search for valves called out in the procedure for liquid sample system and ventilation system alignment.

2. One technician was not sure how to proceed when the ion chromatograph used for the chloride analysis failed to obtain a stable baseline and when the gas samples failed to hold vacuum.

3. Procedure steps were omitted by one technician resulting in an inability to establish purge flow for the liquid sample. About a 10-minute delay occurred while the technician got advice from the supervisor and discovered that a valve was not in the proper position.

4. One technician was not familiar with collection of an undiluted sample or the system flow path when this sample is collected.

5. Technicians could not state expected radiation levels during operation of the post-accident sampling system under any accident conditions.

c. The following procedural problems were noted:

1. A total of three pages were missing from verified copies of the different procedures used by the technicians. As a result, one technician missed an important gas analyzer calibration step and had to be prompted by the observer that the page was missing.

2. The procedure valve check list used for initial liquid sampling system valve lineup is incomplete. For example, the inlet valves from the four sample points are not included. As a result, back flow occurred from the residual heat removal system through the hot leg sample valve. This condition could result in difficulty obtaining the necessary sample flow due to an insufficient pressure drop.

3. A differential pressure reading of 18-22 inches of water required by the procedure to achieve proper sampling system flow was not obtained. In most cases, a maximum of 10 to 15 inches was attainable. No exception is specified to this requirement in the procedure and a procedure change had not been written to address this even though the requirement cannot routinely be met.

4. The procedure does not contain acceptance criteria for agreement between post-accident

samples and grab samples to periodically verify that accurate data are obtained.

Recommendation

Upgrade the reliability of the post-accident sampling and analysis system. Improve the procedure and provide effective training for chemistry technicians by providing regularly scheduled practice on a properly operating unit.

Response

A Chemistry Improvement Program (CIP) has been defined, that addresses the equipment, procedures, and technician knowledge concerns identified above. The specific examples are addressed below:

a. The post-accident sampling system (PASS) is capable of performing its intended function as verified by a July 1988 performance of surveillance instruction SI-487, "Sentry Post-Accident Sampling System Operability Verification and Calibration." The specific equipment findings have been corrected as follows:

1. Position indication for the reactor coolant supply flush valve was corrected during the INPO evaluation.

2. The unit 1 ventilation damper is being repaired under work request B789754.

3. A stable baseline has been achieved and chloride analysis is now being performed.

4. The remote tool for installing the degassed sample collection vial has been repaired.

5. Leaks to the gas samplers have been identified and corrected.

6. The problem with the gas analyzer was caused by misalignment of the chart paper and has been corrected.

Each item above was also identified on unit 1 and performance has been or is being corrected as part of the required performance of SI-487.

b. Necessary training to upgrade technician knowledge as noted above, will be incorporated in required training by April 1989. Technicians will be provided with the upgraded training during the continuing training program by June 1989. Also, post-accident sampling training is being conducted one week per year for technicians qualified to operate the post-accident sampling system for theory and practice. One day per quarter each post-accident sampling team member performs proficiency sampling and analysis using the post-accident sampling system.

c. SI-487, technical instruction TI-66.1, "Post-Accident Sampling and Analysis Methods for the Sentry Post-Accident Sampling System," and TI-66.2, "Sentry Post-Accident Sampling Equipment Training and Test Results Comparison," have been reviewed and appropriate changes to upgrade these procedures and address the specific examples noted above will be completed by October 1988.

Status

Design change request 3250 has been initiated to resolve PASS design deficiencies and improve system reliability. The design change request is scheduled to be worked and completed after refueling outages on both units.

All other items are complete.

CHEMISTRY

CHEMISTRY CONTROL

PERFORMANCE OBJECTIVE: Chemistry controls ensure optimum chemistry conditions during all phases of plant operation.

Finding (CY.2-1)

A number of chemicals that are potentially harmful to personnel and plant systems are left uncontrolled in plant areas. Examples of problems include the following:

a. Many containers were observed throughout the plant without the station labels required by procedure SQA 181, "Hazardous Material Control." The labels are intended to provide users with important information regarding chemical safety precautions for handling and disposal requirements, and restrictions on contact with reactor coolant and stainless steel. Chemicals found in the plant include 1,1,1-trichlorotrifluoroethane, concentrated inorganic acids, and organic lubricants. Elevated levels of chemical impurities such as chlorides, fluorides, and sulfates can result when these chemicals enter plant systems.

b. Many chemicals were noted unattended without labels or identification in several areas. The containers held liquids and solids where the level of hazard to personnel or plant equipment could not be determined.

c. Procedure SQA 181 describes some limitations on use of chemicals with reactor coolant and stainless steel. The procedure does not address limitations or precautions on use of chemicals for other plant systems or materials such as steam generator tubes of Inconel 600 or feedwater heater tubes of copper-nickel. As a consequence, station personnel were not familiar with many appropriate limitations to protect plant systems.

Recommendation

Ensure that station chemicals are properly labeled and controlled to prevent inadvertent exposure of plant personnel and systems to the effects of harmful chemicals. Establish a comprehensive and effective chemical control procedure, and inform plant personnel of the requirements for proper adherence. Periodically assess the overall effectiveness of the program, and take prompt action to address identified problems.

