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AUTH. NAME AUTHOR AFFILIATION
MEDFORD, M. O. Southern California Edison Co.
RECIP. NAME RECIPIENT AFFILIATION
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SUBJECT: Forwards response to Generic Ltr 87-12, "Loss of RHR While RCS Partially Filled." Efforts to mitigate loss of shutdown cooling & possible core uncovery w/administrative control & procrdural protection of mid-loop operations addressed.

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Southern California Edison Company

P. O. BOX 800

2244 WALNUT GROVE AVENUE

ROSEMEAD, CALIFORNIA 91770

M. O. MEDFORD
MANAGER OF NUCLEAR ENGINEERING
AND LICENSING

TELEPHONE
(818) 302-1749

September 18, 1987

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Gentlemen:

Subject: Docket Nos. 50-361 and 50-362
San Onofre Nuclear Generating Station
Units 2 and 3

Reference: Generic Letter 87-12, "Loss of Residual Heat Removal (RHR) While the Reactor Coolant System (RCS) is Partially Filled," dated July 9, 1987

The referenced letter requested Southern California Edison (SCE) to provide information relative to loss of residual heat removal or shutdown cooling while the reactor coolant system is partially filled. The request further specified that the response to Items 1 through 9 contained in the referenced letter be prepared in accordance with 10 CFR 50.54(f).

SCE has prepared the response shown in Enclosure I according to the guidelines set forth in the referenced letter. The response addresses our particular efforts to mitigate loss of shutdown cooling and possible core uncovery with administrative control and procedural protection of mid-loop operations.

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These efforts are supported by inhouse technical analyses and comprehensive training programs to ensure a safe operation of SONGS Units 2 and 3.

If you need additional information regarding this subject response for an assessment of mid-loop operations, please let me know.

Subscribed on this 18th day of September, 1987.

Respectfully submitted,

SOUTHERN CALIFORNIA EDISON COMPANY

By: M O Medford
M. O. Medford
Manager of Nuclear Engineering and Licensing

Subscribed and sworn to before me this 18th day of September 1987.

Agnes Crabtree
Notary Public in and for the County of Los Angeles, State of California

OFFICIAL SEAL
AGNES CRABTREE
Notary Public-California
LOS ANGELES COUNTY
My Comm. Exp. Sep. 14, 1990

My Commission Expires: Sept 14, 1990

Enclosure

cc: Frank J. Miraglia, Associate Director, Office of Nuclear Reactor Regulation
H. Rood, NRR Senior Project Manager, San Onofre Units 2 and 3
J. B. Martin, Regional Administrator, NRC Region V
F. R. Huey, NRC Senior Resident Inspector, San Onofre Units 1, 2 and 3

ENCLOSURE I

SONGS UNITS 2/3 RESPONSE TO GENERIC LETTER 87-12

SONGS UNITS 2/3 RESPONSE TO GENERIC LETTER 87-12

QUESTION 1:

A detailed description of the circumstances and conditions under which your plant would be entered into and brought through a draindown process and operated with the RCS partially filled, including any interlocks that could cause a disturbance to the system. Examples of the type of information required are the time between full-power operation and reaching a partially filled condition (used to determine the decay heat loads); requirements for minimum steam generator (SG) levels; changes in the status of equipment for maintenance and testing and coordination of such operations while the RCS is partially filled; restrictions regarding testing, operations, and maintenance that could perturb the nuclear steam supply system (NSSS); ability of the RCS to withstand pressurization if the reactor vessel head and steam generator manways are in place; requirements pertaining to isolation of containment; the time required to replace the equipment hatch should replacement be necessary; and requirements pertinent to reestablishing the integrity of the RCS pressure boundary.

RESPONSE:

The plant is entered into and brought through a draindown process and operated with the RCS partially filled in order to conduct work which can only occur with the reactor coolant system depressurized and open to containment. Such work may include (1) the support of fuel shuffle during a refueling outage (drain down to below the reactor vessel flange in order to remove the vessel head), (2) repair/maintenance of reactor coolant pump seals, (3) the inspection/plugging of steam generator tubes, or (4) the repair/maintenance of reactor coolant system pressure boundary isolation valves or connected piping and instrumentation, each of which may require drain down, for at least some period of time, below the top of the reactor vessel inlet (cold leg) and/or outlet (hot leg) nozzles.

Since a typical refueling outage includes plans for RCS maintenance as noted in (2), (3), or (4) above, the initial draindown will continue to a level where steam generator/RCS nozzle dams may be installed thereby permitting inspection/plugging of steam generator tubes in parallel with flooding the refueling cavity and completing the fuel shuffle. Other work which must be conducted with the RCS partially filled may be performed when the RCS is initially drained down to install the steam generator nozzle dams or deferred until after the fuel shuffle is completed and the RCS is subsequently drained down to remove them.

Accordingly, during a typical refueling outage, there will be (1) an initial draindown to mid-loop in order to remove the reactor vessel head and install the steam generator nozzle dams and to perform that work which may be completed during this period without delaying the fuel shuffle, (2) an initial fill to flood the refueling cavity to perform the fuel shuffle, (3) a final

draindown to remove the steam generator nozzle dams and to complete what additional work remains on the RCS, and (4) a final fill of the reactor coolant system.

Note that should the reactor be shutdown solely to perform RCS maintenance, (i.e., repair of RCP seals or SG tube leaks) draining will proceed directly to the level required to perform the maintenance. SG nozzle dams would not be installed for such repairs.

The alignments and activities conducted during the draindown process and operation with the RCS partially filled are described in and controlled by the following operating procedures:

(1) S023-5-1.5, Plant Shutdown from Hot Standby to Cold Shutdown

(2) S023-3-2.6, Shutdown Cooling System Operation

(3) S023-3-1.8, Draining the Reactor Coolant System

(4) S023-5-1.8, Shutdown Operations (Modes 5 and 6)

(5) S023-3-2.8.1, Refueling Cavity Draining Operations

(6) S023-5-1.3, Plant Startup from Cold Shutdown to Hot Standby

(7) S023-3-1.4, Filling and Venting the Reactor Coolant System

Procedure S023-5-1.5, "Plant Shutdown from Hot Standby to Cold Shutdown," guides and controls the operational activities necessary to cooldown the plant. After entering Mode 4, the shutdown cooling (SDC) system is placed into service in accordance with Procedure S023-3-2.6, "Shutdown Cooling System Operation." This procedure establishes SDC flow through parallel suction paths from one of the two hot legs to the low pressure safety injection (LPSI) pumps which are used to circulate the reactor coolant through the SDC system heat exchangers. Each of the parallel flow paths contains a pair of isolation valves inside containment, and a third isolation valve outside containment. This configuration is provided in order to prevent the loss of SDC system flow in the rare instance of the inadvertent or spurious closure of one isolation valve.

In order to prevent inadvertent overpressurization of the SDCS piping, two interlocks for each valve inside containment are provided in addition to key-locked control switches for remote manual operation from the control room panel. One interlock prevents opening of the valves whenever pressurizer pressure is above 376 psig, while the other provides for automatic closure of the valve should pressurizer pressure exceed 715 psig. Operability of these interlocks is verified at a minimum of 18 month intervals using simulated pressure signals in accordance with Technical Specification Surveillance Requirement 4.5.2.d.1.

