U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Reports No. 50-295/89018(DRS); 50-304/89017(DRS)

Docket Nos. 50-295; 50-304 Licenses No. DPR-39; DPR-48

Licensee: Commonwealth Edison Company
Post Office Box 767
Chicago, IL 60690

Facility Name: Zion Nuclear Generating Station
Units 1 and 2

Inspection At: Zion Site, Zion, Illinois

Inspection Conducted: June 19-23, July 17-21 and 24, 1989

Inspectors: S.D. Eick for
Z. Falevits, Team Leader — 8/30/89 Date

S.D. Eick
S. D. Eick — 8/30/89 Date

C.F. Gill
C. F. Gill — 8/30/89 Date

T. Tella — 8/30/89 Date

H.A. Walker
H. A. Walker — 8/30/89 Date

Contractors: F. L. McManus
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Maintenance and Outages Section — 8/30/89 Date

Inspection Summary

Inspection on June 19-23, July 17-21 and 24, 1989 (Reports No. 50-295/89018(DRS); No 50-304/89017(DRS))
Areas Inspected: Special announced team inspection of maintenance, support of maintenance, and related management activities. The inspection was conducted utilizing Temporary Instruction 2515/97, the attached Maintenance Inspection Tree, and selected portions of Inspection Modules 62700, 62702, 62704, 62705, and 92702 to ascertain whether maintenance was effectively accomplished and assessed by the licensee.
Results: Areas of strengths and weaknesses were identified as discussed in the Executive Summary. Overall implementation of the licensee's maintenance program is synopsized in Section 4.0 and was determined to be satisfactory.

There were two violations: four examples of failure to follow procedures or inadequate procedures; and four examples of failure to take timely corrective action on numerous identified maintenance deficiencies including lack of adequate and timely corrective action concerning the testing of the Auxiliary Feedwater pump turbines overspeed mechanism. One open item was identified that pertained to an inadequate preventive maintenance program for the Radiation Monitoring System.

DETAILS

1.0 Persons Contacted

Commonwealth Edison Company (CECo)

*T. Maiman, Vice President, PWR Operations
*L. DelGeorge, Assistant Vice President, Quality Program and Assessment
*P. Fay, Maintenance Staff Supervisor
*K. Graesser, General Manager, PWR Operations
*R. Johnson, Assistant Superintendent, Maintenance
*T. Joyce, Station Manager
*W. Kurth, Production Superintendent
*P. LeBlond, Assistant Superintendent, Operations
*T. Rieck, Technical Staff Superintendent
*W. Stone, Regulatory Assurance Supervisor

U.S. Nuclear Regulatory Commission (NRC)

*H. Miller, Director, Division of Reactor Safety
*A. Bongiovanni, Resident Inspector
*F. Jablonski, Chief, Maintenance and Outages Section
*R. Leemon, Resident Inspector
*J. Neisler, Reactor Inspector
*J. Smith, Senior Resident Inspector

*Denotes those present at the exit meeting on July 24, 1989.

Other licensee personnel were contacted as a matter of routine during the inspection.

2.0 Licensee Action on Previous Inspection Findings

2.1 (Open) Violation (295/86026-01A): This violation addressed inadequate work instructions in nuclear work requests (NWRs) for performing maintenance work. Licensee action to resolve this issue is described in the licensee's letter to the NRC dated March 20, 1987. This response was supplemented by NRC letter dated April 14, 1987.

The inspector reviewed 27 completed electrical NWRs and noted that 14 of the NWRs contained the statement "Investigate and Repair as Necessary" or a similar statement such as "Trouble Shoot and Repair." No specific instructions for performing the work were included in the NWR package. Based on this review, many work instructions were not adequate to provide satisfactory control of maintenance. This item remains open pending additional management action to ensure that adequate work instructions are provided. The failure to take timely and effective corrective action to ensure that adequate work instructions are provided for maintenance activities is considered to be an example of a violation of 10 CFR 50, Appendix B, Criterion XVI (295/89018-01A; 304/89017-01A).

2.2 (Closed) Violation (295/86026-01B): This violation documented the failure of maintenance mechanics to sign off steps in the work packages and procedures. Licensee action to resolve this issue is described in the licensee's letter to the NRC dated March 20, 1987. This response was supplemented by an NRC letter dated April 14, 1987.

There was no objective evidence that work required by a number of job steps had been completed. The inspector reviewed 27 completed electrical NWRs and five electrical NWRs for which work was in progress and found that all steps were appropriately signed as complete. This item is closed.

2.3 (Open) Violation (295/86026-02A): This violation documented 13 instances where work proceeded past QC "hold points" without sign-offs or appropriate releases. Licensee action to resolve this issue is described in the licensee's letter to the NRC dated March 20, 1987. This response was supplemented by an NRC letter dated April 14, 1987.

The inspector reviewed 27 completed electrical NWRs and noted no problems with QC hold point signatures. However, in reviewing work in progress the inspectors noted that a QC hold point was bypassed on NWR Z83483. In discussions with the licensee on this matter and detailed findings from this inspection, adequate emphasis was not placed on the responsibility of maintenance personnel to adhere to QC hold points. This item remains open pending further management action to ensure strict compliance to QC hold points.

2.4 (Closed) Violation (295/86026-02B): This violation documented the failure to obtain QC release for completed maintenance work prior to performing post maintenance testing. Licensee action to resolve this issue is described in the licensee's letter to the NRC dated March 20, 1987. This response was supplemented by an NRC letter dated April 14, 1987.

The inspector reviewed 27 completed electrical NWRs and 5 electrical NWRs for which work was in progress and did not identify cases where the QC release block had not been signed if appropriate. This item is closed.

3.0 Introduction to the Evaluation and Assessment of Maintenance

This inspection was conducted during normal plant operations to evaluate the extent that a maintenance program had been developed and implemented at the Zion Nuclear Generating Station. Three major areas were evaluated: (1) overall plant performance as affected by maintenance; (2) management support of maintenance; and (3) maintenance implementation. This inspection was based on the guidance provided in NRC Temporary Instruction 2515/97; "Maintenance Inspection," and Drawing 425767-C, "Maintenance Inspection Tree." The drawing, which is attached to this report, was used as a visual aid during the exit meeting to depict the results of the inspection.

The goals of this inspection were to evaluate maintenance activities to determine if maintenance was accomplished, effective, and assessed by the licensee to assure the preservation or restoration of the availability and reliability of plant structures, systems, and components to operate on demand.

Results of this inspection were derived from data obtained by observation of current plant conditions and work in progress, by review of completed work and by evaluation of the licensee's self assessment and correction of weaknesses. Major areas of interest included maintenance associated with electrical, mechanical, instrument and control (I&C) and the support areas of radiological control, engineering, quality control, training, procurement, and operations. Problems identified by the NRC inspectors were evaluated for effect on Technical Specification operability and technical or managerial weakness.

3.1 Performance Data and System Selection

3.1.1 Historic Data

The inspectors reviewed plant operations history data for 1988 and the available data for 1989, to assess the licensee's performance in meeting established goals. The data pertained to forced outage rate, unplanned reactor trips, Engineered Safety Feature (ESF) actuations, safety system actuations, Licensee Event Reports (LERs), and the available performance data for systems selected. As of June 1989, results were:

- Forced outage rate for 1989 for Unit 1 was 15.6% and for Unit 2 was 11.3%; the goal was less than 4%. (The 1988 goal was not met for Unit 1.)

- One unplanned reactor trip occurred on Unit 1, which was maintenance related; the goal was less than three per unit. (Six reactor trips occurred in 1988; the goal was six for both units.)

- Two ESF actuations occurred on Unit 1; the goal for 1989 was zero. (A total of 14 ESF actuations occurred in 1988 for both units; no goal for 1988 had been established.)

- No unplanned safety system actuations occurred; the goal was zero. (One safety system actuation occurred in 1988 on Unit 1; the goal was zero.)

- Fifteen LERs were issued, four due to equipment failures; the goal for 1989 was 28. (Forty-one LERs were written in 1988; 13 due to equipment failure; the goal was 30 (15/unit).)

- Equivalent Availability for Unit 1 was 82.4% and for Unit 2 84.1%. The goal for Unit 1 was 72% and for Unit 2, 85%. The licensee expected to meet the Unit 2 goal but not the Unit 1 goal. In 1988, the Equivalent Availability for Unit 1 was 72.3%

and for Unit 2 was 74.2%. Both units exceeded the goal of 72.0%. (INPO best Quartile was set at 74.7%.)

- Cumulative Whole Body Dose for 1988 was 1259 Man-Rem. The original goal was 680 Man-Rem; however, the goal was revised to 1260 Man-Rem. The average Cumulative Whole Body Dose for 1986, 1987, and 1988 was 398 Man-Rem while the industry average median was 330 Man-Rem.

Overall, performance in the above areas did not meet the established goals set by station management in most categories assessed.

The inspectors also assessed other data furnished by the licensee to ascertain the availability and operability of selected systems since January 1989. Results of this review indicated that except for the Auxiliary Feedwater (AFW) System, no plant goals were established in these areas for the selected systems. The 1989 safety performance goal for AFW system was less than 0.02 and actual was 0.041. In addition, for the first quarter of 1989, the AFW system on Unit 1 contributed to all of the unavailable hours due to a leaking valve. In 1988, the safety system performance indicator for AFW was less than the INPO 1991 target. No performance data or goals were available for the Reactor Coolant System (RC), Auxiliary Building HVAC (AV), and Control Room HVAC (PV) selected systems.

The licensee established goals to determine if maintenance was accomplished. The goals included maintenance backlog, and preventive maintenance (PM) and corrective maintenance (CM) ratio. However, the licensee had not established goals for measuring effectiveness of maintenance such as the number of limiting conditions for operations due to equipment problems and number of power reductions due to equipment problems. In addition, the inspectors determined that several goals originally set for 1988 had been subsequently raised when the licensee realized that the goals would not be met. For example, the original goal set for reactor trips for 1988 was two per unit; subsequently, it was changed to three per unit. The actual was four trips for Unit 1 and two trips for Unit 2. The goal for Cumulative Whole Body Dose (Man-Rem) was originally set at 680 Man-Rem, but was subsequently changed to 1260. The actual Man-Rem dose for 1988 was 1259. The inspectors concluded that a moving target was not an effective mechanism for achieving set goals.

The inspectors determined that the forced outage rate for 1989 had been significantly worse than the set goal. Three of the six equipment forced outage reductions were greater than 25% power; all due to equipment leaks. Also, the equipment failure per 1000 critical hours during the first quarter of 1989 was 1.24 while the goal was less than 0.35. As a result, the exposure and contamination levels for 1988 were higher than expected and the licensee determined that the goals for this year would probably not be met. In addition, the forced outages diverted manpower from non-outage work requests which resulted in a rise in the number of backlogged non-outage work requests. The inspectors concluded that equipment failures appeared to be a key contributor to the problems that resulted in large forced

outages in late 1988 and early 1989. Increased management attention is needed to reverse this adverse trend.

3.1.2 System Selection

The systems and components selected for this inspection were based on a Probabilistic Risk Assessment (PRA) stuoy furnished to the team by the Reliability Applications Section of the Office of Nuclear Reactor Regulation and review of recent component failures, LERs, Nuclear Power Reliability Data System (NPRDS), and Deviation Reports. The systems selected were:

Auxiliary Feedwater System (AFW)
Auxiliary Building HVAC (AV)
Control Room HVAC (PV)
Reactor Coolant System (RC)

3.2 Description of Maintenance Philosophy

The inspectors reviewed site policy statements, administrative procedures, organization charts, established goals, and documents that described improvement programs for the maintenance process. The licensee did have a documented comprehensive maintenance plan, Conduct of Maintenance, that included milestones and completion dates for improvement programs and goals. Discussions by the inspectors with selected managers indicated that those personnel were knowledgeable and aware of established performance goals.

