U.S. NUCLEAR REGULATORY COMMISSION

REGION V

Report Nos. 50-206/88-16, 50-361/88-15, 50-362/88-16

Docket Nos. 50-206, 50-361, 50-362

License Nos. DPR-13, NPF-10, NPF-15

Licensee: Southern California Edison Company
P. O. Box 800, 2244 Walnut Grove Avenue
Rosemead, California 92770

Facility Name: San Onofre Units 1, 2 and 3

Inspection at: San Onofre, San Clemente, California

Inspection conducted: May 22 through July 2, 1988

Inspectors: for PH Johnson — 8/11/88
F. R. Huey, Senior Resident Inspector, Units 1, 2 and 3 — Date Signed

for PH Johnson — 8/11/88
J. E. Tatum, Resident Inspector — Date Signed

for PH Johnson — 8/11/88
A. L. Hon, Resident Inspector — Date Signed

A. D. Johnson — 8/12/88
A. D. Johnson, Enforcement Officer (May 18 - 20) — Date Signed

Approved By: PH Johnson — 8/11/88
P. H. Johnson, Chief
Reactor Projects Section 3 — Date Signed

Inspection Summary

Inspection on May 22 through July 2, 1988 (Report Nos. 50-206/88-16, 50-361/88-15, 50-362/88-16)

Areas Inspected: Routine resident inspection of Units 1, 2 and 3 Operations Program including the following areas: operational safety verification, radiological protection, security, evaluation of plant trips and events, monthly surveillance activities, monthly maintenance activities, refueling activities, independent inspection, licensee event reports review, and follow-up of previously identified items. Inspection procedures 30703, 60710, 61726, 62703, 71707, 71709, 71710, 71881, 90712, 92700, 92701, and 93702 were covered.

Safety Issues Management System (SIMS) Items:

MPA-B-95 Loss of Residual Heat Removal (RHR) While RCS Partially Filled (GL-87-12) (Completed)

BL-88-01 Defects in Westinghouse Circuit Breakers (Completed)

Results:

General Conclusions and Specific Findings:

1. The inspectors noted that housekeeping improvements are necessary during outage conditions (paragraph 2.b).

2. Two examples indicated weakness in operational control of RCS isolation boundaries and water transfer evolutions (paragraphs 2.c and 3.c).

3. In the area of station maintenance and project work activities, several examples of inattention to detail or poor implementation of administrative controls were noted by the inspector or the licensee (paragraphs 2.b, 3.a, 4.d, 5.c, 5.e, and 7).

4. Two examples were noted wherein nonconformance reports were dispositioned in a qualitative and possibly nonconservative manner, indicating a need for more management involvement in the evaluation and resolution of plant problems (paragraphs 2.d and 8).

5. Unit 2 LER 88-10 (inoperability of Units 2/3 Emergency Chilled Water System) did not properly assess the safety significance of the event (paragraph 9).

Significant Safety Matters:

The purification suction line from the spent fuel storage pool was not designed to preclude siphon draining, contrary to the UFSAR description (paragraph 3.c).

Summary of Violations:

The inspectors observed that measuring and test equipment were not being controlled in accordance with station procedures and program requirements (paragraph 5.c).

Open Items Summary:

During this report period, 1 deviation was identified, 1 unresolved item was identified, 2 new follow-up items were opened and 5 were closed; 1 was examined and left open.

DETAILS

1. Persons Contacted

Southern California Edison Company

*C. McCarthy, Vice President, Site Manager
*H. Morgan, Station Manager
M. Medford, Manager, Nuclear Engineering and Licensing
D. Heinicke, Deputy Station Manager
*D. Schone, Quality Assurance Manager
*D. Stonecipher, Quality Control Manager
*R. Krieger, Operations Manager
D. Shull, Maintenance Manager
J. Reilly, Technical Manager
P. Knapp, Health Physics Manager
D. Pilmer, Manager, Nuclear Engineering
R. Phelps, Supervisor, Nuclear Systems Engineering
A. Kaneko, Supervising Electrical Engineer
D. Peacor, Emergency Preparedness Manager
P. Eller, Security Manager
J. Reeder, Operations Superintendent, Unit 1
V. Fisher, Operations Superintendent, Units 2/3
L. Cash, Maintenance Manager, Unit 1
*R. Santosuosso, Maintenance Manager, Units 2/3
*C. Chiu, Assistant Technical Manager
H. Leake, Lead Electrical Engineer
G. Stawniczy, Project Engineer, Unit 1
M. Wharton, Assistant Technical Manager
*C. Couser, Compliance Engineer

Bechtel Power Corporation

A. Nakashima, Project Engineer, Unit 1
P. Thompson, Site Project Engineer

*Denotes those attending the exit meeting on July 1, 1988.

The inspectors also contacted other licensee employees during the course of the inspection, including operations shift superintendents, control room supervisors, control room operators, QA and QC engineers, compliance engineers, maintenance craftsmen, and health physics engineers and technicians.

2. Operational Safety Verification (71707)
Radiological Protection (71709)
Security (71881)

The inspectors performed several plant tours and verified the operability of selected emergency systems, reviewed the tag out log and verified proper return to service of affected components. Particular attention was given to housekeeping, examination for potential fire hazards, fluid leaks, excessive vibration, and verification that maintenance requests

had been initiated for equipment in need of maintenance. The inspectors also observed selected activities by licensee radiological protection and security personnel to confirm proper implementation of and conformance with facility policies and procedures in these areas.

a. Spurious Actuation of Units 2/3 Cable Tray Fire Systems

On June 15, the inspector toured the Unit 2 cable spreading room (Section 2, 30 foot level). He noted that significant amounts of water remained on the cable spreading room floor and that fire protection blankets on several of the cable trays were soaking wet. The inspector questioned the Unit Operations Superintendent and the Station Manager about the event and neither was aware of any spurious actuation of the cable tray fire system. Upon further review, the inspector determined that the observed conditions were the result of a spurious fire system actuation which had occurred on June 11. The inspector also observed that the licensee had experienced four spurious Units 2/3 cable tray fire system actuations since April 1988 (4/7 - 9 foot level; 4/26 - Section 6, 30 foot level; 6/11 - Section 2, 30 foot level; 6/18 - Section 2, 30 foot level).

During the exit meeting, the inspector expressed the following concerns relating to the repeated spurious actuations of the cable tray fire systems:

(1) The licensee did not appear to be pursuing correction of this problem in an aggressive manner, as evidenced by the lack of supervisory and management awareness of the events and the frequency with which they have been allowed to recur.

(2) The licensee needs to fully assess the long term impact on safety related systems of repeated soakings of the cable spreading areas. In this regard, the inspector noted that there did not appear to be any immediate effect of the recent actuations on plant systems. However, it was noted that some control room instrumentation was temporarily affected by the April 7 event.

The licensee stated that corrective actions had been initiated in response to the earlier spurious actuations; however, additional attention and emphasis would be implemented to ensure that additional actuations do not recur. The licensee also stated that SCE has completed a detailed assessment of potential impact of spurious fire system actuations on plant equipment operability and that no further actions in this regard are warranted.

