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Document Control Branch (Document Control Desk)

SUBJECT: Forwards response to Generic Ltr 87-12 , "Loss of RHR While RCS Partially Filled." Flow diagrams of interrelationships between RCS, RHR & chemical & vol control sys also encl.

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NOTES: See Reports

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WISCONSIN PUBLIC SERVICE CORPORATION

600 North Adams • P.O. Box 19002 • Green Bay, WI 54307-9002

October 19, 1987

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

Gentlemen:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
Response to Generic Letter 87-12

Reference: 1) "Loss of Residual Heat Removal (RHR) While the Reactor Coolant System (RCS) is Partially Filled," Generic Letter 87-12 received July 20, 1987.

2) "Loss of Residual Heat Removal System," NUREG-1269 dated June 1987.

3) Letter from D. C. Hintz (WPSC) to Document Control Desk dated September 18, 1987.

The NRC requested information to assess safe operation of pressurized-water reactors (PWRs) when the reactor coolant system (RCS) water level is below the top of the reactor vessel flange (reference 1). The NRC request is based on concerns pertaining to the large number of loss-of-RHR events that have occurred while the RCS is partially filled. This concern was heightened as a result of the April 10, 1987, event at Diablo Canyon (reference 2). WPSC requested a 30-day extension to the 60-day response time in order to ensure the accuracy and completeness of our submittal (reference 3). This extension was confirmed in discussions with our project manager on September 15-16, 1987.

Enclosed is WPSC's response to Generic Letter 87-12 for the Kewaunee Nuclear Power Plant (KNPP). The Generic Letter contained a number of requests which were somewhat recondite, and as such were subject to interpretation. Our response provides a large body of information including current operational philosophies not only with respect to RHR, but also other ancillary procedures and strategies. Although these responses represent our current systems and operational philosophies as accurately as possible, we would like to point out that they are not intended to be an invariant set of commitments.

A061
1/1

Included, as attachment 1 to this letter, are flow diagram sketches of the interrelationship between the RCS, RHR, and Chemical and Volume Control systems to aid in the understanding of our response and procedures.

Sincerely,

D. C. Hintz
Vice President - Nuclear Power

PMF/jms

Enc.