After the SDC system is aligned and placed into operation, the RCS is cooled down to approximately 140°F, the pressurizer bubble is collapsed, and the RCS is depressurized to atmospheric pressure. Prior to depressurizing the RCS, the last RCP is stopped, and as required by Technical Specification LCO 3.4.1.4.1.a, at least one SDC train is maintained OPERABLE and in operation. The redundant train of SDC is also required to be OPERABLE by Technical Specification LCO 3.4.1.4.1.b if the water level in the secondary side of both Steam Generators is less than 10%. Procedures conservatively require a Steam Generator secondary water level above 50% wide range when being considered as an alternative to the redundant SDCS train.

After the RCS is depressurized, Procedure SO23-3-1.8, "Draining the Reactor Coolant System," is used to drain the RCS via the letdown line to Radwaste. Preparations for draining the RCS and proceeding with partially filled RCS operations include:

(1) Preparing the RCS eductor for service (to remove gases from the system high points as draining proceeds) when appropriate,

(2) Establishing a nitrogen blanket source at RCS vent connections to avoid drawing a vacuum on the RCS, when appropriate,

(3) Adjusting and verifying SDC system low flow and LPSI pump low discharge pressure alarms, and establishing continuous recording of these parameters in order to identify trends, and

(4) Connection of Refueling Water Level Indication (RWLI).

Typically, draining of the RCS is not initiated until at least 120 hours has elapsed since reactor shutdown. If draining is to proceed prior to the nominal 120 hour period, specific written authorization by the Plant Superintendent is required.

Draindown is initiated and RCS level is initially monitored using normal pressurizer level instrumentation. When pressurizer level reaches 15%, temporarily connected RWLI is valved in and the first of several correlation checks on available level indication is performed. RCS level is not reduced below 10%, by installed pressurizer level instrumentation, until proper correlation between permanent and available temporary level indication is obtained. All available level indication is frequently monitored.

During the initial draindown, (prior to RV head removal), the Heated Junction Thermocouple (HJTC) level indication system is maintained operational to provide an additional capability to independently monitor proper operation of the Refueling Water Level Indication System (RWLIS).

When RCS level reaches the reactor vessel flange, draindown is stopped and may only be continued after local temporary level indication (tygon tube and/or gage glass) agrees to within 6 inches of the RWLI wide range level indication

in the control room or to within 4.6 inches of the Critical Function Monitor System (CFMS) display for the wide range RWLI. If indicated levels do not agree within the above acceptance criteria, draindown may continue to a level above the top of the hot leg provided both channels of the Qualified Safety Parameter Display System (QSPDS) are available for vessel level monitoring. Level cannot be lowered below the top of the hot leg until satisfactory correlation between the local and remote RWLI, within the above acceptance criteria, is achieved. When the RWLI correlation is satisfactory, the HJTCs (which provide input to the QSPDS and CFMS) may be removed from service in order to support RV head removal and draining may continue from the top of the hot leg to no less than six inches above the mid-loop level.

Once the level decreases below the top of the hot leg, the SG "U" tubes drain and the RCS loops are no longer considered filled. At this point, Technical Specification LCO 3.4.1.4.2 and operating procedures require both SDC trains to be OPERABLE and at least one train to be in operation.

Prior to draining below six inches above the mid-loop level, correlation between local level indication and the remote narrow range RWLI in the control room must agree within 1 inch or less. Draindown may continue below six inches above mid-loop only if this acceptance criteria is satisfied. When level is decreased to mid-loop, work authorizations are issued to allow removal of the primary manways on the SGs. This initial mid-loop operating condition is typically established 5-6 days after reactor shutdown.

After SG manways are removed, RCS level is lowered to 6 inches below mid-loop and SG nozzle dams are installed. SDC flow and RCS level in the hot leg are closely monitored and strictly controlled at 2300 to 2500 gpm and 6 inches below mid-loop, respectively, to preclude vortexing at the hot leg SDCS suction nozzle. The absolute minimum RCS level allowed by procedure is 7 inches below mid-loop.

After the SG nozzle dams are installed, Procedure SO23-5-1.8, "Shutdown Operations (Modes 5 & 6)," is used to control the activities necessary to enter Mode 6 and establish refueling level conditions. Prior to initiating refill of the RCS for refueling operations, RCS maintenance (if any) that had been initiated while at mid-loop conditions, is verified to have been completed and/or the RCS pressure boundary affected by such maintenance has been restored. RCS level is then raised to approximately one foot below the reactor vessel flange.

Since the RCS loops are still not considered filled, both SDC trains continue to be maintained OPERABLE in accordance with Technical Specification requirements. Typically, this refill of the RCS to above the hot leg occurs at about 10 days into a refueling outage.

Following reactor vessel head removal, the refueling cavity is filled, the Upper Guide Structure (UGS) is removed, and RCS level is raised to greater than 23 feet above the reactor vessel flange. This level of water above the reactor vessel provides a heat sink for removal of decay heat in addition to

that provided by the SDCS. As such, Technical Specification LCO 3.9.8.1, and operating procedures, require that only one SDC train be maintained OPERABLE while in this condition.

Following completion of fuel movement, the refueling cavity is drained in accordance with Procedure SO23-3-2.8.1, "Refueling Cavity Draining Operations," to a level below the vessel flange and above the hot leg, normally one foot below the vessel flange. All the prerequisites and procedural requirements applicable to the initial draindown also apply to the second draindown. Since, during the second draindown, the HJTC level indication system is not available, if the correlation checks between the RWLI and the local indication do not agree within the acceptance criteria, no further draining or increase in SDC flow is allowed until the discrepancies are resolved.

Once the RCS level is lowered below 23 feet, Technical Specification 3.9.8.2 requires that two OPERABLE SDC trains again be available. Typically, the second draindown occurs about 35 days into the outage, and lasts about 10 days.

After the reactor vessel head is set on the flange, level is again lowered to mid-loop in accordance with Procedure SO23-3-1.8, "Draining the Reactor Coolant System." During this second period of mid-loop operation, the SG nozzle dams are removed, the SG primary manways are reinstalled, coordinated work is completed, and the RCS is aligned for filling. About 5 days into the second mid-loop period, the reactor head is fully tensioned, and Mode 5 is entered.

After entering Mode 5, the Shutdown Operations procedure is exited, and Procedure SO23-5-1.3, "Plant Startup from Cold Shutdown to Hot Standby," is entered. This procedure guides and controls all activities required for plant heat up. After the RCS pressure boundary is reestablished, Procedure SO23-3-1.4, "Filling and Venting the RCS," is used to fill the RCS, pressurize the RCS to approximately 360 psia, and run the RCPs in order to remove the air from the SG "U" tubes, RCPs and RV head, thereby filling the loops.

When the loops are filled, the Technical Specification requirement for maintaining two SDC trains OPERABLE is reduced to one provided both SGs have greater than 10% (administratively set at 50%) wide range secondary side water level.

During all phases of plant operation, work is authorized only on systems that have been carefully and fully evaluated by the equipment control process, as described in Procedure SO123-0-21, "Equipment Status Control." The equipment control process evaluates each tag out requirement to ensure that adequate alternate means for performing the impacted safety functions is available, that the requirements of the Technical Specifications are satisfied, and that the administrative requirements of the applicable procedures are satisfied.

The Maintenance Planning/Equipment Control process is managed through a computer based information management system. For a safety related maintenance activity, it requires independent, mandatory review by Maintenance, Operations, QA/QC, and a mandatory review by the Technical Division if the activity is related to any of the following:

(1) Unprecedented or unusual failures,

(2) Design changes or ASME code component which are performed for the first time without engineering direction or vendor supplied manuals, and

(3) Temporary Facility Modifications.