This item remains open, pending inspector review of the licensee's additional corrective actions (50-361/88-15-01).

b. Housekeeping (Units 2/3)

The inspector observed significant improvements in maintenance of plant cleanliness and use of restraints for securing temporary

equipment during periods of routine plant operation. During plant outages, however, it appeared that significant improvements can still be made. During the current refueling outage on Unit 3, the inspector made the following observations:

- During the start of the outage, staging areas inside containment were not well established and maintained.

- Work areas, such as the piping penetration areas and the safety injection pump rooms, became cluttered with tools, consumables and debris.

Licensee management acknowledged the inspector's comments and stated that housekeeping practices during outages would be the subject of further evaluation.

c. Reactor Coolant System Clearance Boundary (Unit 3)

On May 12, 1988, while the reactor coolant system (RCS) was being filled following installation of steam generator nozzle dams, water started pouring out of the steam generator cold leg channel heads through the open manways. Upon investigation of this incident, the licensee discovered that the equalizing valves for the steam generator differential pressure (d/p) transmitters were left open, allowing RCS water to bypass the hot leg nozzle dams and pour into the cold leg channel heads. The low pressure sides of the d/p cells communicate directly with the cold leg channel heads, and are not isolated by the cold leg nozzle dams. The licensee determined that the d/p cell valve alignment was not restored properly following evacuation of the RCS with the eductor. With regard to valve alignment, the inspector made the following observations:

- The d/p cell isolation valves are operated by I&C technicians, not plant operators. Independent verification of valve position was not required by the maintenance order that controlled this evolution.

- In establishing the RCS clearance, the Operations Department did not include these valves as part of the clearance boundary.

At the exit meeting, the inspector observed that this event indicated a need for the Operations Department to maintain better control of clearance boundaries. Licensee management acknowledged the inspector's comments and stated that additional control of clearance boundaries would be evaluated. This item is closed (50-362/88-16-01).

d. Low Pressure Safety Injection Pump Seal Leak (Unit 3)

On June 22, 1988, the inspector observed that low pressure safety injection (LPSI) pump P016 had developed a shaft seal leak. The inspector observed that the licensee documented this condition on NCR 3-2052, and noted that the fuel was removed from the reactor vessel at this time and the shutdown cooling system was not required

to be operable. The inspector reviewed the NCR and made the following observations relative to the NCR disposition:

- Interim disposition was to "accept as is." Additional instruction was provided for operations personnel to monitor seal leakage on a shiftly basis and to report any significant increase in leakage to engineering for additional evaluation. Final disposition was to rework the seal.

- The NCR did not provide a basis for the "accept as is" disposition. Vendor requirements and recommendations were not addressed. Seal failure modes were not considered. Restrictions on plant configuration during the refueling outage were not considered.

- The safety evaluation that was attached to the NCR disposition was qualitative. No reference was made to accident scenarios contained in the UFSAR, and no quantitative information was provided with regard to criteria for seal leakage.

The inspector discussed these observations at the exit meeting and questioned the acceptability of the NCR disposition. Following the exit meeting, the inspector reviewed the vendor's manual (S023-933-610) and found that the vendor recommended seal repair at 50 cc/hr leakage. The seal for LPSI P-016 was leaking 1/2 gpm with the pump in standby, and approximately 1 1/2 gpm with the pump operating. The Station Technical Manager stated that the NCR would be revised to address the inspector's concerns. At that time, fuel had been loaded back into the reactor vessel and the shutdown cooling system was required to be operable. The resolution of this issue will be reviewed during a future inspection (Followup Item 50-362/88-16-02).

e. <u>Use of Special Orders for Plant Operations (Unit 1)</u>

This item is similar to 50-206/88-03-02. It involved the inspector's concern with the appropriateness of a compensatory action implemented by the licensee as part of a justification for continued operation following the identification of safety system single failure problems. In particular, the licensee issued special orders to direct the operator to manually shift safety injection flow in the event of a postulated failure of automatic safety injection valve HV851. The inspector noted that the special orders did not have the same degree of technical and management review and administrative controls as is required for procedures which govern emergency plant operations. For example, one revision of a special order did not contain the precaution found in the previous and subsequent revisions. This omission was apparently due to inadequate review.

In response to the inspector's concern, the licensee eliminated the use of special orders to prescribe manual actions to mitigate the postulated single failure events. The licensee was revising the Emergency Operating Instructions and establishing abnormal system

alignment procedures to implement the planned operator actions. Issuance of the revised procedures, pursuant to the licensee's administrative controls program, was planned prior to Unit 1 restart. Followup Item 206/88-03-02 is closed.

No violations or deviations were noted in this area during the inspection.

3. Evaluation of Plant Trips and Events (93702)

a. Inadvertent Actuation of Unit 1 Diesel Generator

On June 25, 1988, while the Unit was in Mode 5, the licensee's contractor, Bechtel Power Corporation (BPC), was in the process of completing an environmental qualification (EQ) upgrade work package in the cubicle for circulating water pump circuit breaker 152-12C03. Inside this cubicle was another door to which the undervoltage signal fuse for the safety bus was attached. Warning signs on the inner door indicated that the diesel generator would start if the door were opened.

A fuse was installed on an earlier shift according to the work order. Prior to closing out the work package, a subsequent crew consisting of an electrician, a foreman and a field engineer inspected the work completed in the cubicle. In order to assure that the newly installed fuse would not interfere with the inner door, the electrician opened the inner door with the misunderstanding that his work order clearance included this inner door. This action resulted in a loss-of-bus undervoltage signal to the Safety Load Sequencer which started diesel generator #2 automatically. All of the equipment operated properly in response to this inadvertent actuation. The licensee reported this event in accordance with 10 CFR 50.72 requirements.

BPC immediately suspended the three workers involved pending additional training. Other crews were also briefed regarding this event and emphasis was placed on understanding and adhering to work boundaries. The licensee and BPC considered this to be an isolated incident but will continue to enhance the work clearance process.

Based on the discussion with the licensee, BPC and observation of the recent BPC work in the plant, this item is closed (50-206/88-16-01).

b. Auxiliary Feedwater Pump Turbine Overspeed Event (Unit 2)

At 9:01 a.m. on June 30, 1988, the licensee declared turbine driven auxiliary feedwater (AFW) pump 2P-140 inoperable to allow low voltage testing to be conducted on turbine trip throttle valve 2HV-4716. The purpose of this testing was to demonstrate that the trip throttle valve could function under the worst-case voltage conditions assumed in the design basis (approximately 75 VDC at the valve). Special Engineering Procedure SO2-SPE-26, titled Stroke Testing of 2HV-4716 at Reduced Voltages, was used to perform the

test. The test objective was to cycle 2HV-4716 at 75, 70, and 65 VDC. For each voltage condition, the control room operator was directed to open 2HV-4716, obtain open indication, and after approximately 10 seconds, close 2HV-4716. The procedure directed that if a stall condition occurred during valve travel (i.e., the valve stem stops moving prematurely), the technicians were to remove test power from 2HV-4716 and the equipment operator was to manually close the valve. Due to logistical considerations, test power was supplied to turbine governor valve 2HV-4700 as well as to 2HV-4716, and normal power was disconnected.