Response

The three concerns identified in the finding relating to chemical traffic control indicated a potential programmatic problem. In response to these concerns, plant areas have been inspected, and containers of materials that were not properly attended or labeled have been removed. A weekly walkdown by the chemical traffic control coordinator is now being conducted as an integral part of an ongoing surveillance program, and significant improvements have been noted.

In addition, enhanced procedures for the control and use of chemicals have been developed and will be implemented by October 1991. The procedures will address controls to prevent introduction of chemicals into systems other than the reactor coolant system and for chemicals that come in contact with stainless steel. Site personnel and their first-line supervision who procure, use, or dispose of applicable chemicals will be trained on the requirements of the enhanced program by October 1991.

An approved list of chemicals is under development that will limit the total number of chemicals allowed on site and provide readily accessible use information for those approved. A regimented approval process for bringing a new chemical on site has been implemented, and the approved chemical list will be complete by October 1991.

A follow-up self-assessment will be performed by the end of the calendar year, and an independent evaluation of the program will be conducted during the first quarter of calendar year 1992 to ensure compliance with applicable guidelines and requirements. The results of these evaluations will be provided in the six-month status report.

Status

Of 91 operations surveillance instructions, 26 are approved for use and 47 have been drafted. Of 547 technical support surveillance instructions, 357 are approved for use and 138 have been drafted. Of 1,052 maintenance surveillance instructions, 650 are approved for use and 243 have been drafted. The actual number of final instructions will vary slightly as some instructions are combined, divided, or eliminated. The station's current estimate of the Surveillance Instruction Upgrade Program completion is September 1991.

STATUS OF PAST FINDINGS

CHEMISTRY

Finding
(CY.1-1)
(1989)

Some significant system problems that impact the chemistry program have not received sufficient management emphasis. Examples of these problems are as follows:

a. A test of unit 1 (which is in cold shutdown) post-accident sampling system (PASS) to sample reactor coolant and containment atmosphere demonstrated significant deficiencies in procedures, equipment, and technician knowledge. Because use of the PASS during normal plant operation places the unit in a limiting condition for operation, the unit 2 PASS was not tested. Current station plans include a two-year goal to modify the PASS so routine sampling and analyses can be performed without the necessity to enter a limiting condition for operation.

b. Main condenser air in-leakage in Unit 2 is currently about 45 standard cubic foot per minute (SCFM), about six times the industry median value for pressurized water reactors. This problem was identified in 1984. Although work is in progress to identify and repair leaks, the unit action plan dated July 12, 1988 has no expected date for achievement of the less than 10 SCFM goal.

c. Longstanding problems with chlorination of the essential raw cooling water (ERCW) system have caused the residual chlorine to frequently be below the specified limit. Installation of a new chemical addition system has been delayed because the pipe necessary for installation has not been received. In addition, sample points are provided on only two of four system headers. Samples of all headers are needed to verify the proper distribution of the additive.

d. Oxygen levels in the Unit 2 primary water storage tank (PWST) are 2,000 to 3,000 parts per billion (ppb). The plant's specification for oxygen in makeup water to the reactor coolant system is less than 100 ppb. This condition has existed since 1982. A design change request written July 8, 1988, to correct this problem lists a desired installation date of March 1989. Adding oxygenated makeup water increases general corrosion in the reactor coolant system.

e. Frequent additions of highly concentrated chemicals are made to the component cooling system because of an ineffective chemical addition system and excessive system leakage. Replacement heat exchangers needed to correct system leakage have been on site since the end of 1985, but have not been installed. Installation is scheduled to occur during the Unit 2 outage (March 1989). The chemical addition problems will be corrected by installing a permanent addition system. This modification was initiated by Field Change Request (FCR) 6454 in October 1987. The scheduled design completion date of June 1988 has been delayed to September 1988 with installation scheduled for March 1989.

f. During operation, the auxiliary boiler pH, conductivity, and hydrazine values are frequently out of specification as a result of an inadequate chemical addition system. FCR 6562 was written to correct this problem. However, currently it is on indefinite hold.

Recommendation Increase management emphasis to correct long-term chemistry problems such as those described above. Periodically follow up to verify that the implementation of corrective action is progressing satisfactorily and that corrective action produces lasting results.

Response

Increased management emphasis is being placed on the Sequoyah chemistry program to ensure correction of significant system problems. The increased emphasis is documented in the Chemistry Improvement Program (CIP), which was presented to the plant manager and approved in August 1988. The CIP defines actions necessary to correct the concerns identified above as well as other TVA concerns. Implementation of the CIP requires periodic follow-up by the plant chemistry organization and reports to the plant manager to ensure satisfactory progress and lasting results.