cc - Mr. Robert Nelson, US NRC
US NRC, Region III

Subscribed and Sworn to
Before Me This 19th Day
of October 1987

Jeanne M. Stein
Notary Public, State of Wisconsin

My Commission Expires:
June 23, 1991

Attachment 1

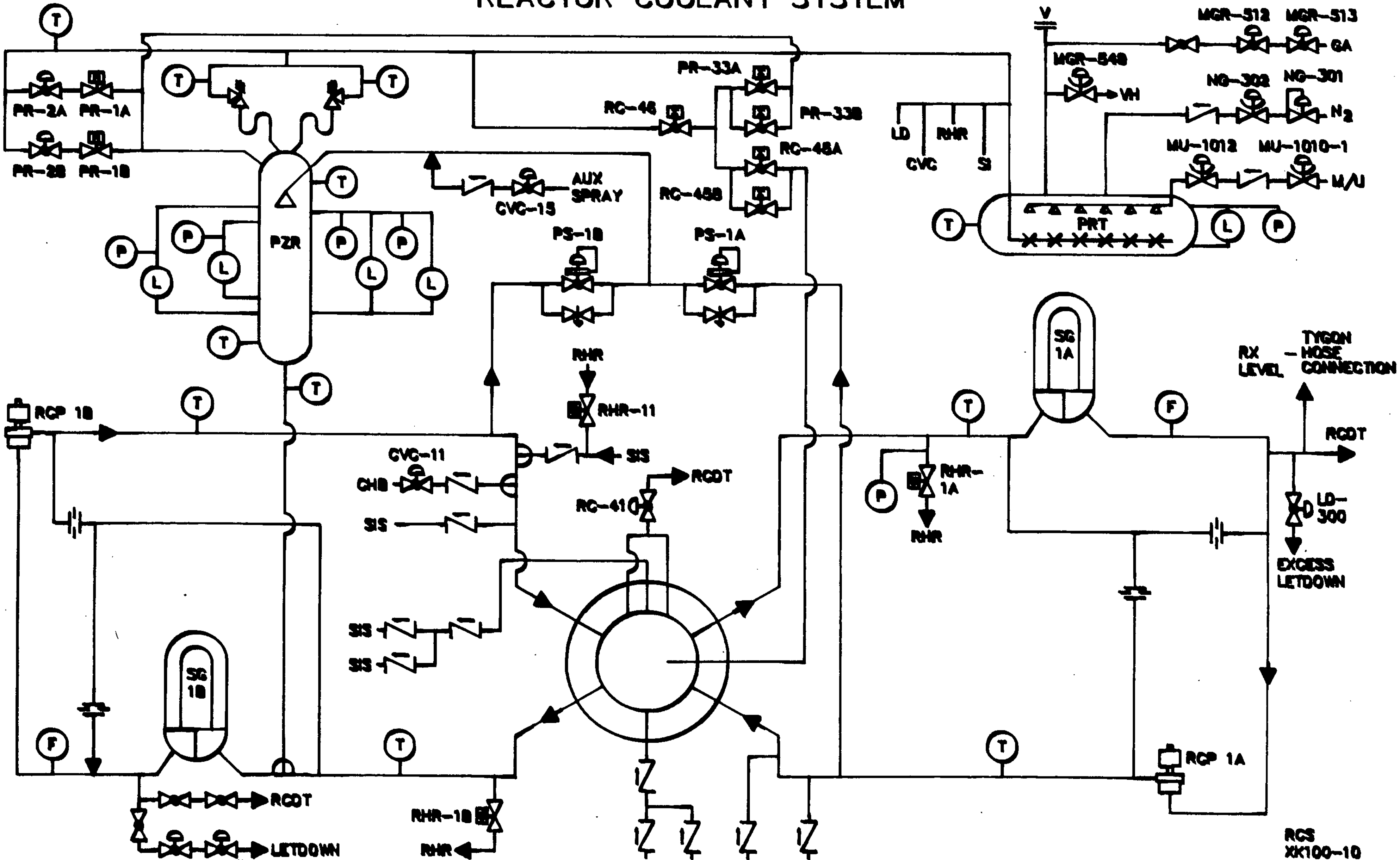
To

Letter from D. C. Hintz (WPSC) to Document Control Desk (NRC)

Dated

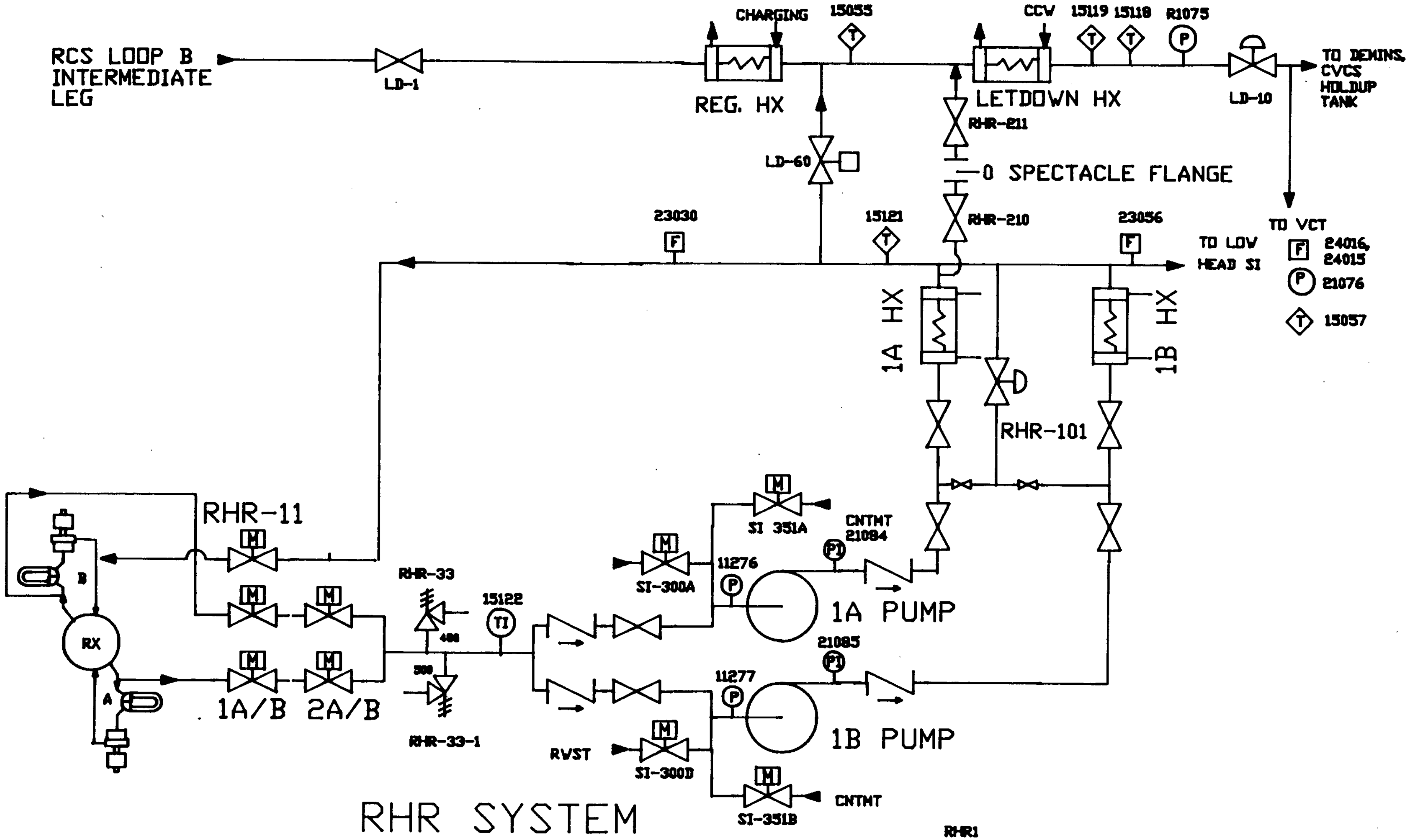
October 19, 1987

REACTOR COOLANT SYSTEM



FOR TRAINING ONLY

RCS
XK100-10
REV. AG
1-18-87



RCS LOOP B
INTERMEDIATE
LEG
LD-1
CHARGING
REG. HX
15055
CCW
15119
15118
R1075
LETDOWN HX
LD-10
TO DEMINS,
CVCS
HOLDUP
TANK
RHR-211
LD-60
0 SPECTACLE FLANGE
RHR-210
TO VCT
23030
15121
23056
TO LOW
HEAD SI
24016,
24015
21076
15057
1A HX
1B HX
RHR-101
RHR-11
SI 351A
CNTMT
21084
SI-300A
11276
1A PUMP
RHR-33
15122
400
500
RX
B
A
1A/B
2A/B
RHR-33-1
21085
11277
1B PUMP
RWST
SI-300D
SI-351B
CNTMT
RHR1

RHR SYSTEM

KEWAUNEE NUCLEAR POWER PLANT

RESPONSE TO

GENERIC LETTER 87 - 12

NUREG - 1269

LOSS OF RHR

WHILE THE RCS

IS PARTIALLY FILLED

WISCONSIN PUBLIC SERVICE CORPORATION

NRC 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 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 manway 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.