Initially, 2HV-4716 was cycled using 75 VDC and the valve operated satisfactorily. Next, the valve was cycled using 70 VDC. The control room operator did not receive the open indication and after approximately 10 seconds, the technicians disconnected the test power from 2HV-4716. As a result, 2HV-4716 and 2HV-4700 were deenergized. At this time, the control room operator observed that 2P-140 discharge pressure was greater than 2000 psig (off scale) and the equipment operator observed that a flange connection on the pump discharge piping had developed a leak. The control operator closed steam supply valve 2HV-8200 and the event was terminated.

Following this event, the licensee initiated nonconformance report (NCR) 2-2427 to provide documentation and resolution of the overspeed condition. The NCR disposition included the following evaluations:

- Cause of Turbine Overspeed: Upon loss of power, turbine governor valve 2HV-4700 is designed to fail in the open position to allow for manual control of the turbine. When open indication on valve 2HV-4716 was not received and the technicians disconnected the test power supply, the governor valve failed open, admitting full steam flow to the turbine. The turbine did not trip on mechanical overspeed at 3900 rpm due to a damaged emergency tappet ball (see Figure 1, attached). The ball is made of polyurethane and a piece was missing such that the emergency governor weight could not impact the ball during the overspeed condition. The licensee discussed this condition with the vendor (The Terry Turbine Company) and learned that there have been other occurrences of emergency tappet ball failures. The vendor had changed the design of this part and currently recommends a yearly inspection to verify integrity. The licensee learned that the vendor did not issue any bulletins relative to these changes. The licensee was also considering the resportabilty of this failure pursuant to 10 CFR Part 21.

- Stress Analysis: Based on turbine and pump data curves, the licensee determined that the turbine achieved approximately 5000 rpm and pump discharge pressure reached approximately 2400 psig. Based on discussions with the operators, the licensee determined that this condition existed for about one minute. Given these conditions, the licensee determined that piping and component stresses were within ASME Code allowable limits.

Prior to returning 2P-140 to operable status, the licensee took the following corrective actions:

- The turbine casing was lifted and the turbine was visually inspected for damage.

- The auxiliary feedwater pump casing bolts were torqued to verify tightness.

- Portions of the auxiliary feedwater system exposed to 2P-140 discharge pressure were visually inspected, including pipe supports.

- The emergency tappet ball assembly was replaced. The licensee has ordered replacement parts to conform with the vendor's current design and plans to install the new design in Units 2 and 3 upon availability of parts. The emergency tappet ball assembly on the turbine for 3P-140 (Unit 3) was to be inspected prior to returning the unit to service. The licensee will require visual inspection of the emergency tappet assembly annually as recommended by the vendor.

- In-service testing was performed on 2P-140 and the motor operated boundary isolation valves exposed to system pressure, 2HV-4705 and 2HV-4706. In-service testing was also completed on turbine trip throttle valve 2HV-4716 and turbine vibration readings were evaluated. All results were satisfactory.

- The turbine overspeed trip device was adjusted and tested. In addition, the licensee was planning to establish a frequency for periodically testing the mechanical overspeed trip device.

The inspector reviewed the licensee's evaluation and NCR disposition, discussed the licensee's actions with NRR, and concluded that the licensee's actions were appropriate. The NCR disposition was found to have been well thought out and executed, except that it did not recognize or evaluate the engineering performance aspects of the event. In particular, it appeared that personnel performing the engineering review for the low voltage test had failed to recognize and institute proper controls for loss of power to the turbine governor valve 2HV-4700.

The inspector verified that all actions were completed and that 2P-140 was returned to operable status within the 72 hours allowed by Technical Specifications. This item is closed (50-361/88-15-02).

c. Spent Fuel Pool Siphoning Event (Unit 3)

On June 22, 1988, the refueling cavity was drained down to allow maintenance to be conducted on 3HV-9378 (see paragraph 8 of this report). After the refueling cavity was pumped down, spent fuel pool (SFP) purification pump 3P-014 was used to pump the lower

cavity down approximately one foot below the reactor vessel flange to allow some margin for water leakage from the spent fuel pool. At this time, the fuel transfer tube was open and the weir gate was installed isolating the spent fuel pool from the fuel transfer pool. Approximately 5 1/2 hours after the lower cavity was pumped down, when the SFP purification system was being realigned for normal operation, the control room was informed that water level in the spent fuel pool had dropped approximately 1 foot. At the same time, water level in the lower cavity had increased approximately 1 foot. Although 3HV-9378 was disassembled at this time, water level in the lower cavity had not increased enough to spill out through the open valve body. The control operator requested that maintenance set up a temporary pump to transfer the water from the lower cavity back into the spent fuel pool, and initiated action to review the SFP purification system valve alignment procedure to preclude recurrence.

Restoration of Spent Fuel Pool Water Level

As requested by the control operator, a temporary pump was placed in the fuel transfer pool to pump water back into the spent fuel pool. The free end of the pump discharge hose was placed in the spent fuel pool, approximately 2 feet below the surface. After obtaining operator approval, the mechanic started the pump to verify flow. The mechanic secured the pump and informed the control operator that he was ready to transfer water. Operations Department could not support the evolution at that time, and instructed the mechanic to go to lunch. Approximately 30 minutes after the mechanic left, the control room was notified that water was pouring out of 3HV-9378, which was disassembled for repair. This event was terminated after the containment work manager started the temporary pump and pumped the water from the lower cavity to the spent fuel pool. Following this pumping evolution, the hose was removed from the spent fuel pool.

Event Analysis

The inspector reviewed the specifics associated with this event, and discussed the details with operations and maintenance personnel. Relative to the initial evolution using 3P-014 to pump down the lower cavity, the inspector made the following observations:

- After the lower cavity was pumped down initially using 3P-014, the pump was secured and approximately 5 hours later valves MU-016 and MU-018 were opened to restore the SFP purification system line up. This created a siphon flow path from the spent fuel pool to the lower cavity until other valves in the system could be closed to isolate the lower cavity. Water was siphoned from the spent fuel pool to the lower cavity causing the level in the spent fuel pool to decrease by approximately 1 foot. This left 26 feet of water above the spent fuel.

- The SFP purification pump suction piping extends to the bottom of the spent fuel pool and does not contain an anti-siphon device. The licensee's UFSAR, paragraph 9.1.3.3, states that all connections to the spent fuel storage pool are made so as to preclude the possibility of siphon draining of the pool.

- Low spent fuel pool water level is annunciated in the control room when the water level decreases to 25' 10" above the fuel. During this event, the water level did not decrease to the low level alarm set point.

- During this event, the spent fuel pool level decrease would have been limited by the skimmers, which were unisolated from 3P-014 suction piping and would have acted as a siphon break. For this configuration, the siphon would have been broken with approximately 20 feet of water remaining over the fuel.

With regard to the use of a temporary pump to transfer water from the lower cavity to the spent fuel pool, the inspector made the following observations:

- When the temporary pump was staged to restore the spent fuel pool level, a siphon flow path was created through the pump discharge hose between the spent fuel pool and the fuel transfer pool. The siphon was primed when the pump was started to check for flow. After the pump was secured, water was siphoned from the spent fuel pool to the fuel transfer pool.