The specific examples cited above are being addressed as follows:

a. Action to correct problems in the post-accident sampling system (PASS) in the areas of equipment, procedures, and technical knowledge have been identified and scheduled as part of the CIP. Equipment upgrades are projected to be complete by April 1989 for Unit 2 and March 1990 for Unit 1. Applicable PASS procedures have been reviewed and necessary changes will be incorporated by October 1988. Necessary training to upgrade technician knowledge has been determined and will be incorporated in the required training program by April 1989. Periodic follow-up of efforts to establish and maintain an effective PASS program will be conducted.

b. Testing and maintenance efforts as of September 1988 have reduced condenser in-leakage to less than 10 standard cubic feet per minute (SCFM) requiring only one of three condenser vacuum pumps to be in service. Condenser exhaust flows are being trended via recorders to correlate measured flow rates to any plant transient or equipment operation. In-leakage values are being reported and discussed daily in the plant manager's morning meeting. Work is continuing to seal all identified in-leakage paths that can be sealed with Unit 2 in operation and to quantify exhaust flow rates that are measured but are not part of condenser in-leakage (e.g., vacuum pump seal leakage). Other identified leak paths will be sealed during the Unit 2, cycle 3 refueling outage or during a forced outage of sufficient duration. Lessons learned during Unit 2 startup and operation are being applied to

Unit 1 to minimize condenser air in-leakage and improve the accuracy of the in-leakage measurement.

c. The essential raw cooling water (ERCW) chemical addition skids and sample points were installed in August 1988.

d. Design n change request (DCR) 2701 (submitted July 8, 1988 to install a nitrogen blanket system on each primary water storage tank (PWST) remains on schedule to be completed by April 1989. This modification is expected to reduce PWST oxygen levels to less than 100 parts per billion (ppb). Water from the PWST is normally sprayed into the volume control tank, which is pressurized with hydrogen, before it enters the reactor coolant system. As a result, oxygen levels in the reactor coolant system are normally below detectable levels of 10 ppb.

e. Field change request (FCR) 6454 to install the new chemical feed system for the component cooling system (CCS) heat exchangers is scheduled to be completed by April 1989.

f. FCR 6562 to install a new chemical feed system for the auxiliary boilers is scheduled for completion by September 1989.

Status

Design change request 3250, phase 1, for the post-accident sampling systems, has been completed. Phase 2 is scheduled for June 1991 completion. Completion of project design and implementation under PCN 0608 is scheduled for November 1992.

Design change request 2701 to reduce dissolved oxygen concentration in the primary water tanks to below 100 parts per billion is undergoing further evaluation. Progress of the evaluation will be provided in the six-month status report.

Replacement of component cooling water heat exchanger A is scheduled for the Unit 1 October 1991 refueling outage under PCN 0454.

Auxiliary boiler chemical feed improvements are being addressed through FCR 6562, which is scheduled for implementation by April 1992.

All other items are complete.

Finding (CY.3-1) (1989)

The post-accident sampling system is not reliable due to equipment deficiencies, procedure deficiencies, and the lack of proficiency of some chemistry technicians. Also, plant personnel indicated that having to enter a limiting condition of operation to operate the system hampers the ability to train personnel on the system.

a. The following are examples of equipment deficiency problems:

1. The position indication for the reactor coolant supply flush valve (FSV-43-311) was inoperable. Verification that this valve is shut is a prerequisite for initiating a post-accident sample.

2. Ventilation damper FCO-31-480 did not operate, preventing adequate ventilation at the post-accident sample panel. The indication used to verify ventilation effectiveness has been out of service since December 1, 1987.

3. Chloride analysis was not performed because the in-line instrument used for this analysis did not produce a stable baseline.

4. The remote tool used to install the degassed sample collection vial was missing a guide pin required for proper positioning of the sample vial on the needle.

5. Leaks in the gas samplers caused 1/2-hour delays to replace the samples on each of two attempts to sample containment gases.

6. The gas analyzer chart recorder was moving erratically which could cause difficulty in evaluating sample data.

b. Technicians were not familiar with equipment arrangement nor with requirements of the procedures. The following problems were noted:

1. The technicians had to search for valves called out in the procedure for liquid sample system and ventilation system alignment.

2. One technician was not sure how to proceed when the ion chromatograph used for the chloride analysis failed to obtain a stable baseline and when the gas samples failed to hold vacuum.

3. Procedure steps were omitted by one technician resulting in an inability to establish purge flow for the liquid sample. About a 10-minute delay occurred while the technician got advice from the supervisor and discovered that a valve was not in the proper position.

4. One technician was not familiar with collection of an undiluted sample or the system flow path when this sample is collected.

5. Technicians could not state expected radiation levels during operation of the post-accident sampling system under any accident conditions.

c. The following procedural problems were noted:

1. A total of three pages were missing from verified copies of the different procedures used by the technicians. As a result, one technician missed an important gas analyzer calibration step and had to be prompted by the observer that the page was missing.

2. The procedure valve check list used for initial liquid sampling system valve lineup is incomplete. For example, the inlet valves from the four sample points are not included. As a result, back flow occurred from the residual heat removal system through the hot leg sample valve. This condition could result in difficulty obtaining the necessary sample flow due to an insufficient pressure drop.

3. A differential pressure reading of 18-22 inches of water required by the procedure to achieve proper sampling system flow was not obtained. In most cases, a maximum of 10 to 15 inches was attainable. No exception is specified to this requirement in the procedure and a procedure change had not been written to address this even though the requirement cannot routinely be met.

4. The procedure does not contain acceptance criteria for agreement between post-accident samples and grab samples to periodically verify that accurate data are obtained.

Recommendation Upgrade the reliability of the post-accident sampling and analysis system. Improve the procedure and provide effective training for chemistry technicians by providing regularly scheduled practice on a properly operating unit.