The inspectors determined that the licensee's maintenance program was appropriately balanced with CM and PM. The licensee's predictive maintenance program was at the early stages of implementation in areas of performance monitoring of heat exchangers, erosion/corrosion pipe monitoring, vibration analysis and oil sampling. A thermography program was in the planning stages with implementation sometime late in 1989. Because of the relative newness of the program, no overall evaluation of the effectiveness of the predictive maintenance program and its implementation was made. The licensee's philosophy of maintenance included limited principles of reliability centered maintenance (RCM).

Zion did not perform stem thrust diagnostic testing of any motor operated valves (MOV); however, current signature measurements were utilized to determine relative condition of the MOVs. The licensee's MOV diagnostic program was considered behind the industry.

3.3 Observations of Current Plant Conditions and Ongoing Work Activities

3.3.1 Current Material Condition

The inspectors performed general plant as well as selected system and component walkdowns to assess the general and specific material condition of the plant to verify that NWRs had been initiated for identified equipment problems, and to evaluate housekeeping. The selected systems and components, which were selected, based on a PRA

study for Zion performed by the Reliability Applications Section of the Office Nuclear Reactor Regulation, are identified in Section 3.1.2 of this report.

Walkdowns included an assessment of the buildings, components, and systems for proper identification and tagging, accessibility, fire and security door integrity, scaffolding, radiological controls, and any unusual conditions. Unusual conditions included but were not limited to water, oil or other liquids on the floor or equipment; indications of leakage through ceiling, walls or floors; loose insulation; corrosion; excessive noise; unusual temperatures; and abnormal ventilation and lighting. Results are as follows:

- Housekeeping appeared to be very good. Generally, the plant was clean and many areas appeared to have been recently painted. Although small water and oil leaks were noted in some areas, none appeared to be excessive. An oil absorbing material was used in most areas to absorb oil from small leaks. This appeared to be a good method for removing the oil; however, in at least one area (on top of 1B diesel) this material was saturated with oil and appeared to be a fire hazard due to potential high temperatures. Licensee personnel immediately removed the oil saturated material from this area.

- The inspector selected 12 tags from equipment in the plant to evaluate the effectiveness of the licensee's tag out program. None of the tags noted appeared to be excessively old. Open NWRs existed for 11 of the tags. The remaining NWR, for Tag M9528, had been closed on February 26, 1989, and the tag had not been removed. Two instances were identified where deficiencies existed and no NWR had been written. It appeared that the licensee's program for the identification of maintenance was good.

- The inspectors noted two of three leads (tag L932 and L001) that were lifted since August 8, 1979, and March 3, 1980, which were still controlled by the temporary alteration procedure. The inspectors were concerned that items almost ten years old were considered temporary and not given the reviews and control required for permanent modifications. The inspector reviewed Procedure ZAP 3-51-4, "Temporary Alteration Program," Revision 13, and noted that a temporary alteration was defined as "changes made to plant equipment intended to be temporary." No discussion of requirements were provided as to the length of time that an alteration can be in place and still be considered temporary. During discussions with the licensee on this matter, the inspectors were informed that the control of temporary alterations had been previously identified as a problem and that the number of temporary alterations had been substantially reduced. In addition, a review of all open temporary alterations was performed every six months to determine if the temporary alteration should be removed or made a permanent modification. The inspectors were told that a modification had been issued to eliminate the need for the two noted temporary

alterations and that this modification would be implemented in the near future.

- The inspectors noted that some of the spare breaker cubicles in the 4.16kV essential switchgear rooms did not contain breakers. The inspectors were informed that present practice kept a breaker in the same location until maintenance was needed. A spare was temporarily used and the assigned breaker would be reinstalled as soon as possible after repair. The inspectors were provided with a list that identified breaker location by cubicle number in the essential switchgear rooms. A sample review of breaker locations indicated several inaccuracies. Since PMs were performed by cubicle number, there did not appear to be a positive method in place to ensure that required PMs were performed on all breakers. Subsequently, licensee personnel verified, using completed NWRs, that the required PMs on Unit 1 breakers had been completed and that the same verification of breaker PMs would be completed for Unit 2 breakers. The licensee stated that a system would be developed to provide positive control to ensure the performance of breaker PMs. This problem had been noted at other CECo plants and appeared to be a problem generic to CECo plants.

- Many electrical panels, equipment control panels and switchgear breaker enclosures, contained loose conductive material such as screws, spare fuses, spare light bulbs, nuts, wire lugs, and metal marking tags. A review of LERs revealed that the licensee had experienced an inadvertent autostart of safeguards equipment due to loose conductive material (LER 88-021-00) on November 2, 1988. Following that event, the licensee inspected all Safeguards and Reactor Protection cabinets in Unit 1 and committed to inspection of Unit 2 prior to restart following the 1989 outage.

- A large number of 4.16kV breaker indicating lights were not illuminated or were broken, and some lens caps were missing. The licensee provided a list of 21 NWRs for repair of damaged switchgear indicating lights during the next switchgear overhaul period.

- The inspectors observed 83 caution cards attached to control room panels. Of these, 42 were the result of pending maintenance. The NWRs for 17 caution cards had dates greater than one year old. The licensee identified two caution cards that were no longer applicable because maintenance had been completed and three caution cards for which no NWRs could be identified. The correlation of caution cards that related to maintenance, and the NWR for the maintenance was difficult because the caution card log did not contain the out of service number nor the NWR number related to the maintenance. A sample of NWRs was reviewed and no safety or operability concerns were noted.

- The inspectors observed that humidity meter indications for the main control room were out of specification. The readings noted were between 0% and 80% for the four devices. The FSAR specifies control room humidity limits of 35-45%. No NWRs had been written to investigate these indications. The last documented observation of the humidity indication for the control room was February 1987, when repairs were made to the system. Routine logging of the control room humidity was not required by licensee procedures and operations failed to notice these erroneous indications when conducting routine walkdowns. Control room humidity was immediately checked and found to be within specification limits. NWRs were written to repair the humidity indicating system for the control room. No maintenance problems related to control room humidity were noted by the inspectors.

- Service water lines and associated flanges, bolts and nuts inside Unit 2 containment appeared to be badly corroded. These pipes and fittings appeared to have never been painted. The inspectors determined that plant management did perform periodic walkdowns of the plant and results or deficiencies were documented on a "yellow card." However, a formal followup system was not established.

Generally, equipment problems identified by the inspectors during plant and system walkdowns had already been identified by the licensee's WR system, or were otherwise corrected. The material condition was considered satisfactory to maintain operability of components at a level commensurate with the components' function.

3.3.2 Ongoing Work Activities

The inspectors observed ongoing work in electrical, I&C, and mechanical maintenance areas. The inspectors selected these activities from the plan of the day listings, work assignments in individual maintenance shops and through discussions with individual foremen. Where possible, safety significant activities were chosen for review.

Maintenance activities were witnessed/observed to determine if those activities were performed in accordance with required administrative and technical requirements. Work activities were assessed in the following areas:

Administrative approval prior to start of work.
Equipment properly tagged.
Replacement parts acceptable.
Adequate work instructions.
Approved procedures available and properly implemented.
Work accomplished by experienced and knowledgeable personnel.
Appropriate post maintenance testing included and conducted.

3.3.2.1 Ongoing Electrical Maintenance

The inspectors observed portions of seven routine electrical maintenance activities:

NWR Z80026	Inspect 1B Safety Injection (SI) pump cubicle cooler fan motor and cubicle termination boxes for undocumented wire and splices
NWR Z82380	Inspect MOV for melamine torque switch
NWR Z82685	Inspect cubicle cooler fan motor for EQ wiring and splices
NWR Z82875	Replace Unit 2 governor valve limit switch actuating arm linkage
NWR Z83034	Failure of 1B AFW pump to stop following inadvertent start from the remote shutdown panel
NWR Z83134	Troubleshoot dc Bus 112 ground alarm
Surveillance PT-30	Monthly battery surveillance on battery 212

The inspectors concluded that electrical maintenance activities were satisfactorily accomplished by skilled maintenance personnel. Maintenance personnel appeared competent and were knowledgeable of the work performed. However, concerns were identified in the observation of the following work:

- NWR Z80026 - Procedure E 028-1, "Cubicle Cooler Fan Motor EQ Inspection/Maintenance," Revision 1, allowed work steps to be completed in nonsequential order. Step 8 required replacement of the junction box covers and Steps 9 and 10 required performance of electrical insulation resistance tests to ground and measured phase to phase resistance. If these steps were not performed in sequence, a wire could be pinched or damaged during cover replacement and not be detected by the electrical checks performed in Steps 9 and 10. The shop foreman discussed the inspector's concern at a shop meeting with Electrical Maintenance personnel. A change to the procedure had been submitted that required workers to close terminal/junction boxes before conducting the resistance and electrical insulation checks. No other concerns were noted.

- NWR Z82875 - Repair of the non safety-related governor valve limit switch involved replacement of the actuating arm linkage to the limit switch. No concerns were noted during the field work observed by the inspectors. However, the inspectors were concerned that the NWR lacked detail and did not completely describe the problem, testing required, or accurately describe the part required. The "test required" block of the NWR was checked "No"; however, the work instructions required that a post maintenance verification be performed to verify proper actuation. The NWR "parts" block was marked "NA"; however, an

incorrect replacement part was supplied from the station warehouse. The part supplied was right hand threaded, while the necessary replacement part required left hand threads. The maintenance electricians fabricated a temporary repair using the old connecting linkage parts.

- NWR Z83034 - Initial conditions for the surveillance transferred control of the 1B AFW pump from the control board to the remote shutdown panel in preparation for starting the 1B AFW Lube Oil Pump. The operator became distracted and turned the switch for the AFW pump to what was believed to be the start position, but actually positioned the switch (clockwise) to the labeled "stop" position; however, the AFW pump started. The operator was directed to stop the pump. When the switch was placed in the labeled "stop" position (clockwise) the pump failed to stop. Control was transferred back to the control room and the pump was secured. The technical staff engineer concluded, and later verified by testing, that the switch was wired correctly and the label plate was incorrect (start/stop positions reversed). Corrective action consisted of a caution tag placed on the Remote Shutdown Panel that indicated the switch label discrepancy. Licensee personnel stated that a label with correct markings would replace the incorrect label. The inspectors evaluated the licensee's label improvement program to ascertain the extent of potential mislabeled plant components. The inspectors concluded that this mislabeled switch was an isolated case and not symptomatic of a widespread problem.

- Surveillance PT-30 - The monthly battery surveillance on station battery 212 was performed per Procedure PT-30, "Station Battery Records Monthly Quarterly Equalizing Charge," dated April 20, 1988. Paragraph 5.2 stated "Verify all electrolyte levels are between 1/4 inch below the full line and the low level line." Maintenance personnel indicated that electrolyte levels were acceptable even though most levels appeared to be at or very close to the full line. When questioned about this matter, maintenance personnel decided that the levels did not appear to be acceptable and stated that the procedure was not clear in this area. The individuals had performed this battery surveillance several times before. This portion of the procedure had been revised at the last revision. The high electrolyte levels were documented and the surveillance was completed. This failure to follow required procedures in performing the battery surveillance is an example of a violation of 10 CFR 50, Appendix B, Criterion V (295/89018-02A; 304/89017-02A).

  This matter was discussed with both the cognizant systems engineer and the master electrician. Based on discussions with the systems engineer, there did not appear to be a problem with the battery. The level requirement had been incorporated into the procedure to prevent over filling of the cells. Licensee personnel stated that Paragraph 5.2 of the procedure would be rewritten for clarification. The failure to follow procedures

was discussed with the electricians as well as the individual's responsibility to understand each procedure step, especially where recent changes are involved. This matter appeared to have been satisfactorily resolved.