- As discussed previously, low spent fuel pool water level is annunciated in the control room, and the control operator would have been alerted to this condition if it had continued unnoticed.

- The spent fuel pool level decrease would have been limited during this event by how far below the spent fuel pool surface the pump discharge hose was placed. In this case, the end of the hose was two feet below the surface, which would have limited the level decrease to 24 feet above the spent fuel.

Technical Specifications require the licensee to maintain 23 feet of water above the spent fuel.

Corrective Action

The licensee's immediate corrective action was to restore spent fuel pool level. Maintenance personnel were reminded of the potential for creating a siphon when transferring water between pools, and were instructed to comply with the caution listed for paragraph 6.3.4 of Maintenance Procedure S023-I-3.1, titled Minor Refueling Procedures. The caution stated: "To prevent siphoning between pools, all hoses used to transfer water between pools will be removed from the pool and/or disconnected when not in use. If hoses must be left connected, they should be continuously monitored or the intervening gate must be open."

On June 30, Special Order 88-05 was issued to alert operations personnel to the potential for water to be siphoned from the Unit 2 or 3 spent fuel pool through purification pump P-014 suction piping. The operators were instructed to unisolate the skimmers by opening valve MU-018 anytime that spent fuel pool purification piping is unisolated with valve MU-016 open. The inspector noted that the procedure which realigns the SFP purification pump suction to the SFP directed unisolation of the skimmers in the same procedure step which unisolated the SFP suction line. In this configuration, the skimmers would provide a siphon break for the spent fuel pool purification piping.

The licensee was reviewing the configuration of piping entering the spent fuel pool on Units 2 and 3, and evaluating the need for additional anti-siphon protection and administrative controls.

Conclusions

The inspector made the following observations relative to this event:

- When a portable pump was used to transfer water from the lower cavity to the spent fuel pool on June 22, 1988, the evolution was not properly planned and tailboarded and a procedure was not prepared to control this evolution. Although the licensee stated that paragraph 6.3.4 of Maintenance Procedure S023-I-3.1 contained appropriate precautions for the evolution, this procedure did not appear to be applicable for transferring water to the spent fuel pool. This is an unresolved item (50-362/88-16-03).

- The control operator identified that a siphon flow path existed from the Unit 3 spent fuel pool on June 22. The licensee did not seriously evaluate this condition until after the inspector expressed an interest in the design adequacy of the penetrations into the spent fuel pool on June 28.

- In response to the inspector's inquiry, the licensee determined on June 30 that purification system piping extended to the bottom of the spent fuel pool and did not contain siphon protection. This was contrary to the description provided by paragraph 9.1.3.3 of the UFSAR which states that all connections to the spent fuel pool are made to preclude siphon draining of the pool. This is an apparent deviation (50-361/88-15-03).

Based on the results of this inspection, an apparent deviation was identified relative to the design of the spent fuel purification system.

4. Monthly Surveillance Activities (61726)

During this report period, the inspectors observed or conducted follow-up inspection of the following surveillance activities:

a. Observation of Routine Surveillance Activities (Unit 1)

- SO1-II-1.1 Surveillance Requirement, Reactor Plant Instrumentation Testing
- SO1-12.3-10 Diesel Generator Load Test (D/G #1)
- Hydrostatic testing of the low pressure section of the safety injection system

b. Observation of Routine Surveillance Activities (Unit 2)

- SO23-V-3.4.1 TCN 5-1 Auxiliary Feedwater In-Service Pump Test
- SO23-II-11.172 Rev. 0 Auxiliary Feedwater Pump (Terry) Turbine Governor Calibration

c. Observation of Routine Surveillance Activities (Unit 3)

- SO23-II-9.503 TCN 3-3 Pressurizer Narrow Range Channel Calibration
- SO123-II-8.10.1 TCN Electronic Loop Verification
- SO23-V-12.1.33 Rev. 1 LINSEIS Model L2025 Recorder Calibration

d. Control of Measuring and Test Equipment (M&TE)

While observing calibration of one of the trend recorders (LINSEIS Model L2025) for the Plant Monitoring System (PMS), the inspector observed that the Ronan X85 calibrator that was being used was past the calibration due date. The calibration was being conducted on June 4, 1988, and the Ronan X85 calibrator (M&TE #C2-1525) had a calibration due date of June 1, 1988. The inspector observed that the PMS trend recorder is quality class 4 and that the calibration was repeated using acceptable M&TE. Paragraph 5.c of this report contains additional discussion regarding the control of M&TE.

No violations or deviations were noted in this area during the inspection.

5. Monthly Maintenance Activities (62703)

During this report period, the inspectors observed or conducted follow-up inspection of the following maintenance activities:

a. Observation of Routine Maintenance Activities (Unit 1)

CW088060621 Terminate Component Cooling Water (CCW) control cable for EQ upgrade

M088052278002	Troubleshoot Feedwater Block Valve MOV-20 failure
CW08806141800	Terminate containment high pressure channel PT-1120c for EQ upgrade

b. Observation of Routine Maintenance Activities (Units 2/3)

M088060605	Troubleshoot Containment Post LOCA Hydrogen Monitoring System (Unit 2)
M088062724	Troubleshoot Electronic Governor for Auxiliary Feedwater Pump 2P-140 Turbine (Unit 2)
M088061423	Main Steam Isolation Valve 3HV-8205 Disassembly, Inspection, and Reassembly (Unit 3)
M088060959	Shutdown Cooling System Isolation Valve 3HV-9378 Repair (Unit 3)
M088010532	Open Steam Generator Differential Pressure Transmitter Vent Valves (Unit 3)

c. Control of Measuring and Test Equipment (M&TE) (Unit 2)

The inspector made the following observations on June 17, 1988 regarding the work being done in accordance with M088060605:

- A strip chart recorder was hooked up to the Post LOCA Hydrogen Monitoring System to monitor Train A and B response to containment pressure fluctuations over time. These data were quantitative in that the response of Train B relative to Train A was being evaluated.

- The strip chart recorder (M&TE #I2-9097) had exceeded the calibration due date of June 16, 1988.

- The D.C. amplifier (M&TE #I2-8696) had exceeded the calibration due date of June 14, 1988.

Upon review of M088060605, which controlled the installation of the M&TE, the inspector observed that the words "none used" were written where the M&TE used should have been recorded by the technician. The inspector discussed this observation, and the observation documented in paragraph 4.d of this report, with a representative of the licensee's QA organization, who stated that these observations appeared to be isolated occurrences. These observations were identified to the licensee as an apparent violation of Maintenance Procedure S0123-I-1.7, which governs the use of M&TE (50-361/88-15-04). The inspector noted that weaknesses in implementation of administrative controls for M&TE had been discussed in a previous inspection report (refer to followup item 50-361/86-19-03).

d. Main Steam Isolation Valve 3HV-8205 Inspection (Unit 3)

Because the licensee has the same type of main steam isolation valve (MSIV) on Units 2 and 3 as are used at Waterford 3, the licensee was notified of failures associated with the Waterford MSIVs (PNO-IV-88-28 dated April 13, 1988). The licensee conducted an evaluation of the failures identified at Waterford and concluded that the major factor contributing to the Waterford failures was valve stroke time. Because the stroke time used at San Onofre was significantly less than the Waterford stroke time, the licensee concluded that a similar failure at San Onofre was unlikely to occur. In addition, the licensee conducted a limited boroscopic inspection of the MSIV internals (refer to Figure 2, attached) on Unit 3 and found all guide rails to be intact. One cap screw head was found lying in the bottom of 3HV-8205. Based on this inspection of the Unit 3 MSIVs, the licensee was satisfied that a serious problem did not exist at San Onofre. Although the NRC recognized the inspections and analyses performed by the licensee, concern remained about the possibility of similar MSIV failures at San Onofre 2 or 3. Consequently, the licensee agreed to disassemble 3HV-8205 for inspection.