Response A Chemistry Improvement Program (CIP) has been defined, that addresses the equipment, procedures, and technician knowledge concerns identified above. The specific examples are addressed below:

a. The post-accident sampling system (PASS) is capable of performing its intended function as verified by a July 1988 performance of surveillance instruction SI-487, "Sentry Post-Accident Sampling System Operability Verification and Calibration." The specific equipment findings have been corrected as follows:

1. Position indication for the reactor coolant supply flush valve was corrected during the INPO evaluation.

2. The unit 1 ventilation damper is being repaired under work request B789754.

3. A stable baseline has been achieved and chloride analysis is now being performed.

4. The remote tool for installing the degassed sample collection vial has been repaired.

5. Leaks to the gas samplers have been identified and corrected.

6. The problem with the gas analyzer was caused by misalignment of the chart paper and has been corrected.

Each item above was also identified on unit 1 and performance has been or is being corrected as part of the required performance of SI-487.

b. Necessary training to upgrade technician knowledge as noted above, will be incorporated in required training by April 1989. Technicians will be provided with the upgraded training during the continuing training program by June 1989. Also, post-accident sampling training is being conducted one week per year for technicians qualified to operate the post-accident sampling system for theory and practice. One day per quarter each post-accident sampling team member performs proficiency sampling and analysis using the post-accident sampling system.

c. SI-487, technical instruction TI-66. 1, "Post-Accident Sampling and Analysis Methods for the Sentry Post-Accident Sampling System," and TI-66.2, "Sentry Post-Accident Sampling Equipment Training and Test Results Comparison," have been reviewed and appropriate changes to upgrade these procedures and address the specific examples noted above will be completed by October 1988.

Status

Design change request 3250 has been initiated to resolve PASS design deficiencies and improve system reliability. The design change request is scheduled to be completed after the next refueling outages on both units.

All other items are complete.

Finding
(CY.6-1)
(1989)

(Related to CY.6-1, 1988)

Increased efforts are needed to identify sources of liquid radioactive waste and minimize the amount produced, processed, and released to the environment. This problem was identified in 1988, but progress in reducing liquid radioactive waste has been minimal. Problems noted are as follows:

a. From October 1988 through September 1989, the station discharged over 8.2 million gallons of liquid radioactive waste. This volume is about twice the volume typically seen in other pressurized water plants. The volume discharged each month has been essentially constant.

b. Many sources of liquid radioactive waste have not been identified. Most known sources are not quantified. Radioactive liquid waste collector tanks and sump levels are not trended to identify changes in the input to the collection system.

c. Long-standing problems with the performance of the boron recovery evaporators have not been resolved. The station's inability to recover this relatively high purity water adds to the high volume of liquid radioactive waste processed and is a major source of radioactivity discharged by the station.

It is recognized that an engineering study to provide baseline information for water management has been conducted and a water processing manager has recently been assigned to develop and implement a program. However, additional efforts are needed to identify, quantify, and reduce the volume of radioactive waste and the amount of radioactivity released to the environment.

Recommendation Identify and quantify sources of liquid radioactive waste. Take action to control and minimize the volume produced, processed, and released to the environment.

Response A contracted study to identify and quantify liquid radwaste sources has been ongoing. Results are scheduled to be issued by February 1990. When this has been completed, corrective maintenance or modifications will be performed to minimize identified leakage sources, and trending will be used to monitor and maintain leakage to a minimum. Acoustic flow monitors or sightglasses will be installed on the drain headers to the floor drain collector tank by June 1990 to aid in determining leakage sources. In addition, a water balance procedure will be fully implemented by April 1990. This procedure will include a "leakage hunt" section with a method to determine water sources.

A Radwaste Improvement Task Group (RITG) is evaluating improvements to liquid radwaste/water processing equipment and programs for waste reduction. RITG recommendations will be used to develop an action plan by September 1990. The status of action plan development and implementation will be discussed in the six-month status report.

Several problems with the boron recovery evaporators are expected to be resolved during fiscal year 1991 with the implementation of the modifications identified by TVA and Westinghouse to prevent system leakage. These modifications have been implemented at Sequoyah's sister plant, Watts Bar.

Status Liquid radioactive waste average flowrate has been reduced from about 15 gallons per minute (gpm) total for both units to about 13 gpm. Contract MA-44955B to install acoustic monitors on inlets to the floor drain collector tank is awaiting implementation. Design change requests 2172, 2327, 2328, and 2864 have been developed to install instrument panel drain line sightglasses, reroute condensate demineralizer waste evaporator (CDWE) steam traps and moisture separator liquids, and install reactor water storage tank rain runoff skirts. Design change requests are in development for installation of drain lines from the outlet of valves 0-SV-12-524 and 525 to the evaporator condensate drain tanks, for installation of manual isolation valves on the auxiliary steam header and CDWE, and for capping the steam supply to the waste and auxiliary waste evaporators. Unit 1 items are scheduled to be accomplished by October 1991, and the other items above by April 1992.

All other items are complete.

OPERATING EXPERIENCE REVIEW

Finding (OE.2-1) (1989)

The station's programs for identifying the root causes of operational events and implementing corrective actions have not been sufficiently effective in preventing repeat events and component failures. The following problems were noted:

a. Design changes required in response to station events are sometimes not implemented in time to prevent recurrent events. Examples include the following:

   1. Many failures of auxiliary feedwater level control valves have occurred. Generic problems with valves, valve controllers, and valve limit switches were identified by the station in 1985. Three of seven corrective actions proposed by the station in 1985 have not been implemented.