3.3.2.2 Ongoing Mechanical Maintenance

The inspectors observed portions of eight mechanical maintenance activities as discussed below:

NWR Z76089	Installation of a viewing window on AFW pump 2C shield
NWR Z77209	Overhaul of condensate booster pump 1A
NWR Z78406	Modification of heater drain lines, including welding
NWR Z79909	Rebuild and repair of 2HR snubbers
NWR Z80465	Modifications, including welding of bulk acid transfer pipe
NWR Z81872	Rerouting of piping and supports
NWR Z82855	Maintenance on Instrument Air Compressor 1A
NWR Z83483	Troubleshoot and repair MOV 2MS006

The inspectors concluded that mechanical activities were adequate and accomplished by skilled maintenance personnel. Maintenance personnel appeared to be knowledgeable and adequately trained in the work performed. However, concerns were identified during the observation of the following work:

- NWR Z83483 - The inspectors reviewed the open NWR package after maintenance had recently completed two repairs to the valve. Numerous deficiencies were found during the repairs that were not identified in the "work performed" section of the NWR, such as: gear teeth for handwheel were broken, handwheel shaft was bent; an unusual amount of grease was found in the bellville spring pack; the torque switch was replaced and wired backwards causing the thermal overloads to trip; the new torque switch did not have a limiter plate installed and no NWR was written to order and install one. These deficiencies were discovered after discussion with workers and after a review of loose notebook papers that had been added to the NWR package documenting noted deficiencies. Also, the NWR maintenance cause code incorrectly listed the root cause of the valve failure as "AM", defined as previous repair/installation status, and identified the valve as both EQ and non-EQ. Failure to fully document as-found conditions and work performed could result in poor work history input to the Total Job Management (TJM) system, and inaccurate failure and root cause analysis. The licensee had yet to review this NWR for root cause and corrective action.

The first repair of the valve incorrectly used procedure P/M016-5N, "Removal and Installation of Limitorque Operators Size SMB-0 Through 4", Revision 5. Valve 2MS006 was an SMB-00 model and required a different procedure to assure correct disassembly and reassembly. Failure to use a procedure appropriate to the valve model type is an example of a violation of 10 CFR 50, Appendix B, Criterion V (295/89018-02B; 304/89017-02B).

The procedure used to install the new torque switch, E022-1, "Inspection and Maintenance of Limitorque Valve Motor Operators," Revision 1, did not provide adequate guidance to prevent miswiring. Attachment F of the procedure showed diagrams of the torque switch without contact numbers and did not require the craft to document the wires removed from the old torque switch for reference when wiring the new torque switch. Also, double verification of proper wiring was not required by the procedure. Miswiring of the torque switch caused the valve thermal overloads to trip during post-maintenance testing. Failure to include adequate procedure steps to prevent miswiring of Limitorque torque switches is an example of a violation of 10 CFR 50, Appendix B, Criterion V (295/89018-02C; 304/89017-02C).

Deviation Report DVR-22-2-87 was written and stated that an operations B-man tried to open the stuck closed valve with a "medium size valve bar." The Limitorque vendor manual clearly advised not to use a cheater bar on the handwheel. Use of the cheater bar could have resulted in the broken teeth on the handwheel gear and the bent handwheel shaft. Use of a cheater bar was not listed in any operations procedure; however, the inspectors were told that operators received training consistent with the vendor's manual. The inspectors concluded this was a poor maintenance practice that warranted a review for pervasiveness and appropriate management attention to ensure its correction.

3.3.2.3 Ongoing Instrumentation and Control Maintenance

The inspector observed portions of three I&C maintenance activities as discussed below.

NWR Z82702 Investigate Low Lube Oil Alarm on 1B EDG

NWR Z83033 Investigate Low Lube Oil Alarm on Loop 2A

NWR Z82111 Change Scaling of Flow Transmitter on Loop 2A

The inspectors concluded that I&C maintenance activities were accomplished by skilled maintenance personnel. The maintenance personnel appeared very conscientious and knowledgeable with an average of 5.2 years experience at Zion. However, concerns in the areas of job planning and procedures were identified during the observation of the following work:

- NWR Z82702 - The work package for the repair of 1B Emergency Diesel Generator (EDG) lube oil level alarm was inaccurate and incomplete because it contained an incorrect calibration sheet and no disconnect/reconnect sheet. The work package incorrectly contained the calibration sheet for the lube oil alarm on 1A EDG. This error was not detected during the job planning process; however, it was noted prior to work authorization. The NWR required the disconnecting of leads. The technician failed to document disconnecting and reconnecting of leads as required by ZAP 3-51-1, "Temporary Alteration Program", Revision 26. A disconnect/reconnect sheet was not included in the work package. In response to this issue, the I&C department was developing a troubleshooting procedure that amplifies ZAP 3-51-1 and contains improved disconnect/reconnect forms and procedures. Failure to follow procedures is an example of a violation of 10 CFR 50, Appendix B, Criterion V (295/89018-02D; 304/89017-02D)

  Documentation of 1B EDG lube oil level during the period where the lube oil level low alarm was inoperative was not in accordance with Procedure PT-0, App. J-2, Revision 3, which required "a check mark in the appropriate space" when logs were taken. Five of eleven logs for 1B EDG had no check mark in the space indicating "Crankcase Lube Oil Level at mark." These logs contained a single check mark in the space for the top item on the log and a single line drawn through the remaining spaces of the log. Not marking an item on the log at the time it is performed and leaving the marking until all items in the log have been completed increased the potential for error and was not in compliance with procedure. The other 6 of 11 logs contained check marks or accurately documented lube oil levels. Management attention is needed in this area to ensure that appropriate checks are performed and documentation of those checks is per procedures and acceptable practices.

  Two procedures were included in the work package; however, the reason and sequence for use was not specified in the work instructions. Procedure IMP-MI-4, "Determining Static Shift" had no correlation with the work instructions and appeared to be incorporated as a contingency. Calibration Procedure 2F-414T, "Loop 2A Reactor Coolant Flow Channel Transmitter" was included to "enter/exit the loop." The apparent task sequencing of the work instructions was to "enter/exit the loop" under NWR 82111 and perform Procedure IMP-MI-2 if necessary. The requirement and sequence for the use of Procedure 2F-414T was not clearly specified in the work instructions.

- NWR Z82111 - Technicians used reference data which had been deleted in Calibration Procedure 2F-414T. SPCR B707, "Instrument Setpoint/Scaling Change Form," authorized changes to Procedure 2F-414T. These changes included the deletion and insertion of new data for zero shift, static shift, reference, and required data. This was accomplished by crossing out the old number with a single line and writing the new number above. The technician who performed the work used the crossed out

reference numbers when taking as-found data for the transmitter. A QC inspector observed this work and did not identify the error. The as-found data was incorrect but did not have a safety significance. In addition, the work package did not contain all required procedures. Procedure 2F-414T required the technician to "Refer to IMP-MI-9 for wet/dry transmitter calibration method." Procedure IMP-MI-9 was not included in the work package; however, it was obtained and used.

3.3.3 Radiological Controls

Maintenance work was observed in contamination and radiation areas as were movements of tools/equipment to and from these areas, and interactions of workers with radiological control personnel were also observed. No apparent problems were noted with health physics support of ongoing work or with ALARA review of specific tasks.

Radiological controls, posting and labeling were good. From a radiological standpoint, cleanliness and housekeeping appeared generally good for the non-outage conditions.

Through observation of work in progress and discussion with licensee personnel, the inspectors determined that radiological controls were integrated into the maintenance process as evidenced by:

- The ALARA staff included personnel with backgrounds in maintenance and radiation protection (RP). The ALARA staff appeared to have the necessary size, expertise, experience, and dedication to implement effective ALARA oversight of maintenance activities.

- Experienced RP-ALARA planners provided input to maintenance planning and assured that good RP practices were incorporated into planned work activities as early as possible.

- Members of the ALARA staff attended planning meetings, performed daily review of RWPs, supervised decontamination crews, administered the shielding program, conducted pre and post-job meetings, and collated and tracked the station's person-rem performance.

- Proposed facility changes were reviewed by the ALARA staff.

- The licensee had developed extensive job history files and generally effectively used a review of these files and previous work packages to factor lessons learned into the planning process.

- Dose savings were achieved through extensive use of shielding, mockups during pre-job training, videotapes of selected jobs, and an extensive photo-library.

- Station dose goals were established for individual work groups based partly on corporate guidelines but primarily upon historical dose information.

- The station's ALARA group provided ALARA awareness training classes.

- Audits by the onsite QA organization and the corporate office of the radiation protection program including ALARA were performed and findings appeared to be well addressed by appropriate station personnel.

- The formal ALARA review program, management support, consideration of ALARA principles by other station groups and the working relationship with the ALARA group appeared conducive to the continuation of a good ALARA program.

The inspectors noted some weakness in maintenance/radiological control interface as follows:

- Although the station's radiological control/ALARA program functioned well for large outage maintenance projects, more emphasis on routine maintenance tasks was desirable. The licensee did not maintain the cumulative dose to maintenance personnel within the station goal.

- Radiological control/ALARA personnel should be more cognizant of system operations and work more closely with operations and maintenance personnel on routine and special system maintenance activities to reduce dose to station personnel and the potential of radiological effluent releases to the environs.

The inspectors also identified maintenance weaknesses regarding radiation monitoring system (RMS) reliability.

- Process and effluent RMS reliability problems were identified in Inspection Reports No. 50-295/87022(DRSS); 50-304/87023(DRSS). The licensee established a RMS reliability task force (Radiation Monitor Committee) which met weekly until about two months prior to the maintenance team inspection. This task force consisted of technical staff, radiation protection, instrument maintenance, and operations representatives and was charged with correction of recurrent RMS problems and timeliness of completion of maintenance work requests. The committee was able to resolve some recurrent problems and significantly improved work request timeliness; however, licensee representatives stated that since the committee's last meeting, work requests were no longer processed in a timely manner, RMS reliability decreased, and management involvement significantly decreased. The day after inspector concerns were expressed to station management, committee members were appointed. The Technical Superintendent was designated as the committee chairman and the first weekly meeting was scheduled for June 27, 1989, to review current radiation monitor problems, proposed RMS Technical

Specification amendments, and a recent consultant's report which included numerous RMS recommendations. This is indicative of the need to provide adequate management oversight and/or convey management expectations to the staff to ensure the continued high reliability of the process and effluent RMS.

- The licensee had an ineffective system for review of Instrument Maintenance Radiation Surveillance (IMRS) procedures and associated work packages. During the review of the assembled work package for WR Z8301, prior to observation by an NRC inspector, the RMS system engineer noted that IMRS No. 31 had a procedural deficiency. The system engineer stated that he usually did not conduct reviews of this type. IMRS No. 31 had correction tables for decay of the radiation sources for a three year period; however, the referenced source calibration was three years and three months ago. Thus, the scheduled maintenance activity could not have been accomplished with this procedure. The IMRS procedures were reviewed every two years, the primary calibration for IMRS No. 31 was approximately two years old when IMRS No. 31 was approved; therefore, the procedure was scheduled for review approximately one year after the procedure would have become inadequate. On June 22, 1989, a fourth year correction table was added to IMRS No. 31 and the procedural revision was submitted for approval review. The licensee stated that other IMRS procedures would be reviewed for errors and the approval process would also be reviewed.

- Tagging of out-of-service (OOS) RMS on the control room status/operation panels appeared inadequate. On June 22, 1989, an NRC inspector observed that, although radiation monitor ORT PR-18A was OOS, it was not tagged as such on the RMS control room status panel. The inspector was informed by the RMS system engineer that OOS RMS had a label, which listed the NWR number, placed on the appropriate panel and when the NWR was completed, the label was removed and placed on the NWR. In the case of the subject monitor, the NWR was completed but the IM technicians were waiting for approximately one day to assure instrument failure did not recur before having the monitor declared back in service. Control room operators keep track by the PT-14 records (Inoperable Equipment Surveillance Tests); however, it appeared desirable for OOS tags to be placed on the RMS panels until the instruments are back in service so that the personnel who operate the RMS or check monitor status would know which instruments are OOS. The licensee stated that a review of the current tagging procedure would be done and revised if necessary.

- The PM program for the RMS appeared ineffective based on a study completed by a licensee consultant in early 1989. The RMS blower PM did not make an improvement in blower performance in that 100 NWRs were issued for this problem in 1987-1988, of which 39 NWRs were during the last half of 1988. The blower manufacturer specified that the blowers should last for 30,000 hours of operation with a PM program that addressed fan

belts, motors, and a specific lubrication schedule; yet the consultant reported a mean time to failure of 7,000 hours. The consultant also reported that the sample canister PM program appeared to be ineffective. A more effective and thorough RMS PM program should be addressed by the licensee.