The licensee's inspection of the MSIV internals led to the following conclusions:

- All guide rails were intact.
- The three bottom cap screws on one of the upstream guide rails had the heads broken off.
- The only notable wear was some galling at the bottom corner of the upstream guide rails and some galling on the top of the upstream side of the LEV-R-Lock arm shoes, where these surfaces made contact.

Based on the inspection, it appeared that the licensee's preliminary evaluation was correct, and that the licensee's plan to evaluate specific valve design weaknesses and implement design changes during a future outage was acceptable. The Unit 2 MSIVs will be inspected by boroscope during the next outage of sufficient duration.

e. Attention to Instructions and Procedures (Unit 3)

During the course of the Unit 3 refueling outage, a number of maintenance errors were identified by the inspector or the licensee which resulted from insufficient attention to procedures. Specific examples include the following:

- While observing work being done on 3HV-9378, the inspector noted that thread engagement was inadequate on 2 of 8 studs securing a blank flange downstream of drain valve S31201MU114. This was inconsistent with instructions in the SCE Torque Manual, M-37204. This condition was corrected by the licensee.

- The licensee determined that the steam generator cold leg channel heads were overflowing during RCS fill on May 12 (see paragraph 2.c of this report). This condition resulted when the instructions on M088010532 were not followed.

- The licensee determined that welding rod for pressurizer heater replacement was mixed with other weld rod, resulting in a need to cut out and reweld four pressurizer heaters that might have been affected. This occurred when established procedures for weld rod issue and receipt were not complied with.

These observations were discussed at the exit meeting. Licensee management stated that continuing emphasis would be given to this concern. This item is closed (50-362/88-16-04).

f. Control of Maintenance Near Operable Safety Related Equipment (Unit 2)

During a previous inspection, the inspector observed that maintenance activities near safety related equipment were not adequately controlled. This concern was identified as NRC open item 50-361/87-04-01. Recently, this item was closed by paragraph 9.e of Inspection Report 50-361/88-11. During this inspection period, the licensee identified that the inboard bearing oil sight glass on high pressure safety injection pump 2P-017 had been broken, apparently due to scaffolding erection activities. The need for additional attention in this area was discussed at the exit meeting. This item is closed (50-361/88-15-05).

6. Engineered Safety Features Walkdown (71710)

Unit 2

The inspector walked down the post accident sampling system using P&ID 40134, titled Nuclear Sampling System, to verify system configuration.

No violations or deviations were noted in this area during the inspection.

7. Refueling Activities (Unit 3) (60710)

The inspector observed refueling activities including fuel shuffle and reconstitution, incore instrument (ICI) cut up and disposal, and fuel alignment plate modifications and noted that these activities were being conducted in accordance with the approved procedures. Although the refueling activities appeared to progress smoothly, the inspector noted the following examples wherein adequate controls were not exercised (50-362/88-16-05, Closed):

a. Foreign Material Exclusion (FME)

During this outage, the inspector observed that poor FME controls were exhibited in the area of the reactor vessel. Although it was

attached to a lanyard as required, a flashlight being used over the open reactor vessel came apart such that the batteries, lens, lens cap, reflector and bulb fell into the upper guide structure. The reflector and bulb assembly was not recovered. In addition to this incident, face shields, tie wraps and tape fell into the refueling cavity during the course of this outage. Except for the flashlight reflector, all of these items were recovered. Although an extensive search did not locate the flashlight reflector, a safety analysis performed by the licensee established that it could not cause harm to reactor components. Although observation of refueling operations showed most items to be properly controlled and secured, the inspector observed cases wherein maintenance and health physics personnel did not maintain lanyards for survey instruments or tools. At the exit meeting, licensee management acknowledged the inspector's comments and stated that improvements in FME would be made.

b. Incore Detector Assembly Replacement

During this refueling outage, 42 of 56 incore detector assemblies were replaced. This activity was controlled by Maintenance Procedure S023-I-3.35, titled Removal and Installation of Incore Instrumentation Assemblies. The detectors were removed from the core and fed through an automatic cutter, which cut the detectors into 13 foot lengths and fed the cut sections into a storage basket. During this evolution, the automatic cutter failed to function properly and the evolution was completed manually. The inspector observed that this activity was not well planned and controlled, which resulted in the following difficulties:

- Various lengths of incore detector assemblies were scattered on the floor of the lower cavity, requiring tedious mapping and recovery efforts.

- One incore detector was inadvertently jammed into one of the upender cans which required extensive retrieval efforts.

As a result of the difficulties experienced by the licensee during this outage, the methods and equipment used to remove and replace incore detectors were being reevaluated by the licensee.

c. Fuel Shuffle

During fuel shuffle activities to offload the core, fuel assembly A056 was lowered into storage location H-34, which was already occupied. After auditing the fuel storage locations, the licensee discovered that storage location H-34 had been filled by a fuel assembly that should have been placed in an adjacent location. During the subsequent inspections, neither fuel bundle was found to be damaged, and the licensee stated that neither fuel bundle would be reused in the core. The licensee also stated that, in the future, the fuel assembly's destination would be visually verified to be empty before an attempt is made to insert the fuel assembly.

No violations or deviations were noted in this area during the inspection.

8. Independent Inspection (62703, 92701)

Failure of Shutdown Cooling Isolation Valve 3HV-9378

On June 2, 1988, work was being done in accordance with M088030500 to adjust the Limitorque actuator limit switches for shutdown cooling suction isolation valve 3HV-9378. The valve was manually opened and, as the electricians started manually closing the valve to set the open limit switches, the valve became difficult to operate at approximately 10% closed. Nonconformance report (NCR) 3-2002 was initiated to investigate and resolve this condition. Valve 3HV-9378 is a 10" Pow-R-Seal gate valve manufactured by WKM Flow Control Division of Cooper Industries, and is similar in design to (but smaller than) the main steam isolation valves discussed in paragraph 5.d of this report (see Figure 2).

Nonconformance Report Resolution

The NCR disposition (Rev. 1) provided the following instructions:

- Loosen the packing and attempt to manually stroke the valve.
- Position the valve as directed by engineering.
- Remove the actuator and attempt to stroke the valve. If the valve strokes freely, rework the actuator. If the valve doesn't stroke, use a soft metal hammer and attempt to force the valve closed.
- If the valve doesn't move, drain down (fuel was offloaded at the time with the reactor cavity flooded) and inspect the valve internals.