   2. A substantial number of failures of the Eberline radiation monitor controller have occurred. Analysis of the failures indicates that a new computer controller memory board is necessary. A design change request has been outstanding for over a year.

APPENDIX II

ADDITIONAL SUPPORTING DETAILS

Appendix II provides additional information concerning selected findings that should be useful in determining corrective action.

CHEMISTRY

Finding (CY.1-1)

Examples of long-standing chemistry equipment and instrument problems are provided below:

1. Examples of secondary system in-line monitors that are inoperable or insufficiently sensitive are noted below:

   a. Recent estimates by station engineering indicated that approximately 40 percent of the secondary chemistry instrumentation is out of service. About 25 percent of the out-of-service instrumentation is permanently inoperable because parts can no longer be obtained for instrument repair. Since many of the chemistry instruments are of the same design and age, additional instrument failures are likely. Examples of out-of-service instruments include the following:

      - Unit 1 hotwell sodium analyzer
      - Unit 1 condensate polisher outlet sodium and silica analyzers
      - Unit 1 steam generator blowdown sodium analyzer
      - Unit 1 #7 heater drain tank dissolved oxygen analyzer
      - Unit 2 hotwell sodium and pH analyzers
      - Unit 2 condensate polisher outlet sodium, conductivity, and silica analyzers
      - Unit 2 feedwater pH analyzer

- Unit 2 steam generator sodium pH and conductivity analyzers
- Unit 2 main steam pH analyzer
- Water treatment plant mixed bed #2 sodium analyzer
- Water treatment plant cation bed #1 and #2 conductivity analyzers
- Water treatment plant effluent #1 and #2 silica analyzers

b. Despite the installation of sample chillers, the sample temperatures to several secondary system in-line instruments were observed above the station guideline temperature of 27 degrees Celsius. Unit 1 feedwater dissolved oxygen and hydrazine sample temperatures were observed at 33 degrees Celsius. The Unit 2 feedwater pH and hydrazine sample temperatures were 32 degrees Celsius, and the Unit 2 main steam A and B sample temperatures were 31 degrees Celsius. Sample temperatures greater than 25 degrees Celsius can cause analytical errors of up to 4 percent per degree.

2. Post-accident sampling system (PASS)

a. The gas chromatograph on the PASS used for analyzing the containment atmosphere dissolved hydrogen concentration is inoperable. Backup instrumentation is unavailable.

b. Step 6.3.7.1 of procedure 1-TI-CEM-043-066.1, "Post Accident Sampling and Analysis," Rev. 0, directs evacuating the reactor coolant liquid sample vial to a vacuum of at least 15 inches of mercury (Hg), and waiting approximately three minutes to verify that the vacuum holds. During sampling, the sample vial was evacuated to an equivalent of 18 inches of Hg, but after three minutes the vacuum had decreased to 15 inches Hg, indicating a slow vacuum leak. The sample was not collected for approximately 15-25 minutes following evacuation of the sample vial, allowing vacuum to further decrease. The vacuum in the sample vial is the motive force to draw the reactor coolant sample and dilution water into the sample vial.

CHEMISTRY

Finding (CY.7-1)

Suggested industry contact for mass balance determination:

Mr. Oscar Flores
Chemistry Supervisor Engineer
San Onofre Nuclear Generating Station
Southern California Edison Company
P. O. Box 128
San Clemente, CA 92674-0128
(714) 368-9282

OPERATING EXPERIENCE REVIEW

The following significant operating experience report (SOER) recommendations were evaluated as not satisfactorily implemented, and further actions are needed (Note: The text of some recommendations is summarized.):

SOER 84-7 "Pressure Locking and Thermal Binding of Gate Valves"

Recommendation 2: Take appropriate actions to ensure that the gate valves identified as being susceptible to pressure locking and thermal binding will open when required.

Present Status: This SOER is evaluated as not satisfactorily implemented due to timeliness. One residual heat removal valve on each unit (1/2 FCV-63-172) has been identified as potentially susceptible to pressure locking and thermal binding. During the Unit 1 fall 1991 outage, design change DCN M06407 was implemented to drill a small hole in the downstream side valve disk to address this potential problem. However, review of startup data in March 1992 indicated that this hole allows about 10 gallons per minute undesirable residual heat removal system flow when in modes 5 and 6 with the reactor coolant system depressurized. Due to this flow, the hot leg injection check valves would have to be tested prior to each entry into

CHEMISTRY

CHEMISTRY ORGANIZATION AND ADMINISTRATION

PERFORMANCE OBJECTIVE: **Chemistry organization and administration ensure effective control and implementation of chemistry activities.**

Finding (CY.1-1)

(Related to CY.1-1, Appendix I, 1991)

Several long-standing chemistry equipment and instrumentation problems reduce station effectiveness in monitoring important fluid systems, identifying ingress of impurities that can increase corrosion, and controlling biological fouling. Management has been aware of these problems, in some cases since before 1988, but many improvements or upgrades have been postponed or were insufficiently effective. The following problems were identified:

a. Many secondary system in-line chemistry monitors are inoperable or are insufficiently sensitive to detect small changes resulting from ingress of impurities in the condensate, feedwater, and makeup water plant effluent. In addition, some instrument accuracies are degraded due to low sample flow or excessive sample temperatures. The station has been aware of these problems since before 1988, but actions to correct these deficiencies have been repeatedly postponed. As a result, these in-line chemistry monitors have not been upgraded and repair parts for some instruments are unavailable. The following instrumentation problems affecting early detection of impurities were identified:

   1. Approximately 40 percent of the secondary system in-line instruments are inoperable, and approximately 25 percent of these are out of service due to parts unavailability. Inoperable instruments include Units 1 and 2 hotwell sodium analyzers, Unit 2 feedwater pH monitor, and the water treatment makeup plant No. 2 mixed bed sodium analyzer. As a result of these inoperable instruments, chemistry technicians collect many once-per-shift grab samples that must be analyzed to determine system chemistry conditions.