NRC Question 1 Part A

A detailed description of circumstances and conditions under which the 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.

WPSC RESPONSE

Kewaunee's reactor coolant system (RCS) is partially drained during the annual refueling outage to accommodate reactor coolant pump (RXCP) seal replacement, reactor vessel head removal, valve and piping maintenance of the RCS up to the first isolation valve, steam generator (SG) work, and Inservice Inspections (ISI). For a routine refueling outage, the RCS is partially drained down as early as conditions permit to install nozzle dams in the steam generators, and drop the RXCP shaft and put it on its back seat. Once the nozzle dams are installed the RCS is partially refilled, the reactor vessel head is removed and the reactor cavity is flooded for fuel movement. Following completion of this work, the RCS is drained down to mid-loop level, the nozzle dams are removed and the RCS is filled and vented in preparation for plant startup.

This past refueling outage, March 1987, was the first time steam generator nozzle dams were installed at KNPP. Using nozzle dams during steam generator work is anticipated to significantly decrease the amount of time spent in a partially drained down condition. Based on our first year of experience, the best time estimate available is that it will take approximately three 10 hour shifts to install the nozzle dams and approximately two 10 hour shifts to remove the nozzle dams. Therefore, Kewaunee's RCS routinely would operate at mid-loop for only a short period of time during refueling; however, experience shows that it may be longer to accommodate certain ISI or maintenance activities.

Several procedures are followed to control the evolution of taking the plant from Hot Shutdown (HSD) to a partially drained down condition. The two controlling procedures are N-0-05, "Plant Cooldown from Hot Shutdown to Cold Shutdown Conditions", and N-RC-36E, "Draining the Reactor Coolant System." The nominal conditions prior to taking the plant from a HSD condition to a Cold Shutdown (CSD) condition are:

- The reactor coolant system temperature and pressure are at normal operating conditions, e.g., 547°F, 2235 psig, pressurizer level 21%, and 0% reactor power.

- At least one of the two reactor coolant pumps is running.

- Normal Chemical and Volume Control System (CVCS) operation.

- The steam generator power operated relief valve controllers are set at 1005 psig.

- Steam generator level is being maintained manually at 33% level with the Auxiliary Feedwater System (AFW).

For the first phase of RCS cooldown, steam generators are used to remove decay and residual heat and the pressurizer is in service for pressure control. As the system is cooled down to approximately 380°F, the RHR system is aligned for cooldown service mode. As the cooldown continues, the auxiliary feedwater (AFW) system is secured, the RXCP(s) are stopped and the pressurizer is filled to a solid condition at approximately 180°F. Pressure is controlled by the CVCS low pressure letdown line control valve, LD-10, and the RHR system provides the cooldown rate and overpressure protection.

When the RCS wide range hot and cold leg temperature reaches $\leq$ 200°F and $\Delta k/k \leq -1\%$ the plant is considered to be in CSD. At that time, the RCS may be depressurized and prepared for draindown using N-RC-36E. The nominal conditions for this procedure are:

- The RCS is solid and the system pressure is approximately 100 psig.

- The RHR System is in service to maintain the RCS Temperature below 200°F as indicated by core exit thermocouples.

- A tygon hose is available for the reactor local level indication.

- The reactor level indicator which is read in the Control Room or on the plant process computer has been calibrated.

The level to which the RCS is drained depends on the scheduled work activity. The centerline of the RCS hot legs is at plant elevation 617'-10¼" which is indicated as 10.2% on the reactor coolant refueling level indicator in the control room. As a reference, the inlet to the RHR system from the RC hot leg is 9.0%, the bottom of the steam generator manway opening is 13.1% and the level for RXCP seal replacement work is 15%, see table 1.1 for corresponding plant elevations. For steady state mid-loop conditions, the operators are directed to maintain level between 10.2% and 11.2% as indicated when the RCS pressure is in equilibrium with the containment atmosphere. (1% is approximately equal to 6.5 inches.)

The following precautions are included in the RCS draindown procedure:

- Do not exceed 200D gpm for a single RHR pump or RHR heat exchanger.

- Monitor the RHR pump(s) for cavitation (see response to question 5, part B); if cavitation becomes apparent, draining is stopped and the primary system is refilled.

- During any draining operation, compare RCS pressure and Pressurizer Relief Tank (PRT) pressure, and CVCS Holdup Tank level, local tygon level and reactor vessel level indication to ensure proper system response.

Based on past experiences the following hydraulic behavior is expected during a normal system draindown:

- Draining the RCS from a solid condition to the centerline of the hotleg will require draining approximately 33,150 gallons of coolant to the CVCS Holdup Tanks.