Maintenance work activities scheduled during all phases of the draindown, refueling, and refill sequence are no exception to this review/planning process. For these activities, the equipment control review process evaluates each tag out requirement with particular emphasis on ensuring that (1) RCS inventory or the ability to control RCS inventory will not be affected, (2) adequate alternate means for performing the safety function is available, (3) the requirements of the Technical Specifications are satisfied, and (4) the administrative requirements of the applicable procedures are satisfied.

Prior to issuing the work authorization to the work groups, on-shift Operations verifies all the prerequisite plant conditions identified in the Maintenance Planning/Equipment Control process are met. Prior to, during, and subsequent to the work activities when post-maintenance and functional tests are required, tailboard meetings are frequently and regularly conducted among Maintenance, Operations, Technical, QA/QC, and other appropriate personnel to resolve any problems that may arise.

In the event that RCS boundary integrity is breached for activities such as RCP seal repairs, SG nozzle dam installation, and repacking of the RCS boundary isolation valves, strict post maintenance and/or operational functional tests are performed to ensure that the RCS boundary integrity is re-established upon completion of the activity. For instance, in the case of repacking an RCS pressure boundary isolation valve, post maintenance testing includes a visual inspection and an operational functional test involving actual cycling of the valve to ensure that there is no leakage.

If a loss of SDC should occur during a reduced inventory period, Abnormal Operating Instruction SO23-13-15, "Loss of Shutdown Cooling," will ensure the following:

(1) Declaration of an appropriate emergency classification,

(2) Makeup to the RCS,

(3) Closure of the containment,

(4) Restoration of the RCS pressure boundary,

(5) Maximizing containment cooling,

(6) Restoration of SDC, and

(7) NRC notification.

For a discussion of the requirements pertaining to containment closure, and the time required to close the equipment hatch should closure be necessary, please refer to the response provided for Question 4.

QUESTION 2:

A detailed description of the instrumentation and alarms provided to the operators for controlling thermal and hydraulic aspects of the NSSS during operation with the RCS partially filled. You should describe the temporary connections, piping and instrumentation used for this RCS condition the quality control process used to ensure proper functioning of such connections, piping and instrumentation, including assurance that they do not contribute to loss of RCS inventory or otherwise lead to perturbation of the NSSS while the RCS is partially filled. You should also provide a description of your ability to monitor RCS pressure, temperature and level after the RHR function may be lost.

RESPONSE:

A. RCS Level Instrumentation

The RWLIS at SONGS 2 and 3 consists of a permanent sight glass as well as narrow and wide range transmitter/indications. These instruments are connected to the RCS after the plant is in cold shutdown and prior to draindown. They are disconnected after the RCS is refilled and prior to going to hot standby. These connections are made on the hot leg opposite from that which the Shutdown Cooling (SDC) System suction is taken. The narrow range indicator indicates level from the bottom to the top of the hot leg and the wide range indicator indicates level from the bottom of the same hot leg to the top of the refueling cavity.

The sight glass, which is connected in parallel to the narrow and wide range level transmitters, provides local level indication from the reactor vessel flange to below mid-loop on the hot leg. In addition, the SDC System provides coolant temperature and flow data in the Control Room.

B. Local RCS Level Instrumentation

Sight Glass (LG-1520)

The dry reference leg for the sight glass is obtained through a separate isolation valve at one of the four level tap condensing pots in the steam space at the top of the pressurizer. The isolation valve has a pipe to tube adapter that attaches to a U-shaped steel spool piece. The spool piece in turn connects to a permanent run of steel tube that runs down to a permanent T-connection. One outlet of the T-connection connects to the top of the sight glass while the remaining outlet connects to the RWLIS differential pressure transmitters. The sight glass is provided with isolation valves in order to facilitate gage glass cleaning and/or replacement. Stainless steel tubing (3/8 inch) connects from the bottom of the sight glass to a lower T-connection. This lower T-connection is in turn connected to the bottom of hot leg number one (via permanently

installed stainless steel tubing and stainless steel braided flexible high pressure hose) at the flange connection downstream of isolation valves 007 and 046. The U-shaped spool piece and stainless steel flexible hose are connected when the plant is in Mode 5 in order to place the RWLIS into service.

Once the RCS has been filled to mid level in the Pressurizer, the RWLIS is isolated from the RCS Hot Leg and Pressurizer and the U-shaped spool piece and flexible hose are then disconnected and threaded tube caps are installed at all connections prior to Mode 4 entry.

RCS Level Scale

A permanent steel scale is installed adjacent to the sight glass. This enables the operator to directly convert water levels noted on the sight glass to actual levels in the RCS. The scale is marked in inches from the reactor vessel flange down to the bottom of the hot leg.

C. Remote Level Instrumentation

Narrow Range Instrumentation

The narrow range transmitter/indicator provides accurate level information to the Control Room when operating at or near mid-loop. The transmitter for the narrow range indicator (LI-1520A) is connected in parallel with the sight glass via the T-connections on the wet and dry reference legs of the sight glass. LI-1520A reads from 0 to 42 inches with 0 inches being the bottom of the hot leg and 42 inches being the top of the hot leg.

Wide Range Instrumentation

The purpose of the wide range transmitter/indicator is to provide the Control Room with the wide range indication needed to control draindown from the top of the reactor vessel flange to the bottom of the loop. The transmitter for the wide range indicator (LI-1520B) is connected in parallel with and adjacent to the narrow range transmitter. LI-1520B reads from -10 feet to + 25 feet with the zero point being at the reactor vessel flange.

RWLI Alarms

Both the narrow and wide range indicators are provided with a Control Board adjustable alarm setpoint. Changes to the RCS level are made by using combinations of Control Room controlled valves and pumps and manually operated valves. There is no automatic level control available unless there is a steam bubble in the pressurizer. After obtaining the desired level, mid-loop for example, the alarm setpoints are set at that level. Should either the wide range or narrow range indicate a deviation of plus or minus 3 inches from the level setpoint, the alarm, REFUELING WATER LEVEL HIGH/LOW is annunciated in the Control Room. When level is

above the hot leg, the narrow range alarm is set at 42 inches. This has the effect of clearing the narrow range level alarm and allowing the wide range controller to actuate the alarm if it detects a level deviation. During mid-loop operation, two redundant channels of level indication and alarm are in operation. With level above the top of the hot leg, one channel of level indication and alarm is in operation.

D. Shutdown Cooling (SDC) Remote Temperature Instrumentation

One recorder in the Control Room displays the following three SDC System temperatures:

(1) Inlet to the A Train SDC Heat Exchanger,

(2) Inlet to the B Train SDC Heat Exchanger, and

(3) SDC common return temperature to the RCS.

RCS T-Hot and T-Cold indicators are normally not relied on when SDC is in service and a Reactor Coolant Pump (RCP) is not running. Since the Core Exit Thermocouple (CET) temperatures are available on the CFMS computer, they can be used in cases where SDC is lost and the In-Core Instruments (ICIs) are still connected. So long as the ICIs are connected, both the HJTCs and the unheated thermocouples provide level indication and core exit temperature information.

E. Pressure Instrumentation

Remote RCS Pressure Instrumentation

There are four channels of pressurizer instrumentation, with each channel comprised of a low range indication system (100 to 750 psia), a mid range indication system (1500 to 2500 psia), and a wide range indication system (0 to 3000 psia). During draindown, the RCS and pressurizer are connected to the quench tank via the reactor vent system. The quench tank pressure indicator system (0 - 130 psig) provides an indirect measure of RCS pressure during stable conditions. After RCS level is drained to below the top of the hot leg, the RCS eductor is connected to the reactor vent system via a temporary connection with a temporary gauge capable of reading a few inches of vacuum and a few pounds of pressure. As part of the design change to upgrade the Chemical Volume Control System (CVCS) and pressurizer instrumentation in the Control Room, the low range pressurizer pressure indication systems are being modified to display in the range of zero to 700 psia.