Maintenance weaknesses regarding RMS reliability were discussed with station management and will be reviewed further during a future inspection (Open Item 295/89018-03; 304/89017-03).

3.3.4 Maintenance Facilities, Material Control, and Control of Tools and Measuring Equipment

The inspectors reviewed the licensee's activities in the areas of facilities, equipment, and material control to assess support given to the maintenance process. Interviews were conducted with various maintenance management and craft personnel to determine the policies, goals, and objectives; and followup observations were performed to determine the extent to which the plant practices, procedures, equipment, and layout supported the maintenance process.

3.3.4.1 Facilities

The electrical maintenance workshop areas appeared to be adequate. No congested or crowded conditions were noted.

Mechanical maintenance facilities were generally adequate; however, the inspectors noted that the "Hot Tool Room," located in the Auxiliary Building, did not have a list of hot tools contained there, and did not maintain any control on the tools issued or received. However, no evidence of contamination of plant areas or personnel due to the lack of positive control of hot tools was noted during the inspection. The licensee stated that a program for control of hot tools was still in the developmental stage.

I&C maintenance facilities were adequate. The instrument maintenance workshop was located on the turbine deck and provided easy access to the control room and auxiliary electrical areas. The master instrument mechanic, foreman, work analysts, and scheduler's offices and the tool issue room were adjacent to the work shop.

3.3.4.2 Material Equipment, and Tool Control

Warehouse facilities at Zion included two warehouses, one inside the controlled area and one outside. Neither warehouse had a Level A storage area; however, the inspector was told there were no items specified as requiring Level A storage. Physical control of access to the warehouse facilities was good, environmental controls were acceptable, and cleanliness and housekeeping aspects were good. A system was in place for control of limited life material; however, some problems were noted in this area, which are addressed later in this section. Control for consumable materials such as solvents and cleaners, thinners, paints, oil, grease, and gasket materials appeared to be acceptable. A separate storage area had been

established for flammable materials and those that required special handling, such as hazardous materials, and those requiring specific safety precautions.

The inspectors reviewed a printout of electrical NWRs on hold for parts. Most of the items were ordered for the upcoming outage and no safety significant non-outage items were noted. None of the NWRs had a high working priority.

The licensee utilized a computerized system for tracking and controlling stock quantities, stock locations, and to initiate procurement of stock parts. This system automatically included the appropriate specifications, documentation requirements, testing, inspections, acceptance, records, acceptable sources, stock quantities, reorder points, and reorder quantities as well as indicating lead times. The computer information was updated as needed by engineering, procurement, or stores, as appropriate.

During the review of the procurement and stores area, the following concerns were identified:

- Three different items of limited life material were found in stores without being identified as limited life material and with no expiration date specified. Items noted were as follows:

  a. Item 350076, RTV Silicone Sealant -- two boxes not identified as limited life material and no expiration date.

  b. Item 709207, White Adhesive Sealant -- 17 tubes not identified as limited life material and no expiration date.

  c. Item 709174, RTV Red Heat Resistant Sealant -- 158 tubes; of these, 1 box of 36 tubes was identified as limited life material on the box. Individual tubes were not identified. None of the other 122 tubes was identified on the box or the tubes. Loose tubes were on the shelf available for issue.

  All of the above items were non safety-related material. During the review of ZAP-13-52-2, "Preventative Maintenance and Limited Shelf Life of Safety-Related, ASME Code, Regulatory Related, and Non Safety-Related Items," Revision 7, the inspector noted that Paragraph 1.b. required the labeling of limited life material which must include the discard date. Significant management attention is required in this area to assure adequate control of limited life material.

- In reviewing welding materials in stores, the inspectors noted that a number of welding backing rings had significant surface rust. This rust made the backing rings unusable without extensive cleaning. The inspector was told that most of the welding material was old and had been transferred to stores from construction.

- Significant differences in the numbers specified to be in stock and the actual numbers in stock were noted in items stored in the warehouse in the controlled area. This condition did not appear to exist in the other warehouse.

- In the electrical maintenance areas, the inspectors noted a significant amount of material stored in the shop area. Some of this material appeared to be used and was stored in open bins but not marked by part number or other identifier. The inspector was told this material was material to be used for parts in non safety-related applications. The inspectors were also told there was no procedure for control of these parts. This did not appear to be appropriate control even for non safety-related parts. Another storage area in electrical maintenance was locked and was marked "Safety-Related." This storage area contained new expendable parts such as lugs and splices that were appropriately identified by both part number and purchase order number.

Overall, this area was considered to be satisfactory. Management attention is needed in the control of limited life material and non safety-related electrical components.

3.3.4.3 Control and Calibration of Measuring and Test Equipment (M&TE)

Control of MT&E was satisfactory in that defective or "calibration due" instruments were segregated from those in calibration and acceptable for use. Procedures were developed for the issue, return, and recall of M&TE. The individual checking out an instrument; the work order, procedure, or location used; date out, and date returned were recorded for permanent records.

All three maintenance disciplines maintained their own M&TE issue room. A strength noted by the inspectors was that the mechanical tool room attendants noted the pre-use and post-use test reading for torque wrenches and micrometers. This practice precluded the issuance of equipment that was out of calibration. If a tool was found to be out of calibration after use, the work crew was issued another tool for the verification of the work done with the faulty tool. This method prevented multiple usage of a defective tool. Much of the certified equipment onsite was sent off-site to Systems Operations Analysis Department (SOAD) for calibration.

3.4 Review and Evaluation of Maintenance Accomplished

3.4.1 Backlog Assessment and Evaluation

The inspectors reviewed the amount of work accomplished compared to the amount of work scheduled. Emphasis was placed on work that could affect the operability of safety-related equipment or equipment considered important to safety, which included some balance of plant components. Maintenance work item backlogs were evaluated for safety impact of deferrals and deferral causes.

3.4.1.1 Corrective Maintenance Backlog

The majority (61.5%) of non-outage corrective maintenance NWRs were prioritized B2, which was defined in the COM as work that must be scheduled within five days. Also, priority B1 non-outage NWRs, defined as work to be scheduled within 24 hours, constituted approximately 10% of the backlog. As a result of discussions with the licensee, the entire backlog of NWRs was reviewed to determine if any affect plant operability or should be immediately completed. The licensee determined that none of the backlogged NWRs needed to be reclassified to a higher priority; however, the majority were reclassified in accordance with the COM. As a result, the percentage of B2 NWRs dropped from 61.5% to 7.5% and B3 NWRs (schedule work as time permits) increased from 24% to 86%. The inspectors reviewed a sample of reprioritized NWRs and no concerns were noted. The licensee stated that changes were needed in Zion's NWR prioritization process to agree with the COM.

The backlog of both outage and non-outage NWRs was tracked by the maintenance department by use of a computerized system. Backlog information could be obtained from the computer at any time. A tracking report was issued monthly to management on the status of the backlogs. The current as well as previous month's backlogs were listed so changes were readily apparent. The report also indicated the percentage of NWRs open more than three months. At the time of the inspection, Zion was meeting the goal of less than 50% NWRs greater than three months old.

Approximately 130 NWRs were identified by the computer as awaiting parts; however, the majority were outage related. The inspectors reviewed several non-outage and outage backlogged NWRs and determined that none had impact on operability.

The inspectors determined that on July 18, 1989, the non-outage NWR backlog was 901 for mechanical maintenance (MM), 148 for electrical maintenance (EM), and 144 for instrumentation maintenance (IM). The CM backlog was low and within the capabilities of current staff; however, pending NWRs were still above the station goal of 850. Based on the number of craftsmen and an average manhours per MWR completion, there was approximately eight weeks work for MM, and two weeks for EM and IM.

3.4.1.2 Preventive Maintenance Backlog

Preventive maintenance NWRs were also tracked by a computerized system. PM was accomplished by nonscheduled NWRs and by scheduled PMs, which were mostly accomplished using procedures rather than work requests. The scheduled PMs were tracked by the General Surveillance Program (GSVR). Also included in the PM program were lubrications that were tracked monthly. Based on review of licensee records, the inspectors determined that on July 18, 1989, the nonscheduled PM backlog was 498 and the scheduled PM backlog was 66. No scheduled PMs were deferred; all 66 were classified as past due. This backlog was low and represented a little more than one months work. The

licensee's ratio of PM hours to total maintenance hours averaged about 46% which was higher than the industry average of 42%.

Review of the outage and non-outage backlog of PM NWRs did not identify any that could adversely affect operability.

3.4.2 Review and Evaluation of Completed Maintenance

The inspectors selected the equipment and systems identified in Section 3.1.2 of this report for further review. The purpose of this review was to determine if specified electrical, mechanical, and I&C maintenance on those selected systems/components was accomplished as required. This review included:

Application of risk-based priority to the performance and extent of maintenance.

Evaluation to determine the extent that RCM was factored into the established maintenance process.

Evaluation of the extent that vendor manual recommendations, IE Bulletins (IEB), IE Notices (IEN), Service Information Letter (SILS), Significant Operating Experience Record (SOERs), and other outside source information was utilized.

Evaluation of the extent that maintenance histories, NPRDS, information, LERs, negative trends, rework, extended time for outage, frequency of maintenance, and results of diagnostic examinations was analyzed for trends and root causes for modification of the PM process to preclude recurrence of equipment or component failures.

Evaluation of completed CMWRs and PMWRs for use of qualified personnel, proper prioritization, adequate work instructions, Quality Control (QC) involvement, quality of documentation for machinery history, description of problems and resolutions, and post maintenance testing.

Evaluation of work procedures for inclusion of QC hold points, acceptance criteria, ease of use, and general conformance to NUREG/CR-1369.

Backlogs for selected components.

3.4.2.1 Past Electrical Maintenance

The inspectors determined that the Electrical Department philosophy addressed elements of RCM, which included vibration analysis. Equipment failure trending and analysis of maintenance problems was addressed in the licensee's TJM and Problem Analysis Data Program (PADS) which is discussion in Section 3.6.2 of this report.

The inspectors reviewed 65 completed NWRs in the electrical maintenance area. Most of the NWRs did not describe the component failure (Maintenance Code Block) or the reason for the failure

(Maintenance Cause Code) as required by ZAP 3-51-1, Revision 33. The reviewed NWRs contained the appropriate approval signatures and the required tests were signed as completed. A review of the tests conducted revealed that the tests properly tested the corrective maintenance activities described in the "work completed" section of the NWR. Approximately half of the NWRs contained brief work instructions which read "investigate and repair as necessary." The work descriptions were not specific. The brevity and latitude implied in these instructions caused the inspectors some concern. However, no instance of failure to use the appropriate procedure or to conduct work in accordance with established policy was noted during actual work observations by the inspectors.

On October 10, 1987, six NWRs (Z63523, Z63524, Z63689, Z63690, Z63691, and Z63692) were written and described the failure of the dc battery to dc bus feed breakers to reliably close on the first attempt. As of June 22, 1989, these NWRs were still open. An investigation by vendor representatives (undocumented) indicated that the problem appeared to be worn bearings. The licensee could not describe with certainty which bearings were worn. Based on discussions with the system engineer, the breakers have always closed on the second attempt. No tracking system had been established to track the operation of these breakers to determine if the closure action performance was degraded. Replacement of the breakers required deenergizing the bus. The Technical Staff and the Electrical Department indicated that they would like to replace the breakers; however, the Operations Department did not want to deenergize the bus. No action plan to replace or repair these breakers was presented to the inspectors. The inspectors were concerned that the licensee was not pursuing an aggressive action plan to return these safety related breakers to fully reliable performance. Failure to take timely corrective action to correct breaker closure failures is an example of a violation of 10 CFR 50, Appendix B, Criterion XVI (295/89018-01B; 304/89017-01B).