- A substantial amount of water is trapped in the Steam Generator tubes. This water cannot be completely drained until the pressurizer surge line is uncovered. This allows air to replace the water in the tubes. It is necessary to drain the RCS to the center line of the hot leg nozzles, 10.2% on the reactor coolant refueling level indicator, to ensure that the Steam Generator tubes are empty.

- During the draindown, level will decrease at a steady rate. When the pressurizer empties, a rapid drop in level will occur as the surge line empties. Tygon Tube level is checked to verify this.

- Level again will decrease at a steady rate until the pressurizer surge line penetration to the B RCS loop is reached. At this point, the level will remain almost constant. It will decrease slightly and increase slightly as the water in the S/G tubes is replaced by air.

- Level will indicate a very slow downward trend as the S/G tubes empty. When the tubes are empty, level will again decrease at a steady rate. The RCS is then drained to the center line of the hot leg vessel penetrations. The level is verified by observing level on the Tygon Tube.

Interlocks on the RHR system are provided primarily for overpressure protection of the piping and components of the system. The procedures caution the operators that the RHR system must not be operated when the RCS pressure is greater than 425 psig. The hot leg suction isolation valves (RHR-1A, 1B, 2A and 2B) are interlocked to prevent them from opening if wide range RCS pressure (as indicated on pressure instruments PT-419 and PT-420) is above 450 psig. Another interlock also closes both valves in a train upon moving the control switch for either valve to the CLOSED position. The RHR return header isolation valve (RHR-11) is also interlocked with PT-420 (Instrument Number 21077) to prevent opening if the pressure is greater than 450 psig. There is no autoclosure on high pressure or temperature.

Examples of other precautions and limitations on the RHR system operation that prevent disturbances to the system are:

- Initiate flow slowly through the RHR heat exchangers to avoid thermal shock to the RCS.

- Observe plant cooldown pressure and temperature limitations when cooling with the RHR system.

- Do not close RHR suction valves (RHR-1A, 1B, 2A and 2B) when the RCS is solid and pressure is less than 500 psig unless the CVCS charging pumps are stopped.

- Starting or stopping an RHR pump with the CVCS and RHR cross connected, as well as opening or closing the cross connect valves can cause pressure variations in the RCS equal to the pump head (approximately 125 psid). These operations must be accomplished by appropriate readjustment of the letdown line pressure control valve.

- The RHR suction relief valves are set for approximately 475 psig and are required to be in service for RCS low temperature overpressure protection (LTOP) whenever the coldest RCS wide range temperature is ≤ 375°F and the reactor vessel head is installed.

Table 1.1

Reactor Vessel Level Indication

Plant Elevation	% Level as Indicated in Control Room	Reference
617' - 2 2/5"	9.0%	Inlet to RHR from RC Hotleg
617' - 10 1/4"	10.2%	Centerline of RC Hotleg
619' - 5"	13.1%	Bottom of SG Manway
620' - 5 1/2"	15.0%	Level for RXCP Seal Replacement
623' - 6"	20.6%	6" Below Reactor Vessel Head Flange
624' - 0"	21.5%	Reactor Vessel Head Flange
626' - 4"	25.8%	Pressurizer Surge Nozzle
629' - 0 2/5"	30.8%	High Point of Reactor Vessel Head
630' - 5 2/5"	33.4%	Reactor Vessel Vent Valve RC-43
630' - 11 1/5"	34.3%	Pressurizer lower instrument tap
647' - 0"	64.0%	23 feet above reactor vessel head flange
649' - 6"	68.5%	Reactor Bldg. Refueling Floor

NRC Question 1 Part B

Time between full power operation and reaching a partially filled condition.

WPSC RESPONSE

During normal de-escalation from full power, the control room staff reduces power at the average of 1/2% per minute. On occasion, the de-escalation has been stopped and held for end of life reactor core physics testing before resuming de-escalation. Once the control rods, including shutdown banks, are fully inserted, it takes approximately 24 hours to reach cold shutdown conditions, i.e. 200°F, where upon it takes approximately 40 hours (for chemistry and degassing) to reach the initial conditions necessary to start RCS draindown.

Shutdown time taken from the 1987 refueling outage data is: 100% power to 0% power, 5 hours, 0% power to cold shutdown, 26 hours, cold shutdown to RCS draindown initial conditions, 40 hours, and from start of draindown to the RCS centerline is 13.5 hours for a total of 84.5 hours.

An analysis was performed to determine the shortest possible time between full power and mid-loop operation assuming a single RHR pump could handle the decay heat loads. This conservative value is 44.5 hours.

NRC Question 1 Part C

Requirements for minimum steam generator levels.

WPSC RESPONSE

During power operation, steam generator level is controlled on programmed values between 33% at 0% reactor power and 44% at 20% to 100% reactor power, and is supplied by the main feedwater system. After a shutdown, the plant uses the auxiliary feedwater system instead of the feedwater system and the level is manually controlled. At RCS temperatures above 350°F, Tech. Spec. 3.4.a.1 requires both steam generators to be operable. Between 350°F and 200°F, Tech. Spec. 3.1.a.2 requires that two of the four heat sinks be operable. These four heat sinks are: steam generator 1A, steam generator 1B, RHR train 1A, and RHR train 1B. When temperature is less than or equal to 200°F both trains of the RHR shall be operable except in the refueling mode where one train may be out of service for maintenance.

When the plant is in cold shutdown, no minimum level requirements are applicable to the steam generator secondary side. The secondary side is either drained down for sludge lancing or filled to the wet lay-up condition depending on scheduled work activities.