Local SDC Pressure Instrumentation

Pressure Indicator PI-9434 provides the operator with local indication of the pressure at the suction of the Train A SDC pump. Likewise, Pressure Indicator PI-9435 provides the operator with local indication of the pressure at the suction of the Train B pump.

F. SDC Flow Instrumentation

Remote SDC Flow Instrumentation

SDC flow is monitored by Flow Transmitter FT-0306 and Flow Indicator FI-0306 (located in the Control Room).

SDC Flow Alarm

During loops partially filled conditions, a Control Room alarm warns the operator if SDC flow falls below 2300 gpm. Additionally, when the Plant Monitoring Computer is available, SDC flow high and low alarms are selected to annunciate an independent alarm system using the Alarming Trend Recorder.

G. Accident Monitoring System

Critical Function Monitoring System (CFMS)

The CFMS is a computer based data acquisition and display system which provides the operator with the status of critical plant functions during all modes of plant operation. The CFMS displays the following:

(1) The saturation margin based on temperatures in the hot and cold legs from the Core Exit Thermocouples (CETs) and from the unheated thermocouples in the HJTC system and pressure in the Pressurizer when the ICIs are connected,

(2) The water level in the head and upper plenum of the Reactor Vessel based on data from the HJTCs when the ICIs are connected,

(3) The location and temperature of the CETs on a mimic of the core (including the representative core exit temperature when the ICIs are connected),

(4) The status of pumps, valves and heat exchangers in the SDC system and key parameters for the operators to trend and determine changes over time such as heatup rate, and

(5) The outputs of the Narrow and Wide Range Level Transmitters discussed earlier in this document.

Qualified Safety Parameter Display System (QSPDS)

The QSPDS is a two channel seismically qualified Class 1E display of safety parameters in the Control Room. This system uses hot and cold leg temperatures and Pressurizer pressure inputs to calculate saturation margin. This system uses Heated Junction Thermocouple (HJTC) temperature inputs (16 per channel) for reactor vessel level, temperature and saturation margin in the region above the core.

H. Instrumentation Available During a Loss of SDC

All of the above described instrumentation will be available during the first draindown operation. All of the instrumentation will be used to verify that the RWLI instruments are all working correctly. After this has been done, the CETs and HJTCs are disconnected as part of the refueling evolution or any planned maintenance.

I. Piping and Connections

The lines used in the RWLIS System are 3/8 Stainless Steel (SS) Tubing. The two connections made to place the U-shaped spool piece into service are standard tube connections. A flange connection is used to connect the flexible hose to the line from the bottom of the hot leg.

J. Operational Controls

Operations and Engineering personnel inspect the RWLIS prior to and after valving it into service. Correlation checks of the level instruments are conducted at preestablished levels during the draindown process to verify the instrument accuracy. Operators are required to verify that various level indications are in agreement as specified in Procedure S023-3-1.8. This procedure requires that the verification be performed three times during the draindown:

(1) Prior to draining below 10% Pressurizer level,

(2) Within one foot below the reactor vessel flange, and

(3) Prior to draining below 6 inches above the mid-loop level.

At each point the RCS draindown is stopped and the correlation is performed prior to continuing to drain down. The criteria to drain below 6 inches above the mid-loop level is that the Narrow Range Level Indication and the Local RCS Level Indication are in agreement to within one inch or less.

Procedure S023-3-1.8 contains a table that provides a quick conversion from a level reading on one instrument to the expected level reading on the other instruments.

K. Engineering and Design Features

The above described equipment was incorporated into the plant in accordance with the SONGS Design Control Program which includes a complete design review and safety evaluation. The configuration is documented on the appropriate design documents. All of the instrumentation is calibrated using approved Instrumentation and Control Procedures and on a frequency established in the SONGS Calibration Control Program.

The design of the RWLIS incorporates the lessons learned at SONGS and at other plants. The design includes the following features:

(1) The pertinent RCS levels are identified on the sight glass scale. The accuracy of the scale was verified by using a surveyor's level to check the mid-loop indication and by physically checking the reactor vessel flange indication.

(2) Engineering evaluated all instrument inaccuracies and established specific guidelines/instructions regarding the instrument correlation that must be obtained in order to assure RCS level instrument operability. These instructions have been incorporated into plant operating procedures.

(3) The RVLIS design temperature and pressure are 200°F and 500 psig.

(4) The RVLIS is designed to ASME seismic 2/1 criteria.

(5) The SS tubing is permanently installed with a minimum slope of 3/4 inches per foot. This prevents a two phase mixture in the sensing lines and eliminates errors in indicated level.

(6) All of the RWLIS materials were purchased to meet Quality Class III requirements as defined in the SONGS 2 and 3 FSAR. However, for purposes of maintenance and operation, the system is treated as safety related.

(7) The use of the condensing pot and the U-shaped spool piece at the top of the Pressurizer prevents moisture from accumulating in the line between the top of the Pressurizer and the sight glass.

(8) The RWLIS is connected to the top of the Pressurizer at a location that will ensure that the vacuum effect of the eductor will not interfere with the accuracy of the system. This was verified by a special engineering test.

L. Installation

In order to avoid the problems associated with the use of the tygon tubing, the sight glass used for RCS level indication during draindown evolutions is hard piped to the RCS. Not only does this avoid indication errors associated with tygon tubes (such as tube kinks, high spot traps for air bubbles, and misrouting over potentially hot pipe), it also greatly simplifies the installation process. The tygon tube/sight glass and the electronic RWLIS are installed with Maintenance procedures.

The placing into service of this sytem and verification of proper operation is controlled by operating Procedure S023-3-1.8 which governs draining of the RCS. The following steps place this system into service:

(1) Verify that the calibration of the narrow and wide range level transmitters is correct,

(2) Use compressed air to blow any moisture or debris out of lines,

(3) Install the U-shaped spool piece to connect a dry reference leg to the Pressurizer steam space,

(4) Connect the flexible steel braided hose to the line from the isolation valves at the bottom of the hot leg,

(5) Valve in the transmitters and the sight glass, and

(6) Vent the narrow and wide range transmitters to ensure that the wet leg to the transmitters is full.

QUESTION 3:

Identification of all pumps that can be used to control NSSS inventory. Include: (a) pumps you require to be operable or capable of operation (including information about such pumps that may be temporarily removed from service for testing or maintenance); (b) other pumps not included in item a (above); and (c) an evaluation of items a and b (above) with respect to applicable TS requirements.

RESPONSE:

Whenever the RCS is in the loops partially filled status, the Unit has been depressurized to atmospheric pressure. However, the Low Temperature Over Pressure Relief (LTOP) valve is aligned to the RCS, and RCS pressure is limited to 406 ± 10 psig per Technical Specification 3.4.8.3.1.a. Therefore, in order for a pump to be considered part of an alternate core cooling system, it would need to meet the following criteria:

(1) A flow path to the RCS which could be utilized before boil-off and/or hot leg pressurization would result in uncovering the core,

(2) Shutoff head greater than 406 psig with an adequate flow capacity at that pressure, and

(3) An adequate suction supply or a resupply system.

The three kinds of pumps normally available to add inventory to the RCS are the Charging Pumps, High Pressure Safety Injection (HPSI) Pumps, and Containment Spray Pumps.