In February 1992, a Unit 2 condenser tube rupture was undetected for nearly two hours. In September 1992, a Unit 2 air in-leakage transient was undetected for over three hours. In each case, chemistry technicians discovered the problem during routine sampling. Early warning of the contaminant intrusion was not provided by the installed instrumentation.

2. Chemistry in-line instrument recorders, such as those for sodium and cation conductivity, have scales ranged for chemistry concentrations encountered over 10 years ago. Because station chemical contaminant levels have improved by one or more orders of magnitude, small changes in contaminant concentrations are too low to be indicated on some installed instrument meters and recorders.

3. Sample flows to five of seven operating in-line Unit 2 secondary chemistry instruments were inadequate based on flow meter indications. When chemistry personnel attempted to adjust sample flow, proper flow could be restored to only one of the five instruments. Low sample flow can indicate sample line blockage and result in unrepresentative samples.

   Also, sample temperatures to several secondary system in-line instruments were observed above the station guideline temperature of 27 degrees Celsius. For example, Unit 1 feedwater dissolved oxygen and hydrazine sample temperatures were observed at 33 degrees Celsius. Sample temperatures greater than 25 degrees Celsius can cause analytical errors of up to 4 percent per degree.

b. Sampling and analysis of reactor coolant and containment atmosphere using the post-accident sampling system (PASS) are not fully reliable due to continuing equipment deficiencies. Problems noted include the following:

   1. The gas chromatograph, used for containment hydrogen analysis, was inoperable during the

observed weekly sampling exercise and has frequently been unreliable since initial installation.

2. Distilled water for the Unit 2 PASS has insufficient pressure to properly flush the sample lines. A booster pump installation was proposed to correct this problem, with original installation planned for March 1990. Installation of this pump is currently scheduled for February 1993.

3. Flow indication for the containment atmosphere sample indicates at least 20 percent flow but less than the desired 100 percent flow. The reason for this discrepancy has not been identified. As a result, sample purge times have been increased from three to 15 minutes. Increased purge times can result in additional radiation dose to the technician operating the PASS.

4. Analytical results obtained from Unit 1 PASS samples were inconsistent with recent reactor coolant sample results. Three of five fission product nuclide activities did not meet the acceptance criteria of less than a factor of two difference. Also, the reactor coolant boron analysis result was not within the $\pm$ 50 parts per million acceptance criterion.

c. Long-standing problems with the chlorination system for the essential raw cooling water system have resulted in residual chlorine concentrations below the minimum specifications for about one-third of the period from January through August 1992. Although several upgrades to the chlorination system were made in 1988, problems with pump and valve inoperability and blocked chlorination piping continue to degrade system performance.

It is recognized that station management is aware of these problems, and a chemistry improvement program has been developed. Actions for this improvement program are scheduled over the next five years.

Additional examples of deficient chemistry in-line monitors and PASS equipment problems are contained in Appendix II, page 1.

Response

Long-term improvements in plant chemistry are defined in the Chemistry Upgrade Program (CUP). The engineering study that defines the scope of this program has been completed, and an implementation schedule will be developed by February 1993. Additional detail regarding these upgrades will be provided in the six-month status report.

Chemistry Instrumentation

The following actions have been taken to ensure reliability and availability of process analyzers:

a. Process analyzers that were out of service have been categorized as:

   1. able to be returned to service

   2. exhibit design-related problems

   3. obsolete because of unavailable spare parts

b. Work requests for equipment in the first classification have been prepared and prioritized for maintenance. The prioritized work requests will be reviewed weekly to expedite equipment repair and return to service. Progress on these repairs will be reported in the six-month status report.

c. Equipment in the second and third classifications has been evaluated to determine if their immediate replacement or modification was necessary. Management concluded that the equipment could be used "as is" for the near term and that the ability to effectively monitor plant parameters would not be impacted. The obsolete equipment will be replaced under the CUP.

The following actions have been taken to improve analytical results:

a. Sample flow for on-line monitors has been adjusted to the maximum extent practicable to achieve a 25-degree Celcius sample temperature. Equipment that is unable to achieve adequate sample flow cooling has been scheduled for troubleshooting and repair.

b. Grab samples will be used in place of on-line monitors where temperature variations affect analytical results. The results of grab samples which are not cooled to 25 degrees Celsius are mathematically corrected as required by procedures.

c. An on-line ion chromatograph is being used to detect and trend early contaminant ingress.