NRC Question 1 Part D

Changes in the status of equipment for maintenance and testing and coordination of such operations while the RCS is partially filled.

WPSC RESPONSE

The status of equipment for maintenance or testing and the coordination of those operations is controlled by the Shift Supervisor. The person responsible for the maintenance or testing must present a work request to the Shift Supervisor and discuss the use of the Hold, Caution, or Danger Cards to be posted during the duration of the event or activity. Therefore, the Shift Supervisor is aware of the maintenance and testing taking place in the plant. Also, he is responsible for the authorization and removal of equipment from service and it's subsequent return to service. The Shift Supervisor uses Administrative Control Directive (ACD) 4.3, "Tagout Control," to aid him. The purpose of this procedure is to:

- Ensure the safety of personnel who may be required to work on or around electrical or mechanical equipment.

- Inform personnel of unusual or dangerous conditions.

- Identify equipment in a controlled status for reactor safety.

- Avoid unauthorized operation of equipment.

- Protect equipment.

- Assure independent verification of operating activities is performed and documented when required.

This procedure is in effect during all modes of operation including mid-loop operation.

In addition, ACD 5.4, "Work Request", requires the initiation of all work requests (WR) to be authorized by the Shift Supervisor. He must also be notified upon completion of all work requests. Therefore, the shift supervisor is made aware of maintenance being performed and serves as the last line of defense.

In the case of a planned shutdown, e.g. refueling outages, the work activities are scheduled in advance by the Refueling Outage Coordinator with input from the plant management staff. The tasks are assigned activity numbers and scheduled on a plan-a-log board. During refueling outages this board is reviewed on a daily basis and updated as appropriate by plant management. A shutdown schedule is issued and made available to employees and contractors. In addition, a shift activity list is prepared each day of the outage as a method of keeping personnel aware of what work is being performed. This activity list is available in draft form one day in advance to allow planning and coordinating of activities, and is available in final form at the beginning of each shift.

NRC Question 1 Part E

Restrictions regarding testing, operations, and maintenance that could perturb the nuclear steam supply system (NSSS).

WPSC RESPONSE

It is the responsibility of the Shift Supervisor to ensure that testing, operations, and maintenance do not perturb the NSSS. It is his responsibility to authorize testing, operations and maintenance activities. It is the responsibility of the Control Room Supervisor to review the tagout of equipment to ensure reactor safety is maintained by adequate equipment status control. In addition, Surveillance Procedures (SPs) and Preventative Maintenance Procedures (PMPs) performed must be authorized by the shift supervisor. The Shift Supervisor has implementing directives such as Administrative Control Directive (ACD) 4.3, "Tagout Control" to aid him. Parts c, d and e of the purpose in ACD 4.3 help control any work and possible disturbances to all equipment including the NSSS. These three parts are:

c. identify equipment in a controlled status for reactor safety.

d. avoid unauthorized operation of equipment.

e. protect equipment.