Since the charging pumps are rated at 44 gpm and only one of the three can be powered due to dilution accident considerations, they are not considered viable as an alternate cooling pump.

Since the containment spray pumps are normally isolated from the RCS, and their shutoff head is about 250 psi, they are not considered viable as an alternate cooling pump.

Since the HPSI pump can supply an adequate flow above 406 psig, they are considered a viable alternate cooling pump, and at least one HPSI pump is required by procedures to be capable of operation before draindown is allowed, and must remain operable during all periods when the loops are partially filled. By procedure, a HPSI pump is required to be immediately available for alternate cooling.

Other pumps not included above are the Primary Makeup Water (PMW) pumps and the Boric Acid Makeup (BAMU) pumps. The PMW pumps are not used as a makeup source during periods when the RCS is partially filled because of dilution accident considerations which require all flow paths to be closed and tagged

closed to preclude inadvertent dilution of the RCS. The BAMU pumps are not relied on as a makeup source during periods when the RCS is partially filled because both may be isolated simultaneously for maintenance.

The Technical Specifications require a boron injection flow path and pump in Modes 5 and 6, and include a requirement that the pumps used have an OPERABLE emergency power source. Either a charging pump or a HPSI pump can be used to meet that requirement.

If a HPSI pump is being used as the Boric Acid Flow Path pump, then its support systems are required by the Technical Specifications to be functional. In order to ensure adequate makeup availability for the decay heat load should a loss of SDC occur, procedures require that one HPSI pump and all necessary support systems be maintained capable of injection during all periods when the loops are partially filled.

QUESTION 4:

A description of the containment closure condition you require for the conduct of operations while the RCS is partially filled. Examples of areas of consideration are the equipment hatch, personnel hatches, containment purge valves, SG secondary-side condition upstream of the isolation valves (including the valves), piping penetrations, and electrical penetrations.

RESPONSE:

The capability of containment closure within 4 hours is required whenever the RCS is partially filled. Interferences (hoses, cables, etc) are not allowed to be routed through the personnel hatches, and points of disconnect are required adjacent to the equipment hatch. Piping and electrical penetrations are maintained intact (capable of closure). Since an adequate RCS makeup system is required during periods when the RCS is partially filled, containment closure within 4 hours will provide added assurance that the health and safety of the public is not endangered if the emergency makeup/core cooling system were to fail.

Further assurance is provided by:

(1) The redundant level monitoring equipment which will help to ensure an early response to a change in RCS inventory,

(2) Training and procedural guidance is provided to ensure rapid and proper identification of abnormal plant conditions during partially filled RCS operations, and to ensure that appropriate actions are taken to correct the abnormal conditions as necessary, and

(3) Administrative controls, to ensure that the RCS inventory and inventory control system are not challenged by maintenance and testing activities, exist through the Maintenance Planning/Equipment Control review process as discussed in the response to Question 1.

Procedures are in place, such as the Shift Superintendent's Accelerated Maintenance procedure, to ensure rapid response of support personnel. Additionally, containment closure is verified by Attachment 2, "Containment Building Penetrations Status Verification," contained in Procedure SO23-3-3-27.1, "Once a Week Surveillance (Modes 5 and 6)." The Containment Building Penetrations Status Verification includes a complete check of the SG secondary-side condition outside of the containment (including the isolation valves) that must also be verified closed if the secondary-side of the SG is open to containment. If the containment were to be breached in some other way (e.g., electrical penetration removed), the Equipment Deficiency Mode Restraint (EDMR) procedure would flag the condition to the control room personnel to ensure verification that provisions had been made for timely closure in the event of an emergency.

The Technical Specifications require that during CORE ALTERATIONS, the equipment hatch be closed with at least 4 bolts, that each air lock maintaining at least one door closed, and that each penetration providing direct access between the containment atmosphere and the outside atmosphere be closed or capable of automatic closure.

QUESTION 5:

Reference to and a summary description of procedures in the control room of your plant which describe operation while the RCS is partially filled. Your response should include the analytic basis you used for procedures development. We are particularly interested in your treatment of draindown to the condition where the RCS is partially filled, treatment of minor variations from expected behavior such as caused by air entrainment and de-entrainment, treatment of boiling in the core with and without RCS pressure boundary integrity, calculations of approximate time from loss of RHR to core damage, level differences in the RCS and the effect upon instrumentation indications, treatment of air in the RCS/RHR system, including the impact of air upon NSSS and instrumentation response, and treatment of vortexing at the connection of the RHR suction line(s) to the RCS.

Explain how your analytic basis supports the following as pertaining to your facility: (a) procedural guidance pertinent to timing of operations, required instrumentation, cautions, and critical parameters; (b) operations control and communications requirements regarding operations that may perturb the NSSS, including restrictions upon testing, maintenance, and coordination of operations that could upset the condition of the NSSS; and (c) response to loss of RHR, including regaining control of RCS heat removal, operations involving the NSSS if RHR cannot be restored, control of effluent from the containment if containment was not in an isolated condition at the time of loss of RHR, and operations to provide containment isolation if containment was not isolated at the time of loss of RHR (guidance pertinent to timing of operations, cautions and warnings, critical parameters, and notifications is to be clearly described).

RESPONSE:

A summary description of procedures which describe activities conducted during RCS draindown modes and operation with the RCS partially filled is contained in response to Question 1. The analytical basis for procedures where applicable is described below.

A. Loss of SDC

Abnormal Operating Instruction (AOI) SO23-13-15, "Loss of Shutdown Cooling," identifies operator actions in the event of a total loss of SDCS flow while the RCS is in the mid-loop condition. If the LPSI pump (used for SDC) is airbound or all flow is lost, then the pump is stopped, the RCS is filled with a HPSI pump through the emergency boration flowpath until RCS level has increased 5 inches and is greater than mid-loop (21" on narrow range level indication), and the other LPSI pump is started. The SDCS is then vented (LPSI pump casings and SDC heat exchangers). If this LPSI becomes airbound, then it is stopped and the SDCS is vented. Following venting, a LPSI pump is restarted.

The procedure specifies that if the time to reach 212°F is exceeded before SDCS flow is restored, then alternate core cooling is to be initiated. Alternate core cooling consists of filling the RCS through the emergency boration flow path to the highest possible level without spilling into containment using a HPSI pump or charging pump, and, if the RCS starts to boil, providing RCS makeup as necessary to maintain maximum inventory. The response to Question 3 describes additional plant capabilities to control RCS inventory.

The procedural guidance to initiate alternate core cooling is based on calculations of core heatup rate and time to start bulk boiling following a loss of SDC as a function of time after reactor shutdown. The results of these calculations which are attached to the procedure indicate that bulk boiling would occur within 23-47 minutes for shutdown times of interest (5-50 days). Calculations of time to core uncovery and makeup rate to maintain inventory have also been performed. Results indicate time to core uncovery of 1.5-3.1 hours and makeup rates of 40-82 gpm for shutdown times of interest. These results indicate that sufficient time exists to initiate alternate core cooling and that a HPSI pump has adequate makeup capacity to makeup for core boiloff.

Current procedural guidance and analytic basis apply to the RCS in a mid-loop configuration and "open" to the containment atmosphere. As a result of Generic Letter 87-12 and evaluation of mid-loop operations, other possible mid-loop plant configurations have been identified and RCS response has been qualitatively assessed. These include:

(1) Mid-loop operation with RCS closed (RCS pressure boundary intact) with and without SGs available,

(2) Mid-loop operation with SG nozzle dams installed, RV head on, SG manways open, and

(3) Mid-loop operation in configuration (1) or (2) above with the addition of an opening in the RCS cold leg (e.g., for RCP seal replacement or other RCP maintenance).