M088060203 was written to implement the NCR disposition. Mechanics attempted to manually stroke the valve and, due to the mechanical advantage provided by the Limitorque actuator, were able to overcome the valve binding. The mechanics heard a loud "pop" and assumed that the valve had broken loose. Following the "pop", manual operation of the valve was much easier. Revision 2 to NCR 3-2002 was issued to provide the following disposition:

- Retighten packing gland nuts.
- After the valve is stroked closed, manually reopen the valve. Torque to 25 ft. lbs. and record breakaway torque and running torque through a full closing stroke. A note indicated that a torque of 25 ft-lbs equated to the allowable opening thrust of 17,100 lbs.

The "work done" section of M088060203 indicated that the NCR disposition was implemented and that the nominal running torque while closing was 90 in-lbs, with a maximum of 200 in-lbs at about 25% closed. Based on the

data that were gathered, Station Technical personnel were satisfied that operation of the valve was within the capabilities of the Limitorque actuator and considered the valve to be operable. The preliminary root cause evaluation used to close out the NCR stated that 3HV-9378 had been manually torqued open such that the gate and segment assembly were stuck in the wedged position. "Manually exercising the valve using the handwheel, overcame the static friction between the gate and segment assembly allowing gravity to return them to their relaxed position." The NCR was closed out on June 3, 1988.

On June 4 the inspector reviewed the licensee's actions related to 3HV-9378 to verify that corrective actions were complete and adequate prior to core reload. At this time, the reactor vessel was defueled and the shutdown cooling system was not required to be operable. The inspector noted that the NCR evaluation was speculative and qualitative, and a sound basis for valve operability was not documented. The inspector expressed this concern to the Station Manager and discussed the following specific observations with the Assistant Technical Manager:

- The preliminary root cause offered one hypothesis as the reason for the difficulties observed with 3HV-9378, but no substantiating data were provided in support of the hypothesis. The root cause document did not indicate that other hypotheses had been considered.

- Data were gathered and used to demonstrate that the Limitorque actuator was capable of operating the valve. Data were not gathered to evaluate the internal condition of the valve. Running torque in the opening direction was not evaluated.

- Although MOVATS testing of the Limitorque actuator was scheduled to be completed, it was not required as part of the NCR disposition and was not scheduled to be done until after the fuel was being loaded back into the reactor vessel.

- Appropriate restrictions were not placed on the amount of force that could be used to stroke the valve initially (when it was difficult to operate), and torque measurements were not required to be taken when the valve was forced free for subsequent evaluation.

- The electricians who opened 3HV-9378 prior to the valve becoming stuck were not interviewed by the licensee to determine the amount of force used in opening the valve. The inspector talked to these electricians and learned that 3HV-9378 was manually stroked open in a normal manner and nothing out of the ordinary was noted; excessive force was not used.

The Assistant Technical Manager agreed that the disposition of NCR 3-2002 was unacceptable and additional work was required. MOVATS testing was expedited to obtain additional quantitative data for evaluation, but fuel load was not delayed pending this additional evaluation.

MOVATS Test Results

On June 4, Station Technical performed MOVATS testing on 3HV-9378 and preliminarily concluded that there were no problems internal to the valve. The inspector observed that the initial sets of MOVATS traces contained anomalies in closing current, closing thrust, and opening current. The inspector requested that some explanation be provided for these anomalies, and the Assistant Technical Manager agreed that additional testing was required.

Additional MOVATS testing was conducted, and each opening current trace became progressively worse. Finally, the valve started tripping on the opening torque switch setting. The licensee concluded that valve disassembly and inspection were necessary, and the core had to be offloaded for a second time.

Valve Disassembly and Inspection

On June 22, after the refueling cavity was pumped down, 3HV-9378 was disassembled and inspected. The following discrepancies were identified:

- The top capscrew on each guide rail for the gate skirt assembly was sheared off.
- The guide rail skirt ("gate seat skirt" in Figure 2) had failed in tension into two pieces. The failure occurred through the second bolt hole from the top of the skirt on each side, where the metal thickness was at a minimum.
- The gate guide rails were intact and still bolted to the bottom half of the skirt. The top horizontal and beveled surfaces of the guide rails were severely galled.
- The Lev-R-Lock arm shoes were galled on the bottom horizontal surfaces and one shoe was wedged into the Lev-R-Lock arm pivot slot.

Root Cause Evaluation

Based on the discrepancies identified, the licensee's preliminary evaluation concluded that valve failure was caused by valve overtravel in the open direction. Due to the gear reduction ratio provided by the Limitorque actuator, the electrician was able to overtorque the valve in the open direction which resulted in this "overtravel" condition.

The inspector and other NRC representatives questioned whether this hypothesis was supported by conclusive data. Valve stack-up dimensions were not evaluated and free body diagrams were not prepared based on these dimensions. Information provided by the electricians (regarding the amount of torque applied in opening the valve) did not appear to support the licensee's hypothesis. Another hypothesis discussed with the licensee was that the valve had failed during normal operation due to excessive tolerances and valve design (e.g., guide rail chamfer).

Corrective Actions

The licensee took the following corrective actions:

- All defective components associated with 3HV-9378 were replaced with qualified spare parts.

- Procedures were changed to limit the amount of travel allowed when manually opening this type of valve.

- Additional MOVATS testing was conducted on other shutdown cooling suction isolation valves to confirm that anomalies did not exist in the current traces.

As long-term corrective action, the licensee was evaluating the need for design changes to the WKM Pow-R-Seal gate valve.

Conclusions

Although the licensee's corrective actions appeared to be appropriate, the inspector questioned whether Station management had required a sufficiently rigorous technical evaluation during the early stages of problem resolution (e.g., before core reload). As a result, licensee personnel missed opportunities to recognize incipient failure of 3HV-9378. Specific observations associated with resolution of the NCR were as follows:

- The disposition for NCR 3-2002 did not address the possibility of internal valve damage, and did not require MOVATS testing as a condition for final acceptance. Senior members of the technical staff also did not appear to be sufficiently involved, especially in view of the valve's similarity to the MSIVs (refer to paragraph 5.d) and the fact that it is unisolable from the reactor coolant system.

- The preliminary technical review of MOVATS data was not sufficiently rigorous and did not question anomalies that existed in current and thrust traces. Although the Assistant Technical Manager did subsequently review and question the MOVATS data, he does not normally review such data; his involvement in this case was prompted by the inspector's questions.

- After 3HV-9378 was disassembled, Station Technical personnel did not perform a comprehensive quantitative evaluation of component configurations to determine exact Lev-R-Lock arm location relative to the guide rails under different wedging conditions.

- Key maintenance personnel were not interviewed in order to understand the sequence of events that led to the valve's failure.

The inspectors discussed these observations with station management during and following the exit meeting (50-362/88-16-06). The licensee acknowledged the inspector's comments. This issue was identified for discussion during a future management meeting.