Post-accident Sampling System (PASS)

In the area of PASS equipment problems, vendor support has been obtained to assist in the improvement of its operability. Outage-required upgrades were implemented during the Units 1 and 2 cycle 5 refueling outages. The modification to achieve as low as reasonably achievable radiation exposures during sampling and to provide emergency PASS facility ventilation has been completed. Modifications have also been completed to provide a less-diluted sample for reactor coolant system (RCS) off-gas hydrogen and isotopic analysis. A preventive maintenance program has been established for PASS equipment. In addition, the following actions will be taken on PASS:

a. A replacement gas chromatograph will be installed on Unit 1 in December 1992. The Unit 2 gas chromatograph will be rebuilt or replaced by March 1993.

b. The flow indicator will be calibrated in December 1992. Following calibration, the PASS will be tested to verify that representative samples can be obtained using approved PASS procedures.

c. A booster pump will be installed to supply higher pressure sample line flush water by February 1993 for Unit 1 and February 1994 for Unit 2.

d. The present method for determining boron concentrations by ion chromatography will be changed to plasma spectrometry. This requires a new laboratory power supply which will be installed by October 1993.

e. Upgrades to the RCS supply, return, and waste handling system and the radiochemical laboratory communications equipment will be implemented by August 1994.

f. The RCS hydrogen and oxygen analyzers will be upgraded by August 1994. In the interim, a backup method of analyzing RCS hydrogen and oxygen will be developed by April 1993.

Biofouling

Long-standing problems with the essential raw cooling water chlorination system should be resolved by the installation of a new, more reliable biocide injection system. This system is expected to be installed by December 1993.

CHEMISTRY PERFORMANCE MONITORING

PERFORMANCE OBJECTIVE: **Chemistry parameters and conditions are monitored, and identified problems are resolved.**

Finding (CY.7-1) **Chemistry data review and evaluation frequently do not identify and resolve some system chemistry problems and data anomalies.** The following problems were noted:

a. Chemistry data from steam generator sludge lancing during the last refueling outage on each unit indicated over 1,500 pounds of iron were deposited in Unit 1 steam generators, and over 700 pounds of iron were deposited in

Unit 2 steam generators. The sources of this iron have not been identified. Secondary system mass balance data is unavailable to indicate sources of iron transport. The station is performing a study of feedwater pH effects on corrosion product formation; however, only major feedwater flowpaths are being monitored. It is recognized that some feedwater and condensate flowpaths, such as feedwater heaters, lack installed sample points; however, increased system sampling or other steps are not being taken to determine the system sources of iron corrosion.

b. Some data anomalies in primary chemistry samples taken during steady state conditions are not investigated or explained. Examples of significant unexplained primary chemistry data changes include changes of several hundred to several thousand percent of nuclide activity in reactor coolant, reactor coolant boron changes of 30 to 65 ppm, and a reactor coolant tritium increase by a factor of three during shutdown conditions. These anomalies can indicate problems with sampling and analysis techniques or problems maintaining desired chemistry conditions.

c. Secondary system chemistry data indicated problems with materiel condition or operation of the makeup water treatment plant. However, analysis and resolution of these indications has not been performed. The following problems were noted:

   1. Over an eight-day period in September 1992, the makeup water effluent sulfate concentration exceeded the station limit of 2 ppb, reaching as high as 11 ppb. This problem was not promptly identified and corrected. Sulfate entering the steam generators is known to concentrate in crevices and contribute to intergranular corrosion and cold leg tube thinning.

   2. Chemistry data from samples of makeup water system mixed bed demineralizer effluent show breakthrough of sulfate and chloride ions, but not silica. Since silica has weak ionic properties, sulfate and chloride without silica breakthrough is unlikely.

Inability to detect silica in makeup water plant effluent may indicate that station techniques or instrumentation for detecting silica are insufficiently sensitive to identify degrading demineralizer performance.

3. Steam generator hideout return reports indicate that aluminum is 10 times more prevalent in the Unit 1 steam generators than in the Unit 2 steam generators. Since Unit 1 condensate is used to rinse the condensate polisher resins for both units following regeneration, greater quantities of makeup water are supplied to Unit 1. The presence of excessive aluminum in the Unit 1 steam generators may indicate over-use of aluminum sulfate, which is used to pretreat water going to the makeup water treatment plant, or degraded makeup water treatment plant demineralizer performance. Aluminum is a chemically reactive element not typically found in nuclear plant steam generators.

d. Numerous errors and data recording inconsistencies were noted in the chemistry logs. Some of the errors included transposing data from one unit to the other during entry in the computer data base, identifying inaccurate reactor modes of operation, and logging incorrect reactor power. Additionally, results were recorded for some analyses that were less than the lower limit of quantification.

Response

The chemistry data collection and review process will be improved with the full implementation of the computer-based chemistry data management software in February 1993. The new system provides the capability to identify out-of-specification conditions, print comprehensive reports of these conditions for review by management, and preclude entry of analytical results below the lower limit of detection.

Chemistry management has emphasized the importance of effective data reviews and follow-up on data anomalies to chemistry technicians and supervisors. An assessment of the knowledge level of chemistry data reviewers is in progress, and training will be provided, as appropriate.