The RCS response to loss of SDC for the above plant configurations is described below in addition to related procedural modifications under consideration.

In the event the RCS is drained down to mid-loop and closed to the atmosphere (i.e., RV head on, SG manways closed, pressurizer and RV head vents open), the RCS response depends on the SG availability. If the SGs are available (i.e., water in the SG secondary side), the RCS will pressurize until the air in the system is compressed into the SG tubes sufficiently that heat transfer area is exposed (approximately one foot) to condense the steam produced by decay heat. A plant specific quasi-steady state hand calculation indicates this would require an RCS pressure of approximately 10 psig (RCS temperature of 240°F assuming SG temperature of 212°F). An independent computer calculation in

Reference 1 using simplified System 80 data indicates an initial RCS pressurization of 5.4 psig (SG at 120°F) increasing to an RCS pressure of 32.1 psig (SG at 212°F). This calculation assumed a homogeneous air-steam mixture in the SG tubes with degraded heat transfer coefficient compared to pure steam condensation but with the full SG heat transfer area available. The results indicate RCS pressurization is low (approximately 10 psig) as the SGs are effective in removing decay heat by reflux condensing. Current procedural guidance is appropriate in this case which is to use a HPSI pump to increase RCS level and provide makeup for small RCS inventory losses through vents, etc.

In the event the RCS is at mid-loop, closed to the atmosphere (i.e., RV head on, SG manways closed, pressurizer and RV head vents open) and the SGs are not available (SG water level less than 10% wide range level), the loss of SDCS flow will cause the RCS to pressurize until the LTOP relief setpoint is reached at approximately 400 psig. SONGS 2 and 3 use the SDC relief valves for LTOP which are physically located below the bottom of the hot legs. Initially, water relief will occur through the SDC relief valve until the RCS water level reaches the bottom of the hot legs. Water relief via the SDC relief valve is not sufficient by itself to remove decay heat and depressurize the RCS. HPSI flow is sufficient to remove decay heat but will not prevent RCS level from dropping to the bottom of the hot legs, as SDC relief valve liquid flow (3089 gpm) exceeds HPSI flow (about 720 gpm at 400 psig). When the SDC relief valve location becomes uncovered and steam relief occurs, the RCS will depressurize and the valve will close. HPSI flow is sufficient to match the steam production rate, so that RCS pressure will subsequently cycle around the SDC relief valve setpoint to remove decay heat and HPSI will provide RCS makeup in a successful feed and bleed mode of core cooling. The effect of steam flow through this valve and the effect on downstream piping has not been assessed. The detailed dynamics of establishing a feed and bleed mode of core cooling via the SDC relief valves has not been analyzed. However, having a SG available would prevent LTOP activation and provide a preferable mode of alternate core cooling. Requiring a SG to be available in this plant configuration will be considered as a procedure enhancement pending further evaluation.

In the event the RCS is at mid-loop with SG nozzle dams installed, RV head on, SG manways open, a loss of SDCS flow will cause the RCS to begin to pressurize, as the SGs are not available (blocked by hot leg nozzle dams). However, this configuration differs from the previous configuration where it was assumed the SGs were not available because RCS pressurization will cause one or both nozzle dams to fail before the LTOP setpoint is reached. This conclusion is based on a test of a nozzle dam of similar design at another plant which showed that the nozzle dam began to weep at 80 feet of water (approximately 35 psig). In the event a hot leg nozzle dam failed or both hot and cold leg nozzle dams failed simultaneously, then the RCS would become an "open" or vented system via the SG manways. However, if a cold leg nozzle dam failed first, then the RCS would depressurize by forcing water out the cold leg SG manway, depressing the water level above the core, and potentially resulting in

partial core uncovery until HPSI was effective in restoring RCS level. Initially, HPSI would not be able to match the discharge through the cold side SG manways at the expected nozzle dam failure pressure.

In order to avoid this scenario, consideration is being given to requiring a RCS hot side vent and hot leg HPSI injection whenever the plant is in this configuration. A sufficiently large RCS hot side vent would prevent RCS pressurization on extended loss of SDCS flow, thereby preventing nozzle dam blowout, and hot leg HPSI injection would further ensure that RCS makeup reaches the reactor vessel where it is needed to prevent core uncovery should some RCS pressurization, level depression, and potential cold side nozzle dam leakage occur (rather than spilling through a failed or leaking cold side nozzle dam and short circuiting the RV).

A final category of plant configurations at mid-loop occurs when there is an opening in the discharge leg due to RCP seal replacement or RCP maintenance requiring partial RCP disassembly. If the RCS is otherwise closed (i.e., RV head on, SG manways closed, pressurizer and RV head vents open) on loss of SDCS flow, the RCS will heatup and pressurize to approximately 30 psig or 400 psig (LTOP setpoint), depending on whether the SGs are available. The RCS pressure would act on the RV water level and crossover leg (loop seal) water level and force water out of the RCP opening. A larger opening and a higher pressure (SG not available) would relieve more water. Water would continue to be discharged through the opening until the loop seal vented or cleared, allowing a steam vent path to the opening which would depressurize the RCS. The potential for partial core uncovery exists during the loop seal clearing process, particularly if the loop seal elevation is lower than the top of the core elevation. HPSI flow may mitigate the situation by providing flow which exceeds that being discharged through the opening. In Reference 1 discharge leg flow path sizes were calculated with discharge rates for water and steam which matched HPSI flow at RCS pressures of 50 psig and 400 psig (600 gpm and 450 gpm HPSI flow, respectively). The flow path sizes calculated were 2.74 in^2 (liquid) and 114 in^2 (steam) with SG available (50 psig), and 0.616 in^2 (liquid) and 8.1 in^2 (steam) with SG not available (400 psig).

The results indicate that with SG available, RCP disassembly beyond seal removal (several square inches) is acceptable, but that major RCP disassemblies (i.e., > 114 in^2) may not be acceptable as steam flow through the path exceeds HPSI injection at 50 psig. With SG not available, RCP disassembly beyond seal removal (i.e., > 8.1 in^2) may not be acceptable as steam flow through the path exceeds HPSI injection at 400 psig. These conclusions are generally applicable to SONGS 2 and 3. Hence, RCP seal replacement appears to be acceptable in this plant configuration with or without SG available, so long as one HPSI pump is available. For RCP openings of a few square inches, HPSI flow exceeds steam flow through the RCP flow path but is less than liquid flow, so that flow path coverage (top of cold leg) would alternate between liquid and steam and the loop seal must vent to allow steam to

the flow path. For SONGS 2 and 3 the loop seal elevation is higher than the top of the core, so that loop seal venting should not uncover the core. For much larger RCP openings associated with major RCP disassembly, it has not been demonstrated in a dynamic sense that HPSI injection can keep up with steam flow through the RCP opening.

For plant configurations including RCP seal replacement requiring the SG be available to limit RCS pressure and hot leg HPSI injection to ensure water gets to the RV are under consideration as procedure enhancements. For plant configurations involving larger RCP disassembly, the requirement of a hot leg vent would provide additional assurance that RCS pressurization and significant inventory loss would not occur.