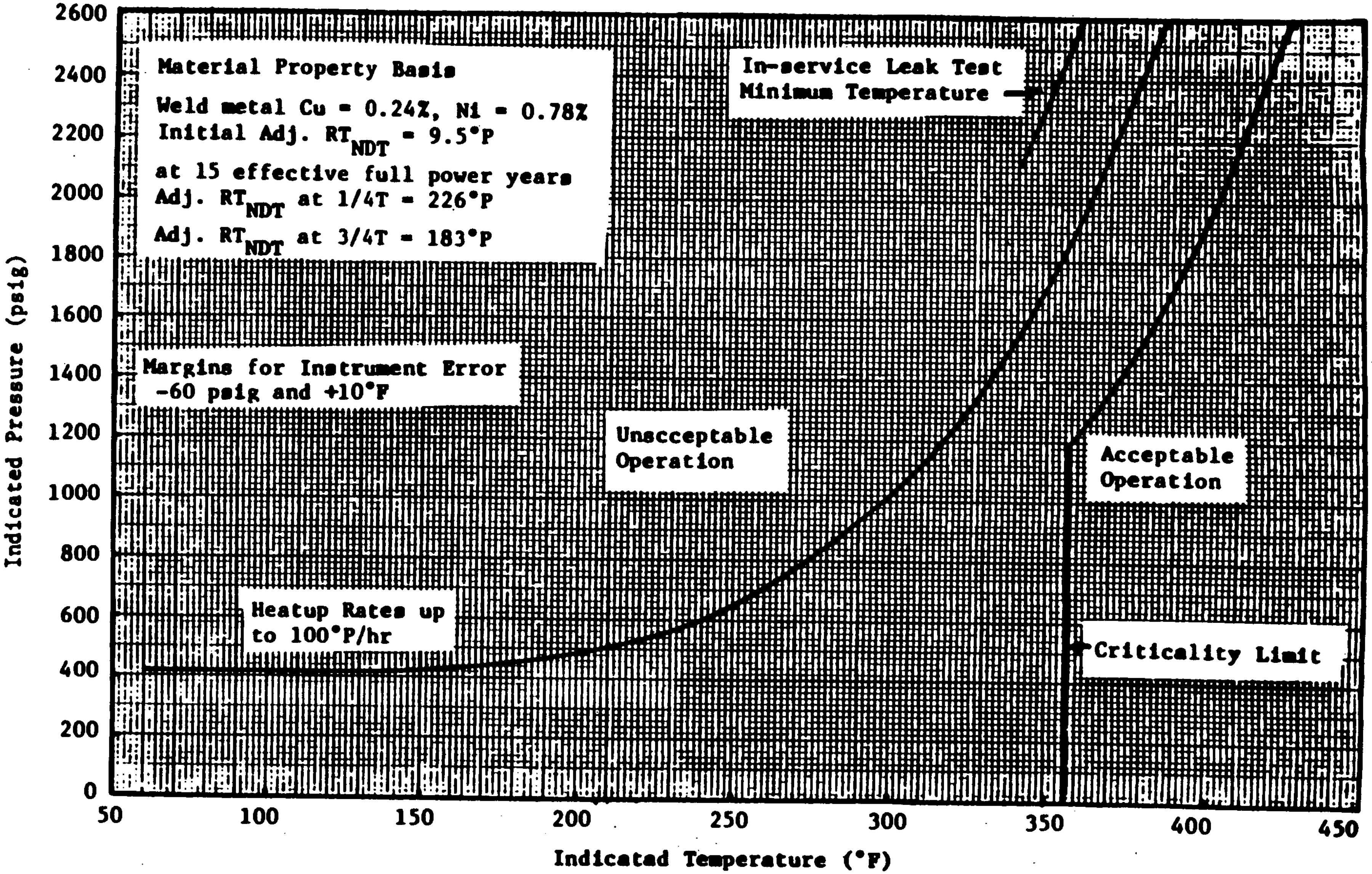
NRC Question 1 Part F

Ability of the RCS to withstand pressurization if the reactor vessel head and S/G manway are in place.

WPSC RESPONSE

The pressure limiting component in the reactor coolant system (RCS) is the reactor vessel. The heatup and cooldown limitation curves for KNPP's reactor vessel are Figure TS 3.1-1 and Figure TS 3.1-2. KNPP's Updated Final Safety Analysis Report (USAR) section 9.3 pages 22 and 23 describe the low temperature overpressure (LTOP) system. Relief valve RHR-33-1, the LTOP valve, was added to the RHR system to protect the RCS (namely the reactor vessel) from overpressurization. The LTOP valve has a nominal setpoint of 500 psig which will prevent a overpressurization event from occuring while the RCS is being cooled by RHR. Below a RCS bulk temperature of 375°F the pressurizer safety valves are not able to prevent an overpressure event from exceeding the limits of 10 CFR 50 Appendix G. Hence, the LTOP system must be operable when the head is on the reactor vessel and the RCS bulk temperature is below 375°F.

Therefore, the LTOP system protects the RCS (reactor vessel) from overpressurization, when RCS temperature is < 375°F.