The inspectors reviewed Electrical Maintenance Procedures to verify inclusions of vendor recommendations, IEBs, IENs, and other outside source information. The procedures were reviewed to determine that appropriate QC hold points were identified. The following procedures were reviewed:

E000-1, "Motor Test or Disconnect/Connect Data," Revision 0

E005-1, "Repair or Replacement of Logic Relays," Revision 7

E022-1, "Inspection and Maintenance of Limitorque Valve Motor Operators," Revision 7

E024-2, "ASCO Solenoid Valve Replacement and Installation," Revision 0

E028-1, "Cubicle Cooler Fan Motor EQ Inspection/Maintenance," Revision 1

TSSP-139-89, "Test of 1B AFW Pump Control Switch at Remote Shutdown Panel," Revision 0

The review indicated that the procedures did contain information or references to outside source documents such as IEBs, IENs, and vendor notices. QC hold points were properly identified in the procedures. The inspectors were concerned that one procedure, E028-1, allowed the sequence of accomplishment up to electrical personnel performing the field work, which could lead to an undetected electrical problem. This is discussed in Section 3.3.2.1.

The inspectors reviewed the Vendor Manual upgrade program, ZAP 6-25-5, "Zion Station Vendor Equipment Technical Information Program (VETIP)," Revision 8. The VETIP program began in late 1988 and is expected to be completed in mid 1991. The program insured no unreviewed Equipment Technical Information (ETI) was used in the performance of work on the equipment defined and to control Equipment Technical Information Manuals. The defined equipment included Safety-Related, Regulatory Related, Reliability Related, and other equipment selected by the station. Information sources for the ETI program included Vendor Manuals/Bulletins/Notices, NRC Bulletins/Notices/Generic Letters/Part 21 Notifications, Station Experience, and Industry Sources. Approximately 150 of an estimated 3,000 manuals have been completed. It is estimated that 45,000 components and equipment will be included in this upgrade program when completed. Manuals that have not been reviewed by the VETIP procedure are used only with approval of the appropriate Maintenance Department Head. However, no check was required to ensure existing maintenance procedures agreed with the new controlled manuals.

A review of selected vendor manuals was conducted to ensure that vendor recommended maintenance actions and frequency were accomplished. The inspectors were concerned that the licensee had not verified that the PM program incorporated the vendor recommendation for maintenance or provided justification, by analysis, for changes to the vendor recommendations. For example:

- The essential switchgear vendor recommended an inspection interval of every 6 months; the licensee schedule was every 18 months.

- The Buffalo-Forge manual for the Auxiliary Building Ventilation Supply Fan could not be located. However, the manual for the exhaust fan (same vendor) suggested a motor bearing lubrication frequency of every nine months. The inspectors could not find the supply fan equipment identification number in the Lubrication Program Auxiliary Building Ventilation records.

3.4.2.2 Past Mechanical Maintenance

The inspectors determined that the mechanical philosophy did include some concepts of RCM. The licensee used vibration analysis for predicting the reliability of pumps and fans. The licensee also measured the pipe wall thickness in steam extraction lines and

feedwater lines to predict possible failures based on reduction in wall thickness.

The licensee was in the initial stages of a new MOV overhaul and diagnostic program for all MOVs in the plant. The overhaul consisted of a complete inspection and PM that included lubrication of the main gear case, limit switch compartment and valve stem, and proper setting of torque and limit switches. The program was scheduled to begin during the next refueling outage.

Zion experienced 26 MOV failures during 1988, which was down from 43 failures in 1987. This downward trend was expected to continue because all safety-related/non safety-related MOVs had been recently added to the PM program.

The licensee did not perform stem thrust diagnostic testing on any MOVs. Current signature traces were used to determine the relative condition of the MOV. Current signature measurements are the simplest, but yield the least accurate results. It was noted that Zion was implementing a MOV test program which would yield stem thrust measurements by yoke strain measurement. This measurement will provide the most accurate information in both the closed and open direction through the entire stroke. Zion was considered behind the industry in taking initiatives to improve valve diagnostics.

The inspectors reviewed the following Zion procedures used for maintenance activities for completeness, necessary approvals, adequacy of work instructions, inclusion of QC hold points, and acceptance criteria, when applicable.

P/M017-1N, "Hydraulic Snubber Handling and Rebuilding Procedure," Revision 8

P/M017-3N, "ITT Grinnell Hydraulic Snubber Removal, Decontamination and Reinstallation," Revision 3

PT-7, "Auxiliary Feedwater System Checks and Tests," Revision 42

TSS 15.6.48, "Hydraulic and Mechanical Snubbers Surveillance," Revision 21

ZAP 3-51-1, "Organization and Routing of Work Requests," Revision 33

ZAP 10-51-1, "Backseating Instructions," Revision 4

ZAP 10-52-10, "Vibration Monitoring/Analysis Program," Revision 12

The inspectors determined that the procedures reviewed were generally adequate. However, Zion Station Administrative Procedure ZAP 10-52-10 included criteria for alert and action limits for vibration levels of the auxiliary feedwater turbines as 5.91 and 10.61 mils peak to peak, respectively. The station vibration coordinator stated that these limits were based on the Canadian government specification CDA/MS/NUSH 107 for small turbines. The

procedure also stated that specific limits from pump manufacturers will apply, if more limiting than CDA/MS/NUSH 107. The inspectors reviewed the turbine vendor manual and found that recommended vibration levels were 3 and 5 mils peak to peak respectively, for operation and trip of the AFW turbine. Therefore, the vendor recommendations would apply. Neither the system engineer nor the vibration coordinator were aware of the more restrictive criteria from the vendor. The inspectors reviewed past vibration measurements and found no instances where vibration levels exceeded 3 mils. However, excessive unacceptable vibration levels on these turbines could have gone unnoticed.

The inspectors evaluated the extent that vendor recommendations, IE Bulletins, IE Notices, and vendor information bulletins or letters were utilized in the maintenance of the components selected, including feedwater pumps and turbines.

Vendor manuals reviewed were as follows:

ETI 000017, "Terry Turbine Instruction Manual," Revision 0

ETI 000082, "Pacific (Dresser) Pumps Instruction Manual," dated October 3, 1986

ETI 000103, "Trane Reciprocating Compressors Manual," Revision 0

ETI 000108, "Circulating Water Pumps Manual," dated October 1969

The inspectors verified that the vendor recommendations were adequately addressed in the licensee's PM program; however, the following was noted.

- The AFW pump turbine manual included recommendations from Woodward Governor (Bulletin 36694D) that the overspeed governor and trip mechanism be tested regularly, preferably once a week. Schutte Koerting Company, who supplied the throttle and trip valves, included a recommendation that the moving parts be lubricated at least once a week, and that all parts be kept clean. Contrary to the vendor recommendations, the licensee had never tested the overspeed trip mechanism of Unit 2 AFW turbine. The Unit 1 trip mechanism was tested once during April 1987, with limited success.

  The inspectors were concerned that lack of testing of the the Zion Unit 2 AFW turbine overspeed trip mechanism could subject the downstream piping of the AFW system to overpressurization should the turbine overspeed and the trip mechanism fail to function. Information Notice No. 88-67 was issued on August 22, 1988, and described a July 1988, failure of the AFW pump turbine overspeed trip mechanism at San Onofre Station. A failure of the overspeed trip mechanism at Rancho Seco Nuclear Plant occurred during January 1989, an incident in which the AFW system was overpressurized.

The licensee was aware of the AFW turbine test deficiency as early as July 1986, when General Electric (GE) Memo G-EBO-6-225 was received and identified problems with the Terry Turbine trip assemblies. A similar finding was made again by INPO during Zion's February 1989 assessment. The licensee proposed corrective action to this finding was to test the linkage and valve mechanism monthly and conduct the actual overspeed tests periodically, typically during each refueling outage.

Subsequent to the inspection and NRC concerns, the licensee tested the Unit 1 linkage and valve mechanism on July 22-23, 1989, in accordance with Zion procedure TSSP 151-89, Revision 0. During the test, the valve did not actuate as required when the manual trip lever was depressed. Maintenance had to be performed to remove paint and corrosion from the mating surfaces and lubricate parts.

Subsequent to this maintenance, the Unit 1 AFW turbine overspeed trip mechanism was tested successfully. The licensee informed the NRC inspectors that the linkage and valve mechanism tests on the Unit 2 auxiliary feed turbine were successfully completed on July 23, 1989.

The following are concerns regarding the lack of testing of the AFW turbine overspeed trip mechanism:

- There were no documented records available to demonstrate that the AFW turbine overspeed trip tests were conducted during preop/startup testing phase.

- Vendor recommendations for testing the overspeed trip mechanisms weekly were never translated into station PM procedures.

- Actual overspeed trips were never performed on the AFW turbines prior to 1987 on Unit 1, and July 1989, on the Unit 2 AFW turbine even though the licensee had knowledge of IE Notice 88-67.

- Corrective action to test the overspeed trips from 1987 until 1989 was untimely.

- The licensee did not evaluate the safety significance of non-operability of the overspeed trips.

Based on the above, the inspectors concluded that the licensee did not take timely or adequate corrective actions to inspect, maintain, and test the overspeed trip mechanisms of the AFW turbines, even though the licensee knew of the problem since at least July 1986. The inspectors determined that if the Unit 1 AFW turbine overspeed trip had been required to operate during an actual event, the failure could have overpressurized the Unit 1 AFW piping system. The failure of the overspeed trip mechanism was considered significant, as the AFW system is designed to prevent or mitigate a serious safety event. The licensee's inadequate and untimely corrective action of several years in dealing with this significant issue is an example of a

violation of 10 CFR 50, Appendix B, Criterion XVI, (295/89018-01D; 304/89017-01D).

3.4.2.3 Past Instrumentation and Control Maintenance

The inspectors determined that the I&C maintenance philosophy included some concept of RCM. Maintenance was primarily based on vendor manuals and previous maintenance history.

The inspectors evaluated the extent that vendor recommendations, IEB's, IENs, SILs, and other outside source information was utilized in I&C maintenance. The component selected for evaluation was the Rosemount, Inc. pressure transmitters. The inspectors reviewed the following documentation:

10 CFR 21 Report from Rosemount, Inc., dated February 9, 1989.

IEN 89-42, "Failure of Rosemount Models 1153 and 1154 Transmitters."

Vendor Manual 4302, "Model 1153B Alphaline Pressure Transmitters for Nuclear Service," Revision E.

The 10 CFR 21 Report documented a problem with pressure transmitters that manifests itself as degraded response time over full range and/or overall increased response time. The licensee had reviewed the problem and had a testing procedure developed by Northeast Utilities that will be used to test all Rosemount transmitters during routine outages. This testing should detect any degradation of the Rosemount transmitters installed at Zion.

The inspectors reviewed selected vendor source documents to determine if requirements specified were incorporated into appropriate maintenance procedures. The source documents reviewed were:

Heise Digital Pressure Indicator, Model 710A

Heise Digital Pressure Gage, Model 901 A/B

Hewlett Packard Digital Multi-Meter, 3466A

The inspectors verified that the vendor recommendations were adequately addressed in the appropriate calibration procedures with the exception of the temperature and humidity controls discussed in Section 3.3.4.3 of this report.

The inspectors reviewed component history for the I&C components and systems selected to determine whether methods had been established and implemented for detecting repetitive failures and adverse quality trends, and whether appropriate corrective action had been taken to address adverse trends. The inspectors also utilized NPRDS and LERs in the review to ascertain the effectiveness of the licensee's trend analysis and root cause analysis. Concerns were identified with the licensee's approach to both trend and root cause analysis and are discussed in Section 3.6 of this report.

The inspectors reviewed completed CMs and PMs for use of qualified personnel, proper prioritization, QC involvement, quality of documentation for the work history and post-maintenance testing. The following concerns were identified:

- Post-maintenance tests were insufficiently specified and poorly documented as discussed in Section 3.5 of this report.

- Work history documentation was poor. Simple, general statements were used to describe completed work such as "Completed calibration" or "Repaired." Cause codes were not indicated in 8 of 27 NWRs reviewed.

- QC hold points were required in only 5 of 27 NWRs reviewed.