If the RCS is at mid-loop with SG nozzle dams installed (RV head on, SG manways open, pressurizer and RV head vents open) and with an opening in the discharge leg due to RCP seal replacement or other RCP disassembly, then loss of SDCS flow will cause the RCS hot side to pressurize as the hot leg nozzle dam prevents the SG from being available for heat removal. For a small RCP opening, the RCS will pressurize until one or more nozzle dams fail. The small RCP opening will not discharge enough liquid to remove decay heat and will not significantly affect the pressurization rate. Liquid will be lost through the opening which can be made up by HPSI flow at low pressures before nozzle dam failure. HPSI flow can delay RCS pressurization by absorbing decay heat but cannot prevent it. If a cold leg nozzle dam fails, the hot side pressurization will force liquid out the cold leg SG manway. Core uncovery is likely as HPSI flow cannot match liquid flow through the SG manway at nozzle dam failure pressure. This scenario is similar to that described previously for the RCS with nozzle dams installed.

For a much larger RCP opening, the RCS hot side will begin to pressurize, forcing water through the opening. The loop seal cannot vent and provide a steam vent path to the opening as long as the hot leg nozzle dam is intact. The vent path through the RV annulus bypass is not significant enough to equalize hot and cold leg pressure before the discharge leg becomes filled with liquid due to hot side pressurization. HPSI flow cannot make up for the liquid discharged through the large opening. Hence, the core is likely to uncover whether nozzle dam failure occurs or not.

To avoid the potential consequences of extended loss of SDCS flow while in this plant configuration, procedures require a hot side vent (pressurizer or hot leg SG manway) to prevent RCS pressurization and hot leg HPSI injection availability for additional assurance that RCS makeup gets to the RV.

B. Containment Integrity

AOI SO23-13-15, "Loss of Shutdown Cooling," also provides for actions related to containment integrity. If SDC is not restored within 15-30 minutes, the procedure requires that containment be evacuated of

non-essential personnel, containment purge be stopped, containment integrity be established (close all openings to outside atmosphere), and containment cooling be maximized by placing all available cooling units in service. It is estimated that containment integrity could be established within 4 hours.

A preliminary assessment of the onsite and offsite radiological consequences of a loss of SDC event was made assuming no core damage. The onsite assessment assumed an expected I-131 concentration in the RCS and a boiloff rate corresponding to 5 days after shutdown which results in a release of approximately 4 μCi/sec to containment atmosphere. Assuming no purge or other release from the containment building, the I-131 concentration in containment after 1 hour would be 2 μCi/cc or 20 MPCs. Personnel working within the containment would accumulate approximately 44 MPC-hours at the end of 2 hours which is about 8% of the quarterly exposure allowed by regulations. Appendix I of 10 CFR 50 limits the total annual release of I-131 in gaseous effluents to one curie. If all I-131 discharged into containment were released to the environment, the cumulative release in 2 hours would be 0.03 curie or 3% of the annual limit. The offsite dose assessment in Reference 1 assumed RCS specific activities using System 80 data based on ANSI N237 (no credit for degassing), a boiloff rate corresponding to 1 day after shutdown, site meteorology per Regulatory Guide 1.4, and no credit for containment integrity. The dose results were 31 mrem (thyroid) and 15 mrem (whole body) for a 2 hour dose calculation at the site boundary. Use of actual RCS concentrations would reduce this dose results by roughly two orders of magnitude. Hence, onsite and offsite dose consequences are small as long as the loss of SDC event does not produce fuel damage.

The potential for core damage was also assessed. Core damage would not occur for some time after the onset of core uncovery. For the plant configuration where the RCS is "open" to the atmosphere, time to core uncovery following loss of SDC was estimated at 1.5-3.1 hours (5-50 days after shutdown). The preferred recovery method is to restore SDC. However, the availability of one HPSI pump is sufficient to makeup for boiloff and other alternate methods of removing decay heat are also available. In Reference 1 analysis was cited that substantial core damage via boiloff scenarios will not occur until the time the level drops below the core midpoint, as clad temperature remains below 1200°F due to steam heat transfer. This would provide an additional 45 minutes to 1 hour before core damage.

For the plant configuration where the RCS is "closed" to the atmosphere, if SDC cannot be restored, then SG availability or primary feed and bleed using LTOP/HPSI are alternate methods of core cooling which will keep the core covered.

For the mid-loop plant configuration where the RCS is closed except for an opening in the cold leg (e.g., RCP seal replacement), a HPSI pump can makeup for liquid inventory losses through the opening. Heat removal is

via SG or feed and bleed (HPSI/LTOP and/or RCP opening depending on RCS pressure). For a larger opening in the cold leg (e.g., major RCP disassembly), the loop seal will vent steam to the opening. For SONGS 2 and 3 the top of the loop seal is above the top of the core, so that core uncovery is not expected during the venting process. Subsequently, HPSI flow will makeup for steam boiloff to remove decay heat.

For the plant configuration where the RCS is closed due to nozzle dams installed, the failure of a cold leg nozzle dam due to RCS pressurization could result in potential core uncovery. The depth or length of time of core uncovery has not been analyzed. However, Reference 1 performed an analysis with the methodology of the PARCH code to determine steady state temperature vs. core uncovery depth. The results indicated a peak clad temperature of 1335^{o}F within 3.5 minutes for a steady state uncovery depth of 2.19 inches (decay heat level 1/2% corresponding to 1 day after shutdown). Hence, a short time exists to restore RV level and recover the core before major core damage would occur. Based on the above, it is believed that the probability of core damage following a loss of SDC event is extremely low given the time available to restore SDC and the alternate methods of heat removal available. The administrative measures under consideration discussed previously would preclude core uncovery for all mid-loop plant configurations.

C. Air Entrainment

Air entrainment in the SDCS has been observed to cause transient RCS level differences between the hot leg and the cold leg (4"-8"). The air entrainment causes the apparent RCS level to rise in the cold leg as the air displaces the water. Levels eventually equalize as the air leaks out of the cold leg through the gaps between the hot leg and the downcomer and the core barrel alignment keys. The transient level difference does not affect RCS level indication which is correctly measured in the hot leg. The potential for vortexing and air entrainment at the connection of the SDC suction line and the RCS which could lead to SDC pump cavitation is avoided by controlling maximum SDC flow as a function of hot leg level. A curve is attached to the procedure (SO23-3-1.8) which defines an acceptable operating window (SDC flow vs. hot leg level) which is well below a known vortexing curve based on previous SONGS 2/3 SDC suction line vortexing events. Hot leg level is closely monitored during mid-loop operation by redundant channels of level indication which have been satisfactorily correlated.

Reference 1: CE Owners Group, "Loss of RHR Scenarios -- Detailed Qualitative Assessment," September 1, 1987

QUESTION 6:

A brief description of training provided to operators and other affected personnel that is specific to the issue of operation while the RCS is partially filled. We are particularly interested in such areas as maintenance personnel training regarding avoidance of perturbing the NSSS and response to loss of decay heat removal while the RCS is partially filled.

RESPONSE:

Formal operator training for partially filled RCS operations and the associated potential loss of SDC system is conducted in the form of theory review, systems training, requalification/simulator training, and on-the-job training. The formal operator training process is coordinated and conducted by the Training Division which has received INPO accreditation.

A specific objective of Science and Engineering Fundamentals Lesson Plan 2FD203, "Fluid Mechanics in Pumps," is to "[c]ompute NPSH and list various methods by which an operator can change NPSH." This training is intended to provide the necessary background knowledge for operations personnel to identify and understand the circumstances which could lead to a loss of NPSH on any pump and to allow the operator to deal with conditions which could lead to a loss of shutdown cooling event.