9. Review of Licensee Event Reports (90712, 92700)

Through direct observations, discussion with licensee personnel, or review of pertinent records, the following Licensee Event Reports (LERs) were closed:

Unit 1

87-15 R1 Engineered Safety Systems Design Fails to Meet Single Failure Criteria

Unit 2

88-09 Spurious Train "B" Toxic Gas Isolation System Actuation on High Chlorine Level

88-10 Inoperability of Both Emergency Chilled Water System (ECWS) Trains Due to Low Freon Level

The inspector reviewed the licensee's submittal, and found that the description of safety significance had not addressed the ability of the emergency chillers to reject the design basis heat load or the possible impact of the observed conditions on the accident analyses in the Unit 2/3 UFSAR. The inspector also noted that the transmittal letter for Inspection Report 50-361/88-15 had requested the licensee to provide additional information regarding this event, including specific criteria for chiller refrigerant level which will ensure system operability. Licensee management agreed that the LER was incomplete and stated that it would be revised.

88-11 Fuel Handling Isolation System Train "A" Actuation Due to Failure of Radiation Monitor 2RT-7822 Power Supply

88-12 Fuel Handling Isolation System (FHIS) Train "B" Spurious Actuation Due to Failure of Two Detector Preamplifier Transistors

Unit 3

88-04 Spurious Containment Purge Isolation System (CPIS) Actuation Due to Circuit Errors

87-11 R2 Reactor Trip on Low Steam Generator Water Level

Followup inspection on Unit 1 LER 88-01, "Environmental Qualification Program Deficiencies," was performed by a region-based inspector on May 18 - 20, 1988. The inspector examined the following items and discussed the related matters with personnel responsible for the activities in progress to resolve the identified equipment qualification (EQ) deficiencies.

- Design Criteria for Midcycle Environmental Qualification (EQ) Upgrade, Revision 1

- Design Criteria for Modifications to Eliminate 10 CFR 50.49(b)(2) Circuit Interactions, Revision 2
- Items requiring isolation with new fuses
- Fuse replacement items
- General action item list dated May 20, 1988
- Corrective Action Request (CAR) SO-P-1119
- 120 VAC and 125 VDC 50.49(b)(2) fuse coordination study (program and results), by Impell Corporation
- Quality Assurance Surveillance Report, dated April 8, 1988
- 50.49(b)(2) Device Identification Effort, SONGS 1, Electrical Engineering Tasks
- SONGS 1 EQ power distribution and selected electrical wiring diagrams
- EQ Master List verification program
- Proposed field Changes and Field Change Notices 1-88-007 and 1-88-019
- Completed maintenance order for replacement of valve SV-135 with a check valve
- Engineering and Construction Department QA procedures 37-26-12 and 37-30-63, concerning establishing and revising the EQ Master List

Based on the foregoing, the inspector concluded that the licensee was taking appropriate actions to correct or otherwise resolve all equipment qualification deficiencies. The licensee planned to issue a revision to the LER to reflect additional deficiencies and corrective actions identified during the reassessment. This LER remains open pending further followup inspection.

No violations or deviations were noted in this area during the inspection.

10. Followup of Previously Identified Items (92701)

a. (Closed) NRC Bulletin 88-01, "Defects In Westinghouse Circuit Breakers" (50-206, 50-361, 50-362/IB-88-01) (SIMS Item BL-88-01)

Summary

This Bulletin required the licensee to identify and inspect Westinghouse DS-206, DS-416, DSL-206, DSL-416 and DS-420 type circuit breakers in Class 1E applications and report the results to the NRC.

Status

The licensee completed the required action and reported in a letter dated April 4, 1988 that these breakers are not used at Unit 2/3 in Class 1E applications. The licensee reported in a letter dated May 3, 1988 that DS-206 and DS-416 breakers are used at Unit 1 in Class 1E applications but DSL-206, DSL-416 and DS-420 types are not. A summary of the affected breakers inspected by the licensee was included in this letter. This summary stated that required short-term inspections were completed, and that those breakers awaiting pole shaft replacement had been designated as spare breakers, not to be used in the plant. The results of the long-term inspections will be submitted following the next refueling outage. This item is closed.

b. (Closed) NRC Generic Letter 87-12, Loss Of RHR While The RCS Is Partially Filled (50-206, 50-361, 50-362/GL-87-12) (SIMS Item MPA-B-95)

Summary

On July 9, 1987, the NRC issued GL-87-12 to request all PWR licensees to describe the operation of the plant during the approach to and during operation with a partially filled RCS to ensure that the licensing basis was met.

Status

The licensee submitted the response in a letter on September 18, 1987 for Unit 2/3 and a letter on September 24, 1987 for Unit 1. Two additional letters were submitted on December 23, 1987 to clarify the earlier submittals. These letters described precautions to be taken by the licensee prior to and during mid-loop operations. The inspectors have been closely monitoring the licensee's plant operations in preparation for and during mid-loop operation in recent outages and have found the licensee's program and actions to be satisfactory. This item is closed.

c. (Open) Open Item (50-361/87-13-01) Evaluate Adequacy of Startup Rate Circuit Calibration

The licensee has completed this evaluation. This item remains open pending review by the NRC.

d. (Closed) Unresolved Item (50-361/88-08-01) Maintenance Procedure Deficiencies

The inspector reviewed the maintenance documentation associated with the core protection calculator (CPC) keyboard failure, and verified that M088033466 was issued to implement the disposition of NCR 2-2371. The inspector concluded that this maintenance activity was properly controlled.

e. (Closed) Open Item (50-361/88-11-01) CPC Out of Bypass with Steam Generator Low Flow Bistables Tripped

The licensee was unable to identify the cause for this condition. At the time of occurrence, the bistables were key-locked in the bypassed position. The bistable would only come out of bypass if reactor power exceeded 10(E-4)%, and the Unit Superintendent speculated that perhaps electrical noise in the circuit had caused this condition. No activities which would explain such an electrical spike could be identified. This item is closed.

f. (Closed) Open Item (50-362/88-03-02) RCS Isolation Valve Leak Rate Test Evaluation

The licensee reviewed the inspector's concerns with regard to RCS boundary isolation valve leak rate measurement. To resolve the inspector's concerns, TCN 2-7 was issued to Operations Surveillance Procedure SO23-3-3.31.1. The inspector reviewed the revised procedure, and found the licensee's actions to be acceptable. This item is closed.

11. Exit Meeting (30703)

On July 1, 1988, an exit meeting was conducted with the licensee representatives identified in Paragraph 1. The inspectors summarized the inspection scope and findings as described in the Results section of this report.

The licensee acknowledged the inspection findings and noted that appropriate corrective actions would be implemented where warranted. The licensee did not identify as proprietary any of the information provided to or reviewed by the inspectors during this inspection.