The inspectors reviewed I&C procedures for inclusion of QC hold points, acceptance criteria and ease of use. The licensee was aggressively updating I&C procedures at a rate of approximately 60 per week. New procedures were detailed, contained vendor recommended refurbishments, required tools and necessary acceptance criteria; however, QC hold points were not included and management attention is needed to assure adequate QC coverage. The procedures were considered user friendly.

3.5 Maintenance Work Control

The inspectors reviewed several maintenance activities to evaluate the effectiveness of the maintenance work control process to assure that plant safety, operability, and reliability were maintained. Areas evaluated were control of maintenance work orders, equipment maintenance records, job planning, prioritization and scheduling of work, control of maintenance backlog, maintenance procedures, post maintenance testing, completed documentation, and review of work in progress.

Job planning was not detailed. Several work packages were inaccurate or incomplete, and contained insufficient information to support consistent quality work. Work packages appeared to be developed to support any contingencies that could develop from the problem/work requested in the NWR and were not tailored to the work instructions. The work instructions were often vague and contained general directions such as "repair/replace" or "investigate and repair." Pre-job scoping was frequently not effectively performed.

In some instances, procedures required for the work identified in the work instructions were omitted from work packages. Other procedures, not related to the work instructions, were incorporated in the work packages without indication of how or in what sequence the procedures were to be used. Examples of insufficient job planning are contained in Sections 3.3.2 and 3.4.2.1 of this report.

PMT requirements were insufficiently specified, and the results of post maintenance tests were inadequately documented in work packages. Station procedures for PMT were drafted but had not been approved.

Work analysts had received some guidance and informal training had been conducted on PMT; however, weaknesses still existed. Examples of problems noted include the following:

- NWR 83200 - Required the replacement of a filter in the system due to a high differential pressure (delta-P). No PMT was specified to check the delta-P under normal system flow following completion of the maintenance. The delta-P was not recorded at the completion of work.

- NWR 78321 - Identified a problem with Nuclear Instrument indication. The work instructions required the verification of compensating voltage per Calibration Procedure IN-35E. This procedure was not used to perform the work and PMT was not specifically specified. The "work performed" section of the work package stated "comp. voltage read - 40.98 vdc". PMT should have included verification of the nuclear instruments calibration per procedure.

During the inspection, increased emphasis on PMT was noted with nine of ten I&C work packages, and four of five electrical work packages prepared by work analysts that clearly indicated PMT. However, most of the completed work packages reviewed did not specify PMT after maintenance activities that would require such testing.

The inspectors reviewed the areas of maintenance work planning and scheduling. The inspectors reviewed these items with the mechanical scheduler and the mechanical senior work analyst. Personnel appeared to be knowledgeable in the areas assigned. The inspectors were told the mechanical maintenance department planned to increase the current staff of four work analysts to nine, in view of the increased scope of work. The inspectors noted concerns in prioritization of the maintenance work as discussed in Section 3.4.1.1.

3.6 Engineering Support of Maintenance

The inspectors evaluated the extent to which engineering principles and evaluations were integrated into the maintenance process. This was accomplished by review of maintenance work orders, activities associated with failure analysis, and other maintenance activities to evaluate the effect of engineering support. Areas reviewed were engineering support to PM, material qualifications, compliance with codes and regulations, system engineering concepts, industrial initiatives and post-maintenance testing.

3.6.1 Engineering Support

The "System Engineer" concept was not fully functional at Zion Station. Tech Staff engineers, in general, were given assignments on a functional basis such as erosion/corrosion program, plant life extension, vibration analysis, eddy current analysis, and pump and valve program. Some assignments in the thermal group were made on a system basis.

Specific responsibilities for system engineers were not included in any specific procedure; however, the position descriptions for engineers were issued in a paper dated April 15, 1987. Minimum qualifications for systems engineers were not considered to be very demanding since requirements could be two years related experience or a high school diploma and one and one half years related experience. Discussions with several technical staff engineers indicated that the experience and expertise varied widely. While some engineers appeared to be knowledgeable in the systems assigned to them, others were not. The inspectors noted that some engineers kept notes on events in the assigned systems, but these were personal notes and were not considered to be comprehensive.

The following additional problems in the system engineer area were noted:

- The assigned engineer received the "blue" copy of the NWR when initiated; however, completed NWRs were not received. This prevented the system engineer from evaluating assigned system failures, detecting adverse trends, and determining root causes.

- As mentioned earlier, several responsibilities were assigned on a functional basis. The results obtained by the specialists were not routinely sent to the system engineers for review and analysis. For instance, the vibration coordinator did not inform the system engineer of vibration levels of a pump or a fan unless the vibration levels exceeded the alert or action limits. Similarly, the IST coordinators did not inform a system engineer about deteriorating performance of a pump, unless the performance was unacceptable as per the applicable code requirements. The assigned system engineers were not aware of events or performance problems unless unacceptable levels of performance had been reached.

- The inspectors noted some weakness in resolving problems due to distribution of work to different sections of the technical staff. When the inspector raised the issue of severe corrosion of service water piping inside the containment, the Service Water System engineer was not aware of the condition. The inspectors were referred to the Erosion/Corrosion Coordinator. The Erosion/Corrosion Engineer stated that the corrosion of service water piping inside the containment was handled by the corporate office.

- The inspectors discussed the silting problem in small heat exchangers, due to silt carried from the lake water. The system engineer for the Service Water System did not have a comprehensive understanding of these problems. The inspectors were informed that the silt problem would be handled by the corporate engineering staff.

3.6.2 Technical Supp[illegible]

Component trending was provided by Zion's TJM system. Station personnel were alerted in the event of an excessive number of "hits" (two) for corrective maintenance actions in a 12 month period. Hits were based on Equipment Identification Numbers or Manufacturers' Model Numbers. Excessive "hits" generated a report to Corporate Headquarters, which was forwarded to the station PADS Coordinator for evaluation. In the event the evaluation indicated the need for further analysis a PADS review was indicated and forwarded to the technical staff for evaluation. Other problems that could result in a PADS initiation included: (1) A safety-related, regulatory related, code, or reliability related component that caused the equipment or system to be declared inoperable or required more than 80 man-hours to repair; or corrective maintenance was the result of unsatisfactory PMT or the Min-Max TJM report showed a trend of repeat or rework. (2) A preventive maintenance or surveillance test that indicated a measured data point had deviated from its allowable band of operation and was not covered by a DR/LER/DVR/IDR. (3) A surveillance or a preventative maintenance activity had failed resulting in corrective maintenance.

The purpose of the PADS program was to provide a consistent method of performing systematic analysis of maintenance problems to determine the root causes and establish appropriate corrective action consistent with the importance of a given piece of equipment to prevent future failures. When initiated, a PADS report required the Work Analyst to review the TJM Maintenance History for failures occurring on the same type of equipment, model number, or components that have previously failed at the station. The analyst was also required to notify the system engineer or technical staff. The Work Analyst indicated the probable root cause and provided corrective action recommendations with concurrence from maintenance.

The trending and Root Cause Analysis (RCA) programs for maintenance activities were inconsistent and fragmented. A RCA procedure was in draft but had not been implemented. A Deviation Report (DVR) program existed only for major maintenance problems. The Discrepancy Report (DR) instruction had been in effect for only three months and the effectiveness of the program could not be evaluated. Trending programs existed, but were inconsistent and uncoordinated, and procedures were inadequate. Examples of trending programs included, Instrument Discrepancy Reports (IDR), Certified Instrument Discrepancy Reports (CIDR), TJM and NPRDS.

The primary document for initiation of RCA appeared to be DVRs. The DVR program had high thresholds for the initiation of a DVR. This limited the program to a very narrow range of events. The program was limited further by the inconsistent application of these thresholds. For example, a DVR was required for a 10% derating. The licensee's Monthly Report Data Forms for 1988 indicated 18 deratings of greater than 10% where no DVRs were initiated. Zion had 13 deratings in 1988/89 due to problems with steam generator chemistry on startup for which no DVRs were written. The DVR coordinator indicated that startup chemistry events were a perennial problem and that the pervasiveness and causal factors relating to startup

chemistry problems were known. However, RCA documentation for steam generator chemistry problems could not be provided when requested by the inspectors.

Other areas where RCA was considered a concern were:

- Consistent inoperability of Radiation Monitoring Instruments.
- Consistent failure of all dc Bus Tie to Battery breakers to close on the first attempt.
- Accelerated tube leakage of 2A steam generator with 212 tubes plugged compared to 54, 40, and 40 tubes plugged in the other Unit 2 steam generators.

The licensee's long term programs for improving RCA were relatively new; therefore, the implementation and effectiveness were difficult to assess.

Trending programs were uncoordinated. TJM, NPRDS, and PADS had different cause codes for documenting the same maintenance problem. Cause codes were insufficient. For example, TJM did not have cause codes for electrical/electronic component aging failures. No guidance was provided to indicate what components were covered by individual trending programs. This caused overlapping coverage and potentially a lack of coverage for some components.

The inspectors noted inconsistencies in the collection and dissemination of trending data. Cause codes needed for trending were not documented in 8 of 27 completed NWRs reviewed. No semiannual report for the IDR program has been issued for the past year.

Incomplete procedures existed for the IDR and CIDR programs. The reporting requirements for these programs were in ZIAP 5-51-12, Revision 26. This procedure required copies of IDRs to be forwarded to the Technical Staff; however, no procedure existed for the trending and reporting of IDR data by the Technical Staff. ZAP 15-53-1, "Processing Discrepancy Reports," Revision 1, required the initiation of a DR for broken or out-of-tolerance M&TE. The I&C department did not use DRs for MT&E problems. CIDRs were written for broken or out-of-calibration MT&E and turned into the QA department in place of DRs. The QA department did not log CIDRs as required by the DR procedure and no formal procedure existed for the trending and reporting of CIDR data.

3.7 Maintenance and Support Personnel Control

The inspectors reviewed the licensee's staffing control and staffing needs. Inspection activities included interviews with plant personnel, training facility observations, in plant observations, and review of documentation.

The licensee had developed a comprehensive plan for personnel control, which was proceduralized and integrated into the maintenance

process. The organization chart was available and generally up to date. Selected personnel at various management levels were interviewed and were found to be knowledgeable of responsibilities and accountability. The staffing requirements for the Mechanical, Electrical, and I&C departments appeared to be adequate for non-outage work. The inspectors were told these departments were supplemented with contractor services during heavy outage work loads. Contractor services could not be adequately assessed during this non-outage inspection.

The maintenance training program was accredited by INPO on November 25, 1987. The inspectors observed the licensee's training facilities and noted the use of mock-ups for all maintenance disciplines.

3.8 Review of Licensee's Assessment of Maintenance

The inspectors evaluated the licensee's quality verification process in the maintenance area by the review of audit reports, surveillance reports, corrective action documents, the maintenance self assessment, and the Auxiliary Feed Water Safety System Functional Inspection (SSFI) report. The documents were reviewed to assess technical adequacy, root cause analysis, timeliness of corrective action, and justification for close out of corrective action documents.

3.8.1 Audits and Surveillances

The inspectors reviewed records of five audits conducted during the last year which covered portions of maintenance. A complete audit of maintenance had not been performed. Maintenance audit coverage was usually provided by specific product audits which were very limited in scope, only addressed small portions of maintenance, and did not appear to be performance oriented. However, two of the audits reviewed appeared to provide good coverage of PM in the mechanical and electrical disciplines. These audits were conducted in December 1988, and March 1989, and resulted in the identification of several significant PM problems. These included inadequate equipment lubrication and PM activities not being completed as scheduled. Although some improvement had been made, these same conditions still existed and were noted during this inspection. The inspectors were told that a complete maintenance audit was scheduled in July 1989. The inspectors reviewed the check lists for this scheduled audit and noted that the methods of verification were not specified; therefore, it could not be determined if the audit would be performance oriented or not.

The inspector reviewed records of four QA surveillances conducted during 1989 between January and March. These surveillances, although very limited in scope, included the observation of work and appeared to be performance oriented. No findings were identified during these surveillances. Based on the results above, it appeared that the QA surveillance program was performance oriented and provided a good supplement in the licensee's assessment of maintenance.