Plant Systems Lesson Plan 2XA202, "Reactor Coolant System," is used to train the operators on the details of mid-loop operations and Procedure SO23-3-1.8, "Draining the Reactor Coolant System," as well as in other areas of RCS operation. Initial Licensed Operator Training Lesson Plan 2A0715, "Loss of Shutdown Cooling," covers in detail a loss of SDC during mid-loop operations. This training provides the operator with specific operational circumstances dealing with the loss of SDC. The lessons review actual station procedures which identify the process of establishing mid-loop operations while on Shutdown Cooling, and review the procedural actions required of the operator if SDC flow is lost during mid-loop operations. These lessons provide the operator the insight necessary to deal with a loss of SDC event from mid-loop.

Licensed Operator Requalification Training Lesson Plan 2RS729, "Loss of Shutdown Cooling," provides simulator training in dealing with this event. The SONGS 2 and 3 plant specific training simulator is used in the continuing licensed operator training program to reinforce identified manipulations necessary to the safe operations of the actual units. The loss of SDC is one of these identified manipulations which is required to be practiced by the licensed operators at least once every two years. However, in practice, this manipulation is routinely reinforced on an annual basis.

The Loss of Shutdown Cooling Event at SONGS Unit 2 in 1986 was reviewed in the 1986 Licensed Operator Requalification Program as a self-study assignment. Each licensed operator reviewed the event and took a quiz on the material. Systems and important operational events are identified for review during the

formal classroom presentations as part of the requalification program requirements. The operation of the Shutdown Cooling System has been and will continue to be one of the important systems covered as part of this ongoing program. Emphasis has been placed on this subject in the past and it is currently being reviewed in this year's lesson materials.

As part of the on-the-job training/qualification program for a particular watch-station, an operator must complete a qualification card which requires the operator to verbally communicate knowledge of specific system operation and details. Not only does this qualification card process include the shutdown cooling system, it also includes the procedures which govern the operation of this system and the operator action to be performed on this system. The responses given by the qualifying operator are evaluated for completeness by a qualified operator before the qualified operator will validate the qualification card.

As discussed in the response to Question 1, the Maintenance Planning/Equipment Control review process plays a key role in ensuring that maintenance activities do not result in any adverse impact on partially filled RCS operations and shutdown cooling. Accordingly, the Training Division instructs all appropriate maintenance personnel in the following topics: (1) Equipment Control, (2) Work Authorizations, (3) Administrative Procedures, (4) Procedure Compliance, and (5) Plant and Industry Events.

These training topics also place emphasis on areas such as what to do if an unexpected condition arises during the performance of a work evolution, whom to notify if a parameter is found to be unsatisfactory during performance of a maintenance procedure.

Similar to the Operations preshift briefing, the maintenance crew briefing serves as a crucial forum to ensure that maintenance status is transmitted in a clear and orderly fashion from a crew to the next, and that the latest important changes affecting ongoing maintenance activities are communicated in a real time manner. During partially filled RCS operation a shift maintenance supervisor regularly attends the Operations preshift briefing. This maintenance supervisor also serves as a maintenance focal point to the Operation Shift Superintendent. In this way, abnormal maintenance conditions are effectively communicated to Operations, and changes in plant conditions which can affect ongoing maintenance activities are effectively communicated to Maintenance.

Lastly, all of the procedures and lesson plans used in the conduct of business at SONGS 2 and 3 are reviewed on a periodic basis. The purpose of the review is to ensure all information in the written procedure/lesson plan is current, accurate and reflects all pertinent information.

QUESTION 7:

Identification of additional resources provided to the operators while the RCS is partially filled, such as assignment of additional personnel with specialized knowledge involving the phenomena and instrumentation.

RESPONSE:

In addition to redundant instrumentation (several level indicators), detailed procedural guidance, training and the planning/equipment control information management system described in the responses to earlier questions, the following division personnel are available to the operators either around the clock on site or be available on site on short notice:

A. Technical Division

Cognizant Engineers are assigned to provide required technical input and evaluation on an "on-call" basis.

B. Equipment Control

Additional licensed operators are assigned to resolve conflicts as to when a component or system may or may not be taken out of service.

C. Operations and Maintenance Support Division

Additional personnel are assigned to provide up to the minute status on SG tube inspection and plugging activities and Inservice Inspection activities.

D. Refueling Group

Additional personnel continuously monitor and provide up to the minute status on fuel movement and/or other core alterations.

E. Maintenance Division

Additional personnel monitor and provide up to the minute status on partially filled RCS maintenance repair work such as RCP seals, and RCS boundary isolation valves.

F. Outage Management Division

Outage managers resolve scheduling conflicts when competing activities need to be performed in the same plant condition window. Containment coordinators are assigned specifically to monitor all activities inside containment throughout the outage. In reality, all these division personnel, and the operators, work as a team to ensure that partially filled RCS operations as well as repair and test activities are conducted smoothly.

At SONGS 2 and 3, it is recognized that the Operations Shift Superintendent, in addition to having the responsibility to ensure the safe operation of the Unit, is a key member in the overall management structure of the site. For this reason, he is authorized by organization and encouraged by management to utilize any site resources or personnel to resolve his concerns. These include direct communication with the Station Manager or the Vice President and Site Manager, if necessary.

QUESTION 8:

Comparison of the requirements implemented while the RCS is partially filled and requirements used in other Mode 5 operations. Some requirements and procedures followed while the RCS is partially filled may not appear in the other modes. An example of such differences is operation with a reduced RHR flow rate to minimize the likelihood of vortexing and air ingestion.

RESPONSE:

During normal Mode 5 operations with the RCS filled, SDCS flow is maintained between 3500 and 4500 gpm; RCS temperature may be increased to 190°F; installed pressurizer level indication is not supplemented with additional level indication; additional means of providing makeup to the RCS is not required; frequent close monitoring and trending of SDCS flow, LPSI pump discharge pressure and motor amps is not required; containment closure capability within 4 hours is not required; additional alignment verifications and tagging of RCS pressure boundary valves is not required; and the RCS eductor is not connected.

During partially filled operations, SDCS flow is reduced to between 2300 and 2500 gpm; RCS temperature is maintained below 140°F; additional wide range and narrow range RCS local and remote level indicators with alarms are connected and utilized to monitor RCS level; SDCS flow, LPSI pump discharge pressure and motor amps are closely monitored and trended; the capability to close containment within 4 hours is maintained; RCS pressure boundary valves are closed and tagged closed to prevent dilution; and the RCS eductor is placed in service to remove radioactive gas from voids within the RCS and reduce airborne activity inside containment.

QUESTION 9:

As a result of your consideration of these issues, you may have made changes to your current program related to these issues. If such changes have strengthened your ability to operate safely during a partially filled situation, describe those changes and tell when they were made or are scheduled to be made.

RESPONSE:

The information discussed in the responses to the other questions forms the basis of our current program for operation while in a loops partially filled condition. The program has evolved over many years of operation based upon our own experiences and insights as well as those of the nuclear industry. Based on our consideration of Generic Letter 87-12, we have enhanced our program in two areas.

The procedure for handling a loss of SDC now contains a time requirement and a reference to a checklist to verify containment closure. The procedure for draining the RCS now contains a prerequisite to verify containment status to ensure closure capability within 4 hours. The sequence of installing and removing nozzle dams, and opening the Pressurizer manway to provide a large RCS vent path was added to the RCS draindown operating instruction. The use of hot leg injection for makeup if SDC flow were lost was added to the "Loss of SDC" abnormal operating instruction. Special operator training was conducted to provide a complete discussion of mid-loop operations including the insights of SCE's preliminary analysis of the hazards and Generic Letter 87-12. Core uncovery sequences, air entrainment indications, limitations of installed instrumentation, and recovery methods of the Abnormal Operating Instruction were covered.

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