KEWAUNEE UNIT NO. 1 COOLANT HEATUP LIMITATION CURVES
APPLICABLE FOR PERIODS UP TO 15 EFFECTIVE FULL POWER YEARS

Figure TS 3.1-1
Amendment No. 70
12/18/86

70

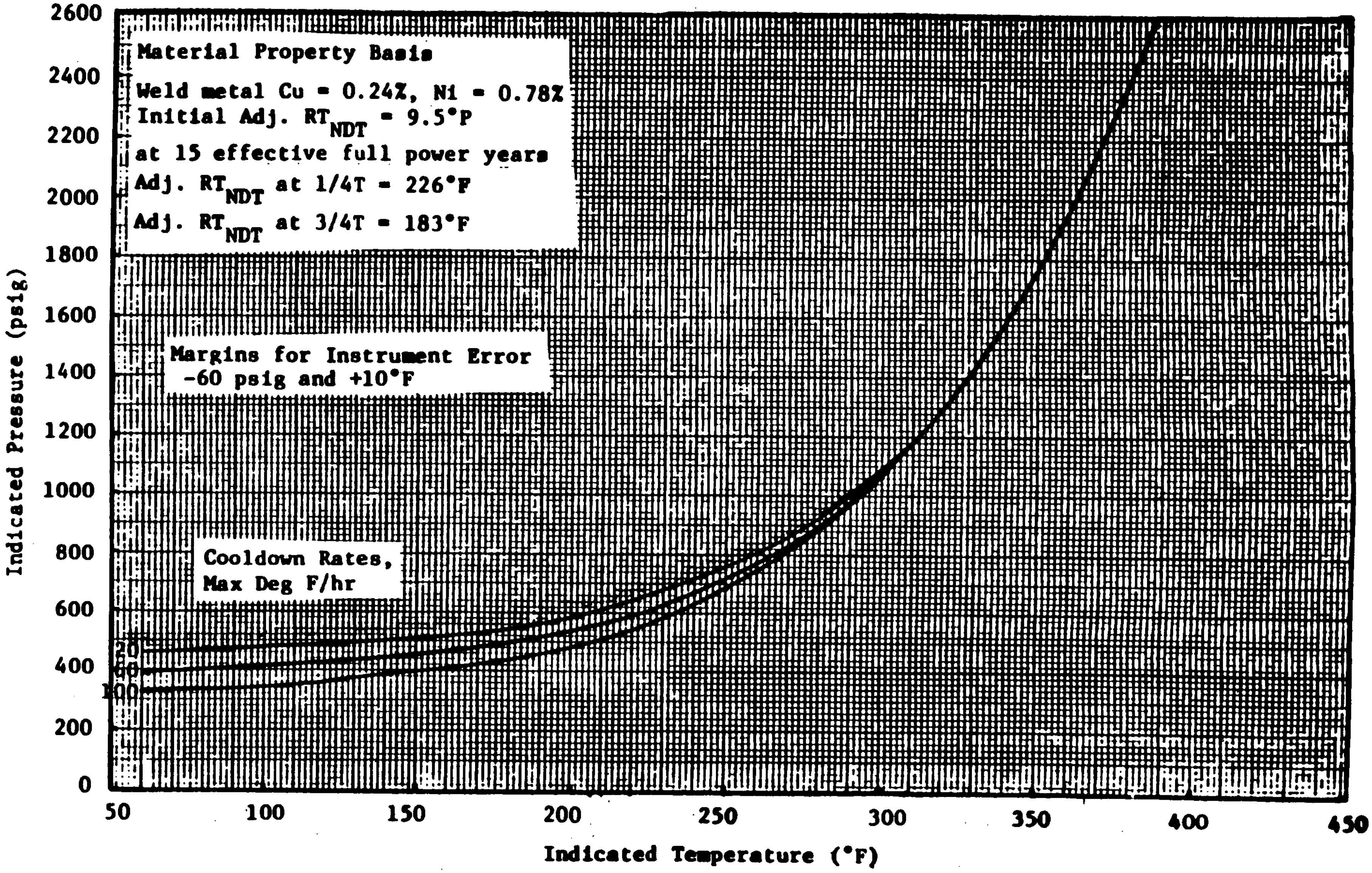


Figure TS 3.1-2
Amendment No. 70
12/18/86

KEWAUNEE UNIT NO. 1 COOLANT COOLDOWN LIMITATIONS
APPLICABLE FOR PERIODS UP TO 15 EFFECTIVE FULL POWER YEARS

NRC Question 1 Part G

Requirements pertaining to isolation of containment.

WPSC RESPONSE

The Kewaunee Nuclear Power Plant Technical Specifications give a detailed description of the containment integrity provisions required during the different plant operating modes. Containment System integrity is not required when the reactor is in the cold shutdown condition with the reactor vessel head installed, or the reactor is in the refueling shutdown condition with no fuel movement in progress. The basis for this Containment System integrity requirement is the fact that the circumstances of cold shutdown and refueling shutdown should preclude both criticality and the release of stored energy. The conditions that define these two operating modes are listed below:

Mode	Reactivity k/k	Coolant Temp Tavg °F	Fission Power %
Refueling	$\leq$ -10%	$\leq$ 140	approx. 0
Cold Shutdown	$\leq$ -1%	$\leq$ 200	approx. 0

Since mid-loop operation is done at or below the cold shutdown condition no containment integrity provisions are required.

NRC Question 1 Part H

The time required to replace the equipment hatch should replacement be necessary.

WPSC RESPONSE

The equipment door is not opened during every refueling outage, but only for specific projects requiring it (see response to NRC Question 4). In the unlikely event that the containment vessel equipment door would be removed and needed to be replaced, it has been estimated the containment equipment door could be installed in less than 4 hours. This estimate is only for the equipment door and does not include the bolts being torqued down or leakage testing of the seal.

NRC Question 1 Part I

The requirements pertinent to reestablishing the integrity of the RCS pressure boundary.

WPSC RESPONSE

When in a cold shutdown or refueling shutdown condition during mid-loop operation there are no requirements for integrity of the RCS pressure boundary. During the refueling outage there are many tests, modifications, and maintenance activities being performed on the RCS which would potentially affect its ability to serve as a pressure boundary. Due to the necessity of these tests there are no requirements for reestablishing RCS integrity under these conditions because it would preclude this work. While the steam generators would probably not be used to remove decay heat during a loss of RHR event there are other means available to provide cooling (as specified in Procedure A-RHR-34).

NRC 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 temporary connections, piping, and instrumentation used for this RCS condition and the quality control process 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.

NRC Question 2 Part A

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.

WPSC RESPONSE

Temperature

There are several indications available to the operators in which to monitor RCS temperature depending on the RCS configuration. The direct instrumentation includes the core exit thermocouples (assuming the reactor vessel head is installed and the thermocouples are connected), the RHR pump suction temperature indicator (15122), and the RHR pump discharge temperature indicators (12075 and 12076).

In addition, the plant process computer provides a redundant method of determining RCS temperature status. The computer provides the operators with temperature readings from RHR and component cooling water along with the average core exit thermocouple heatup rate (°F/hr). (There is a possibility that the core exit thermocouples would be disconnected during mid-loop operation in preparation for vessel head removal.)

Level

During the initial draindown of the RCS, level indication is provided to the control room by the cold calibrated pressurizer level transmitter (24075). When 50% pressurizer level is indicated, the RCS can be monitored locally inside containment using a tygon tubing. Also, at 50% pressurizer level the reactor coolant refueling level transmitter (24068) is valved into service to provide level indication to the control room and as an input to the plant process computer. The plant process computer is capable of providing current level indication in addition to long-term trending. All three methods of determining RCS level are monitored and compared against one another.

In addition to these indicators, other level indicators may be available to the control room operators during specific phases of the draindown process. These include the RHR pumps outlet flow indicator (2303D), the RHR pump ammeters (41335 and 41336), and the volume control tank level (24016 and 24015) when in a steady state condition. During a draindown, the VCT will be bypassed.