3.8.2 Review of Maintenance Self Assessment and SSFI

3.8.2.1 Maintenance Self Assessment

The inspectors reviewed the report of the licensee's self assessment of maintenance performed by maintenance management personnel from other CECo nuclear power stations and corporate operations, maintenance, stores, and training staffs during September of 1987. A copy of this assessment was not sent to QA for utilization in QA followup audits of maintenance. Based on reviews and comparisons with other industry self assessments of maintenance and the results of this current NRC inspection, the inspectors concluded that the licensee's self assessment was effective in the identification of maintenance problems and concerns. However, many of the problems and concerns identified during the self assessment in 1987 were noted by the inspectors during this inspection. This indicated inadequate or untimely corrective action. The following weaknesses were noted:

- AFW components including overspeed protection testing were not tested per vendor recommendations; discussed in Section 3.4.2.2 of this report.
- Failure to follow procedures and inadequate procedures; noted in Sections 3.3.2.1, 3.3.2.2, and 3.3.2.3 of this report.
- Post-Maintenance Testing; discussed in Section 3.4.2.3 of this report.
- Temporary Modifications; discussed in Section 3.3.1 of this report.
- Work Control; discussed in Section 4.3.1 of this report.

Failure to provide adequate and timely corrective action on known problems in post maintenance testing, temporary modifications and work control is considered to be a violation of 10 CFR 50, Appendix B, Criterion XVI (295/89018-01C; 304/89017-01C).

3.8.2.2 Safety System Functional Inspection (SSFI)

A self initiated SSFI of the AFW system was conducted from June 1 to September 13, 1988. No maintenance deficiencies were identified during the SSFI; however, two maintenance concerns were identified. These concerns related to the failure of engineering to provide adequate documentation of torque switch settings to maintenance, and the failure to test the AFW turbine overspeed trip mechanism. The first concern was followed up by QA and was recently closed. The findings and concerns from the SSFI concerning the AFW turbine had not been addressed and again validated the team's finding of untimely corrective action.

3.8.3 Effectiveness of Corrective Action

Findings from the product audits associated with maintenance appeared to be adequately closed. The findings from the audits of PM conducted in December 1988 and March 1989, were still open; however, improvements appeared to have been made in the preventive maintenance area.

Overall, the licensee's self assessment of maintenance was not totally effective, primarily due to the lack of followup and corrective action on problems identified during the maintenance self assessment and the lack of substance and depth in QA audits.

Recent improvements in the audit program including the scheduling of specific audits to cover maintenance and the current emphasis on performance based audits have the potential to substantially improve management's ability to adequately assess the maintenance process.

4.0 Synopsis

4.1.0 Overall Plant Performance

4.1.1 Performance Indicators

The historical data indicated a trend of poor performance in maintenance. Failure to meet the safety performance goal for the Auxiliary Feedwater System due to a leaking valve was attributed to poor maintenance. In addition, five of the six forced outages in 1989 were due to equipment failures that indicated lack of or poor maintenance. The sixth forced outage was during maintenance related troubleshooting. Goals had not been set for all categories and systems.

4.1.2 Plant Walkdowns

Housekeeping was considered good. Overall, the material condition of the plant was considered satisfactory for a plant in operation.

4.2 Management Support of Maintenance

4.2.1 Management Commitment and Involvement

Management was committed to improve maintenance activities at Zion as shown by the work in progress on assigned sections of the Conduct of Maintenance program; however, implementation of these programs appeared to be severely lagging.

Management was committed to the improvement of the maintenance process at Zion as evidenced by:

- Commitment for a more aggressive implementation of the numerous new maintenance related programs that were recently started at Zion.

- Aggressive involvement in upgrading housekeeping.

- Commitment to a reliability centered maintenance type study on the Feedwater System.

- More aggressive approach to implement a multi-faceted predictive maintenance program at Zion; for example, use of thermography.

Based on weaknesses identified during this inspection, it was apparent that continued involvement and strong commitment by management is necessary to improve maintenance activities to the level desired by Commonwealth Edison. Areas in need of management attention are:

- Lack of aggressive system engineering involvement in the maintenance process.

- Lack of prompt corrective action to address recurring problems identified previously by various maintenance assessments at Zion. In addition, incomplete work packages, inadequate procedures, inadequate or non-existent post maintenance testing and temporary modifications were also identified by the team and by various self assessments as recurring problems.

- Vendor recommendations were not incorporated into maintenance procedures nor assessed for a basis not to do so, and all components requiring preventive maintenance were not identified in the preventive maintenance program.

- Lack of interim measures to address weaknesses that were not yet corrected by the maintenance pilot programs at Zion.

- Lack of QC involvement in corrective maintenance activities.

- Limited diagnostic program for motor-operated valves as compared to other sites that have been inspected.

- Lack of personnel adherence to procedure requirements which appeared to be a recurring problem.

- Lack of a comprehensive trending program and aggressive failure analysis for corrective maintenance.

4.2.2 Management Organization and Administration

The inspection indicated satisfactory performance of the management organization in the administration of the maintenance program. Although the forced outage goals were not met in 1988 and will probably not be met in 1989, the equivalent availability of Units 1 and 2 in 1988 exceeded the goal and will probably meet or exceed the goal for Unit 2 in 1989; however, increased management attention to address equipment failures is needed to meet the goal for Unit 1. The following observations were made:

- A long range maintenance program had been established as specified in the Conduct of Maintenance Manual.

- Plant housekeeping improvements such as the plant painting program had made definite housekeeping upgrades.

- Ongoing facilities improvement should also help consolidation of groups.

However, based on the weaknesses noted below, it was apparent that the administration of the maintenance program needs increased management attention. For example:

- Although thermography was not a part of Zion's current predictive maintenance program, a program is being initiated.

- Increased management attention was needed to implement the various pilot and new programs.

- Additional management attention was needed to repair equipment leaks.

- Performance indicators did not measure effectiveness of maintenance such as the number of limiting conditions for operation and power reductions due to equipment problems.

- Goals and performance data were not set for three of the four systems selected for this inspection, and several set goals were changed (increased) during the year.

- Prioritization process of Nuclear Work Requests needs to be assessed.

4.2.3 Technical Support

The licensee's technical support of maintenance was considered satisfactory; however, significant weaknesses were identified that were caused by inadequate implementation of the "System Engineering" concept. These weaknesses, if left uncorrected, could lead to poor plant performance. Some weaknesses were:

- No specific guidelines exist for the implementation of the "System Engineering" program.

- System engineers did not routinely receive the performance data on the components in the systems assigned unless the alert or code limits were exceeded.

- System engineers did not appear to be taking an active role in failure analysis and trending.

- System engineers did not appear to have reviewed all assigned vendor manuals for preventive maintenance and periodic inspections to ensure recurring maintenance requirements were included in the maintenance program.

- Trending and root cause analysis of system and component problems was inconsistent and fragmented.

- A comprehensive evaluation was not performed for testing auxiliary feed turbine overspeed trips since the problem surfaced in 1986.

- Total Job Management data base was not complete or accurate in the areas of cause codes and as-found data.

4.3 Maintenance Implementation

4.3.1 Work Control

The licensee's work control activities were considered satisfactory with the following strength:

- Although the pending non-outage corrective Nuclear Work Request backlog did not meet the goal of 850, the backlog of corrective and preventive maintenance was low and within the working capabilities of the maintenance department.

The inspectors noted that weaknesses existed as follows:

- Poor work request format, which included inadequate space for workers' notes and no space for post maintenance testing, resulted in inadequate and inaccurate Total Job Management data.

- Detailed work instructions on numerous work requests were not specified.

- Deficiencies noted by workmen were documented in an uncontrolled manner, on loose notebook sheets, which tended to preclude use of the information in future maintenance activities.

- The work request prioritization system was inadequate and not consistently followed. Instances were identified where high priority work requests were not completed for an extended time period without technical justification. The present system allows for corrective work to continue indefinitely.

- Work request cause codes were incorrectly used. In addition, not all required blocks were filled in and data was not used for trending.

4.3.2 Plant Maintenance Organization

The licensee's performance in this area was considered satisfactory. Strengths and weaknesses were identified, such as:

- Instrument and Control maintenance department had aggressively upgraded procedures.

- Although plant system integrity was maintained and controls of maintenance activities were monitored, rework and

troubleshooting activities, implementation of vendor technical recommendations, work planning, and adherence to procedure requirements were considered weak.

4.3.3 Maintenance Facilities, Equipment and Material Control

The inspectors considered the licensee's performance as satisfactory. The following weaknesses were identified:

- Inadequate program to control hot tools.
- In plant storage was of a lower standard than the standard warehouse storage.
- Several examples were noted where limited life items were not properly controlled.

4.3.4 Personnel Control

Management personnel were knowledgeable of responsibilities and accountability. Staffing requirements for the maintenance departments appeared adequate for non-outage work.

5.0 Open Items

Open items are matters which have been discussed with the licensee, which will be reviewed further by the inspector, and which involve some action on the part of the NRC or licensee or both. Open items disclosed during the inspection are discussed in Paragraph 3.3.3.

6.0 Exit Meeting

The inspectors met with licensee representatives (denoted in Paragraph 1) on July 24, 1989, at Zion Nuclear Generating Station, Units 1 and 2, and summarized the purpose, scope, and findings of the inspection. The inspectors discussed the likely informational content of the inspection report with regard to documents or processes reviewed by the inspectors during the inspection. The licensee did not identify any such documents or processes as proprietary.