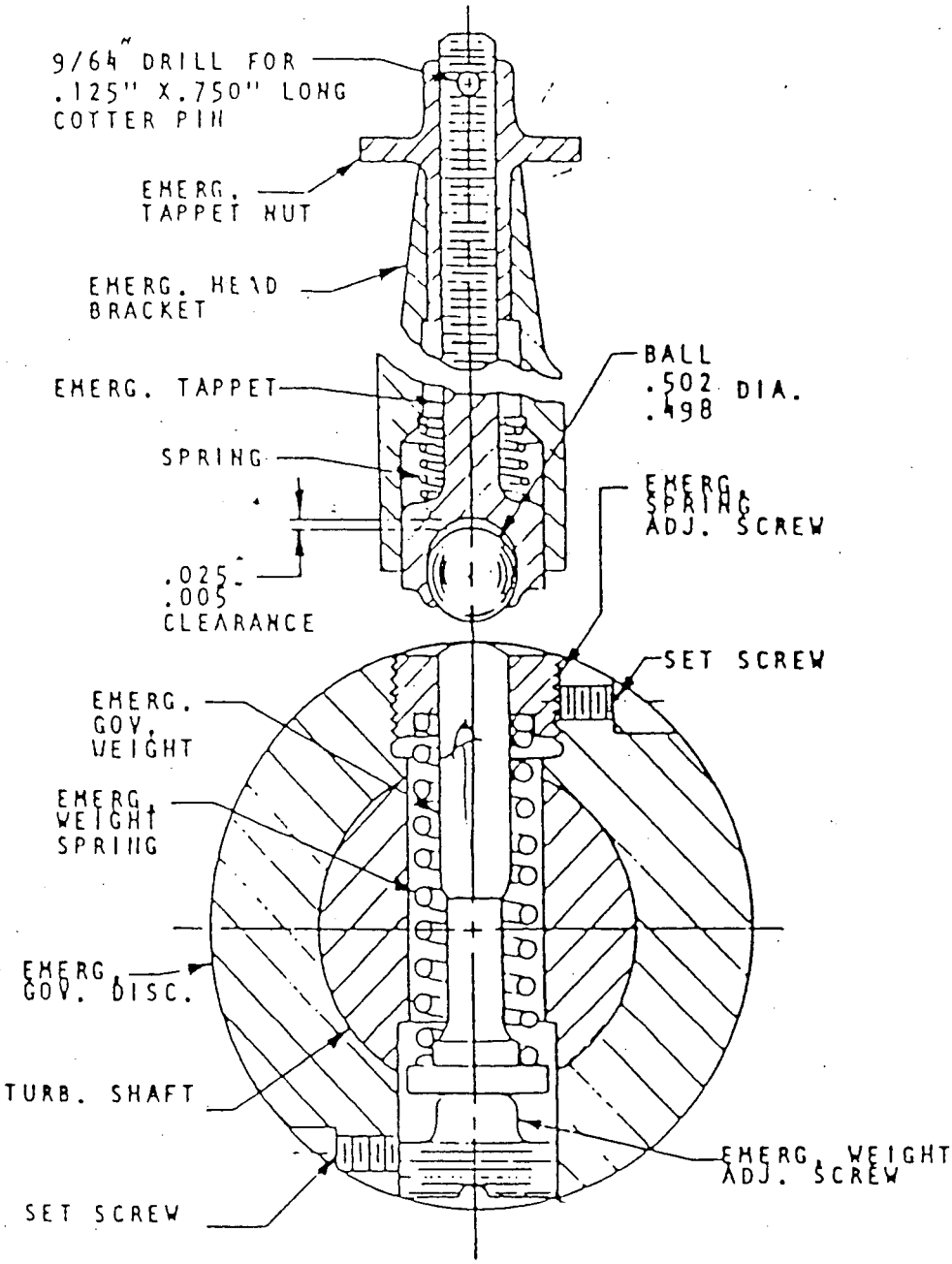

FIGURE 1

TERRY TURBINE EMERGENCY OVERSPEED TRIP DEVICE

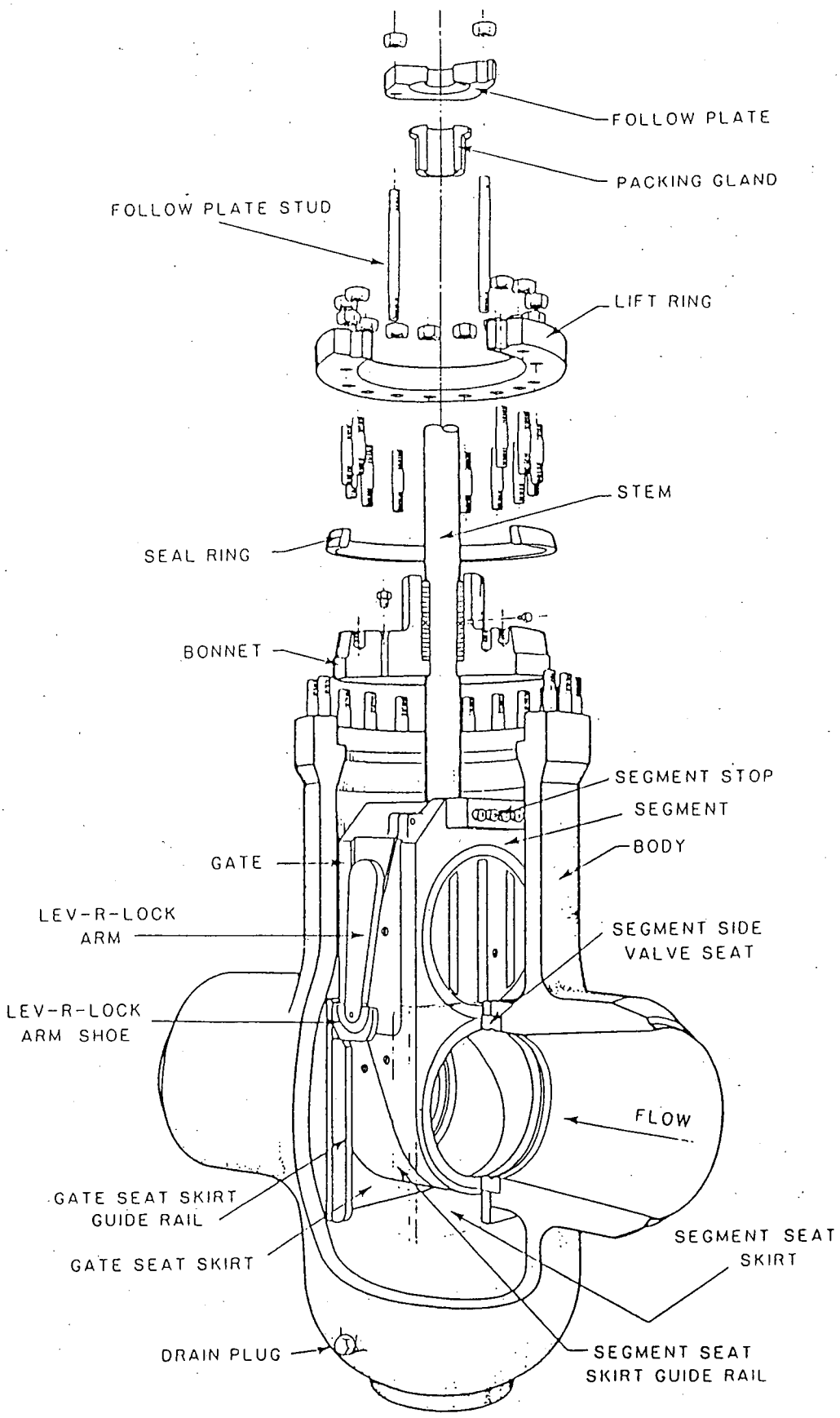

FIGURE 2

WKM POW-R-SEAL GATE VALVE