In addition, the following actions will be taken to address problems noted in the finding:

a. Work requests for water treatment plant process analyzers identified as "able to return to service" have been prepared and prioritized for maintenance. Work requests on this equipment will be reviewed weekly by chemistry and maintenance personnel to expedite equipment repair and return to service. Progress on these repairs will be provided in the six-month status report.

b. Silica detection will be addressed by a design change. Currently, on-line detection capability is interrupted when sample flow to the instrument is stopped by taking the mixed bed or the water treatment plant out of service. No-flow conditions cause the reagent to crystallize and subsequently occlude the analyzer optics. A design change will provide a continuous source of water flow to the instrument to prevent crystallization. This change is scheduled for implementation by December 1993.

c. To reduce sources of steam generator hideout, the conductivity requirement for rinse water return to the hotwell has been reduced from 0.1 to 0.08 μmho.

d. Prior to the evaluation, a decision was made to evaluate the use of ethanolamine as an alternative to morpholine for secondary chemistry control on Units 1 and 2 by February 1993. This additive change is anticipated to reduce the frequency of condensate polisher regenerations and the associated addition of some impurities to the steam generators. Results of this evaluation and subsequent actions will be provided in the six-month status report.

CHEMISTRY PERSONNEL KNOWLEDGE AND PERFORMANCE

PERFORMANCE OBJECTIVE: Chemistry personnel knowledge, training, qualification, and performance support effective implementation of chemistry practices.

Finding (CY.8-1)

Knowledge weaknesses exist in several areas among technicians responsible for chemistry sampling and analysis. These weaknesses include insufficient understanding of some plant chemical additives and their effects and of some laboratory practices. Insufficient continuing training on chemistry fundamentals and changes to the plant chemistry program contribute to these problems. The following are examples of the problems noted:

a. Based on discussions during the evaluation, a number of chemistry technicians displayed insufficient knowledge of reasons for using some chemical additives and the effects of these additives on primary and secondary system chemistry. Examples included why the station adds morpholine instead of ammonia to the secondary system, why oxygen is present in the reactor coolant system and how hydrogen addition affects this, and what target pH control range is used to limit reactor coolant system corrosion product solubility.

b. Several inappropriate practices and knowledge weaknesses were observed in use of laboratory equipment and implementation of ALARA principles. The following problems were noted:

1. Two technicians were observed performing reactor coolant analyses with the laboratory fume hoods positioned above the marking for acceptable ventilation face flow. Personnel did not understand the significance of markings on the hood's sash for the position needed to provide adequate ventilation. These markings provide the hood position for use with radioactive liquid and gas samples or hazardous chemicals.

2. A technician observed sampling and performing an analysis on pressurized reactor coolant observed ALARA practices during sampling, but did not minimize radiation exposure while performing the

analysis in the laboratory. The sample container in use during the analysis had a dose rate of about 100 millirem/hour.

3. A total immersion thermometer was used partially submerged, which can degrade its accuracy. When questioned, some technicians were unaware of the difference between partial and total immersion thermometers.

c. During discussions regarding quality control charts, a number of technicians displayed insufficient understanding of the purpose of quality control charts, the recognition of instrument biases, and the significance of data analysis using the concept of standard deviation.

d. Continuing training for chemistry technicians has been insufficiently effective in maintaining or improving knowledge of chemistry fundamental concepts such as those described above. Since 1989, the continuing training program has not included chemistry fundamentals topics from the initial training program for use as refresher training. These topics were not identified by line or training management for inclusion in continuing training.

e. Chemistry training staff has not used structured in-plant observations sufficiently to identify technician chemistry fundamentals knowledge weaknesses such as those noted above. In addition, based on discussion during the evaluation, site chemistry training staff was unfamiliar with some current station chemistry additives and practices, and exhibited many of the same knowledge weaknesses noted among the chemistry technicians.

It is recognized that chemistry line management has identified other areas of chemistry technician knowledge and skills needing improvement, such as training on specific, complex analytical equipment and analysis techniques. These identified knowledge and skills weaknesses have been or were being incorporated into the continuing training program.

Response

While plant and chemistry management had identified some of the knowledge weaknesses found during the evaluation, a comprehensive plan has been developed to address these and other chemistry training problems. A test has been administered to technicians to assess their theoretical knowledge strengths and weaknesses. The results of the test will be given to a chemistry curriculum review committee, and the following action plan will be implemented:

a. Increase biennial technician training from 80 hours to 140 hours. (complete)

b. Review and revise the knowledge catalog. (complete)

c. Review and revise skills catalog and redesign job performance measures by February 1993.

d. Update job/task analysis by March 1993.

e. Revise the basic training program by March 1993. This will be an ongoing action as needed.

f. Complete retraining and requalification of technicians by July 1993.

g. Revise continuing training (80 percent knowledge and skills; 20 percent new material) by September 1993.

Shift chemistry supervisors will be retrained in the areas of laboratory hygiene and radiological safety, and technicians will be trained in appropriate laboratory practices. To further strengthen technician knowledge and improve instructor knowledge of current chemistry conditions and practices, continuing training will be supplemented by knowledgeable, experienced people from the site and corporate staffs who perform as "adjunct professors" (APs). This effort was initiated in November 1992.

To address known weaknesses, the following subjects will be included in fiscal year 1993 chemistry technician continuing training:

a. general corrosion and raw cooling water corrosion

b. primary and secondary chemistry control

c. radiochemistry

d. gamma spectrometry and liquid ion chromatography

e. proportional and scintillation counting

f. laboratory radiological control practices