APPENDIX A

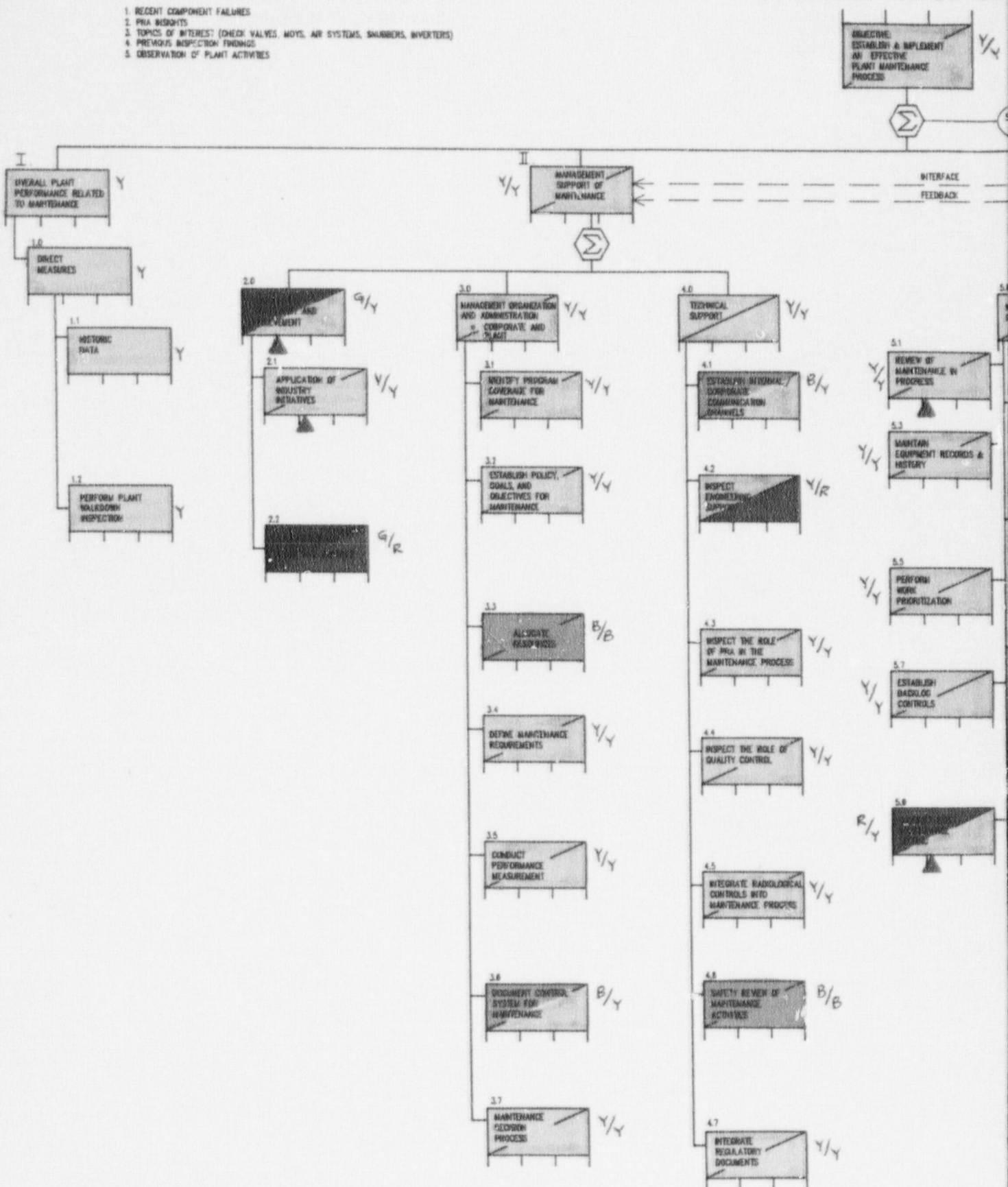
AC	Alternating Current
AFW	Auxiliary Feedwater System
ALARA	As Low As Reasonably Achievable
AV	Auxiliary Building HVAC
BOP	Balance of Plant
CECo	Commonwealth Edison Company
CIDR	Certified Instrument Discrepancy Reports
CM	Corrective Maintenance
CMWR	Corrective Maintenance Work Request
COM	Conduct of Maintenance
DC	Direct Current
DG	Diesel Generator
DR	Discrepancy Report
DVR	Deviation Report
ECCS	Emergency Core Cooling System
EDG	Emergency Diesel Generator
EID	Equipment Identification
EM	Electrical Maintenance
EPRI	Electrical Power Research Institute
ESF	Engineered Safety Feature
EQ	Environmental Qualification
FCR	Field Change Request
FSAR	Final Safety Analysis Report
GE	General Electric
GE SAL	General Electric Engineering Service Advice Letter
GE SIL	General Electric Service Information Letter
GSRV	General Surveillance
HP	Health Physics
HVAC	Heating, Ventilation and Air Conditioning
I&C	Instrument and Control
IDR	Instrument Discrepancy Report
IEB	IE Bulletin
IEN	IE Notice
IM	Instrumentation Maintenance
IMRS	Instrument Maintenance Radiation Surveillance
INPO	Institute for Nuclear Power Operations
ISI/IST	Inservice Inspection/Inservice Testing
K	Kilo
LER	Licensee Event Reports
MCC	Motor Control Center
MM	Mechanical Maintenance
MOV	Motor Operated Valve
M&TE	Measuring and Test Equipment
NPRDS	Nuclear Power Reliability Data System
NRC	Nuclear Regulatory Commission
NWR	Nuclear Work Request
NUMARC	Nuclear Utility Management and Human Resource Committee
OOS	Out of Service
PADS	Program Analysis Data Sheet
PM	Preventive Maintenance

PMT	Post Maintenance Testing
PMWR	Preventive Maintenance Work Request
PRA	Probabilistic Risk Assessment
PV	Control Room HVAC
QA	Quality Assurance
QC	Quality Control
RC	Reactor Coolant System
RCA	Root Cause Analysis
RCM	Reliability Centered Maintenance
RMS	Radiation Monitoring System
RWP	Radiation Work Permit
SALP	Systematic Assessment of Licensee Performance
SER	Significant Event Report
SOAD	System Operational Analysis Department
SOER	Significant Operating Experience Report
TJM	Total Job Management
TS	Technical Specification
V	Volt
WR	Work Request

PRESENTATION TREE
MAINTENANCE INSPECTION

TREE INITIATORS

1. RECENT COMPONENT FAILURES
2. PRA INSIGHTS
3. TOPICS OF INTEREST (CHECK VALVES, MOVS, AIR SYSTEMS, SNUBBERS, INVERTERS)
4. PREVIOUS INSPECTION FINDINGS
5. OBSERVATION OF PLANT ACTIVITIES



NOTE: THIS DWG. IS USED IN CONJUNCTION WITH 425801, 425802, 425803, 425804, 425806, 425807 & 425808.

PRESENTATION TREE
MAINTENANCE INSPECTION

TREE INITIATORS

1. RECENT COMPONENT FAILURES
2. PRA INSIGHTS
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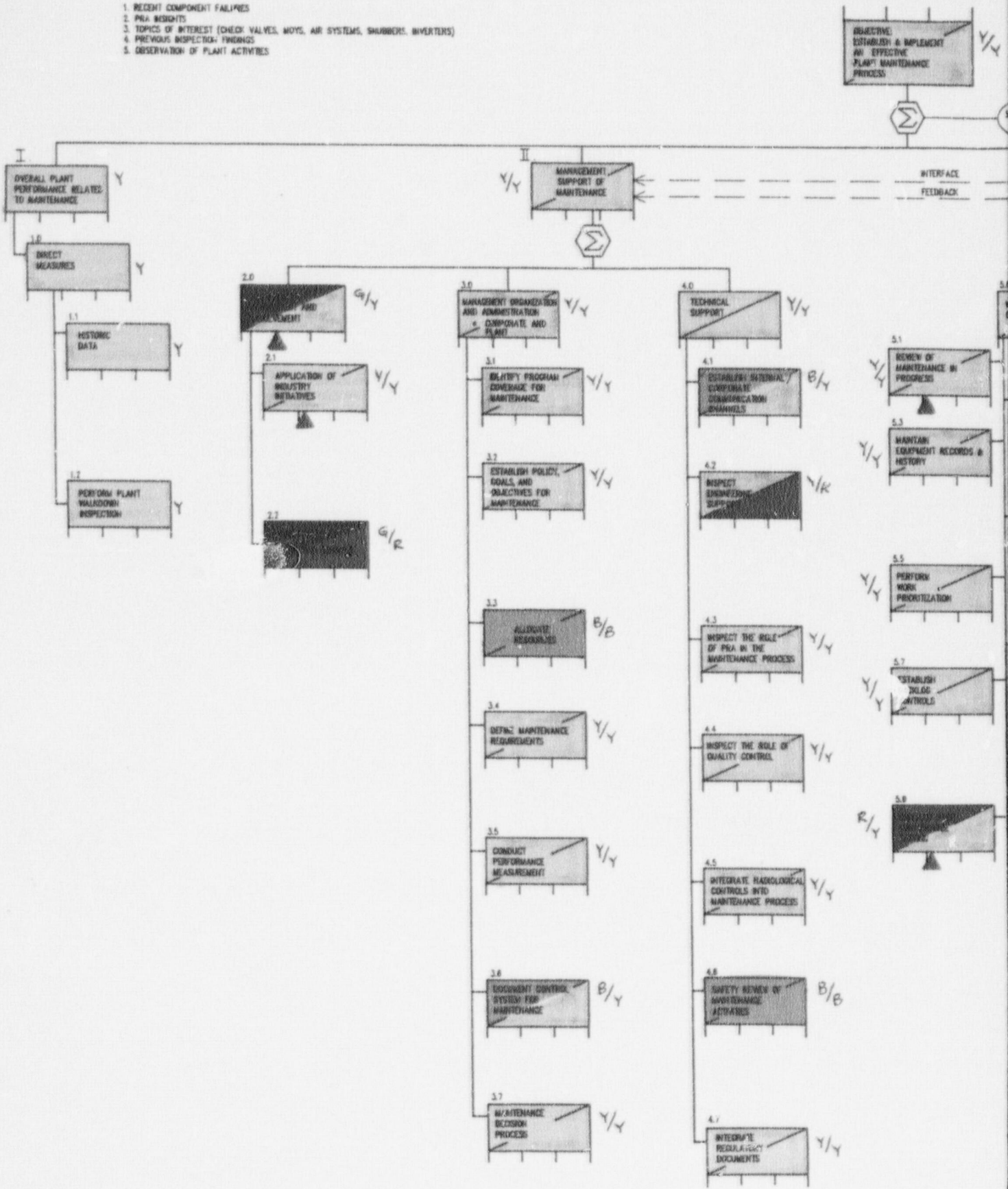

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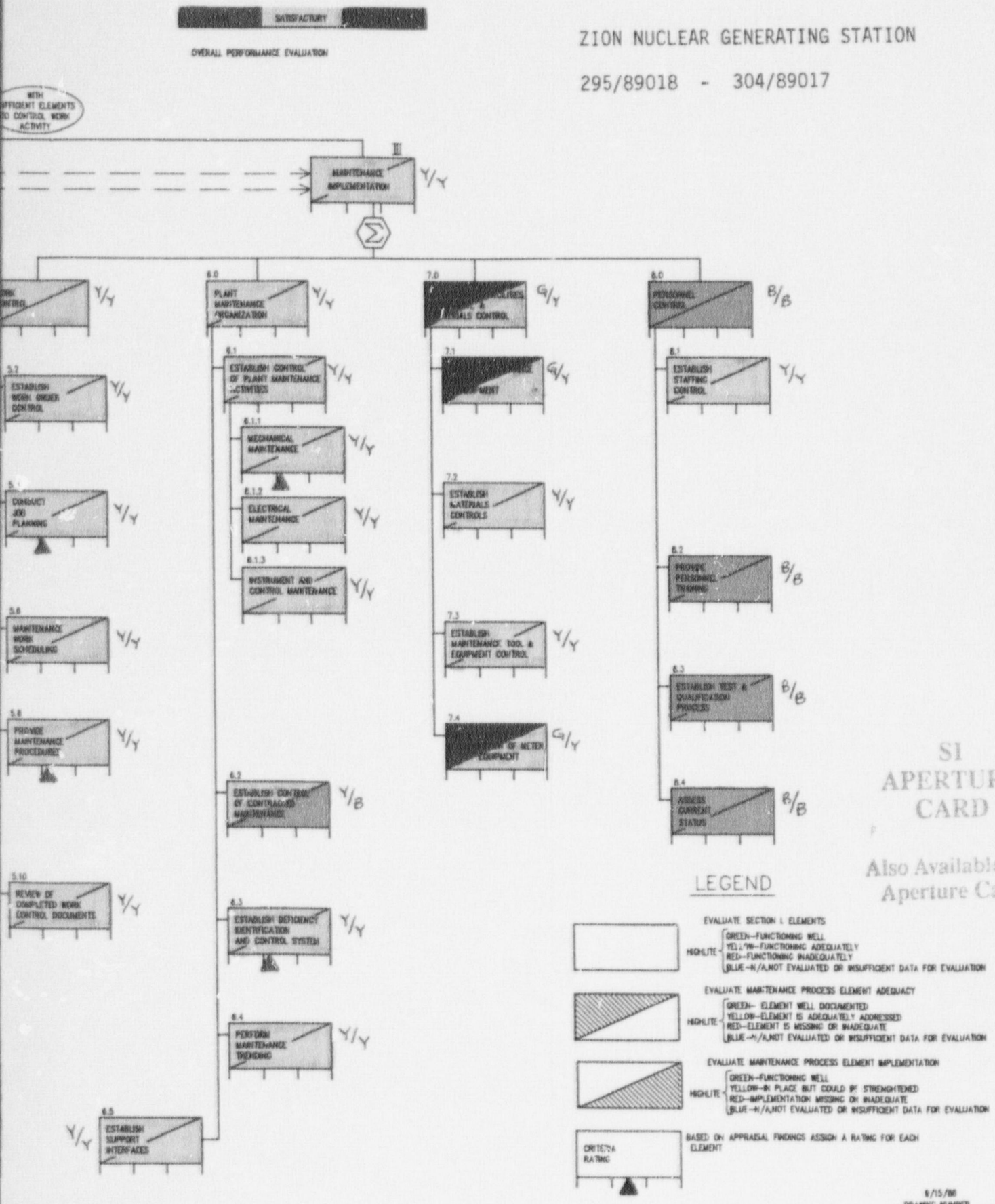
TREE

ZION NUCLEAR GENERATING STATION

295/89018 - 304/89017



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