Pressure

During RCS draindown and subsequent mid-loop operation, RCS pressure is monitored by using the reactor coolant wide range hot leg pressure instruments (21077 and 21038), the Pressurizer Relief Tank (PRT) pressure indicator (21083), and the local RHR pump suction pressure gages (11276 and 11277). The RHR pump discharge pressure gages (21084 and 21085) are also indications of RCS pressure. This information is available on control room installed instrumentation and the plant process computer.

An additional aid to the operators in mid-loop operation is the annunciator window "RHR Loop RC Flow Low Alarm" (Annunciator 47023-45). The annunciator actuates when there is less than 1250 gpm of discharge flow with either RHR pump running. Less than 1250 gpm flow is indicative of a valve misalignment, a pipe break, or pump cavitation or vortexing. When the annunciator actuates, the operators are directed by procedure to check the pump discharge pressure. Thus, further assurance is provided for a prompt operator response to a potential loss of RHR flow event.

NRC Question 2 Part B

Describe temporary connections, piping, and instrumentation used for this RCS condition and the quality control process 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.

WPSC RESPONSE

There are no temporary connections, piping or instrumentation used for the RCS during a partially filled condition. The level instruments used are permanently installed and are valved into service prior to use. These instruments are described in our response to question 7.

NRC Question 2 Part C

Description of our ability to monitor pressure, temperature, and level after the RHR function may be lost.

WPSC RESPONSE

Temperature

Direct RCS temperature could be monitored using the core exit thermocouples, when available, together with the plant process computer which provides the average core exit thermocouple heatup rate. Besides the instruments directly monitoring RCS temperature, additional indication is available to indirectly inform the operator that the RCS temperature is increasing. These include the in-containment radiation monitoring airborne activity and the reactor source range count rate.

Level

RCS level could be monitored using the reactor coolant refueling level transmitter (either from the recorder or the plant process computer), and the tygon tube level indicator inside containment.

Pressure

The RCS pressure would be monitored using the reactor coolant wide-range hot leg pressure instruments (as indicated on either the control room recorder or the plant process computer) and PRT pressure during draindown.

Some alarms in the control room that could alert the operators in the event of a loss of RHR cooling capabilities are:

1) RHR Loop RC Flow Low--Annunciator 47023-45

2) RHR Improper Lineup--Annunciator 47023-31

3) High Radiation Alarm (associated with R11/R12)

4) RHR Pump Pit Monitor High Radiation Alarm (R22)

In addition, personnel are normally in containment and they could alert the control room if they noticed any unusual conditions such as coolant leakage or steam formation.

NRC Question 3

Identification of all pumps that can be used to control NSSS inventory. Include: (a) pumps you require be operable or capable of operation (include 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.

WPSC RESPONSE

The following pumps are capable of operation to supply NSSS inventory during the approach to a partially filled RCS condition and during operation with a partially filled RCS.

Pump	Number	Type
Charging Pumps	3	Positive displacement
High Head Safety Injection	2	Horizontal Centrifugal
Low Head Safety Injection (Residual Heat Removal)	2	Vertical Centrifugal

A review of the KNPP Technical Specifications was made to determine which pumps are required to be operable or capable of operation during the cold shutdown and refueling modes. Only these two modes were identified since the approach to a partially filled RCS condition and operation with a partially filled RCS would only occur in these modes. The KNPP technical specifications become more restrictive above the cold shutdown mode.

This review identified the following two applicable technical specification requirements. The first one is T.S. 3.1.a.2.B which states:

> Two residual heat removal trains shall be operable whenever the average reactor coolant temperature is less than or equal to 200°F and irradiated fuel is in the reactor, except when in the refueling mode one train may be inoperable for maintenance.

The basis of this technical specification requirement is to ensure adequate decay heat removal capabilities. Refueling mode is defined as $\geq$ 10% shutdown and reactor coolant $T_{AVG} \leq 140°F$.

The second applicable Technical Specification is T.S.3.2.a which states:

> When fuel is in the reactor there shall be at least one flow path to the core for boric acid injection.

The basis for this specification is to ensure a flow path is always available to the core for injecting boric acid. There are two sources of boric acid, these are the boric acid storage tanks and the refueling water storage tank (RWST). All seven pumps are capable of taking a direct suction on the RWST. The safety injection pumps and the charging pumps (using the boric acid transfer pumps) can take a suction on the boric acid tanks.

Table 3.1 summarizes those pumps required, and the pumps capable of operation to control NSSS inventory during cold shutdown and refueling shutdown conditions.

TABLE 3.1

Plant Mode	Pumps Required By T.S.	Available Pumps
Cold Shutdown	2 RHR pumps plus one of the remaining available pumps	1A RHR pump 1B RHR pump 1A charging pump 1B charging pump
Refueling Shutdown	1 (A or B) RHR pump plus one of the remaining available pumps	1C charging pump 1A SI pump 1B SI pump

Even without any pumps available, flow paths to the core for boric acid addition exist. At mid-loop operation these sources of boric acid addition may include the passive SI accumulators, and gravity drain of the RWST and VCT to the RCS, depending on RCS cavity level.

NRC 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.

WPSC RESPONSE

The plant would be at or below the cold shutdown condition while operating with the RCS partially filled. The circumstances associated with the cold or refueling shutdown operating conditions should preclude both criticality and the release of stored energy. For this reason, no containment integrity provisions are required by Technical Specifications while operating with the RCS partially filled. The following paragraphs discuss the containment penetration conditions during mid-loop operations and the actions possible to achieve containment closure.

The containment vessel equipment door is only scheduled to be removed to bring replacement reactor vessel head o-rings into containment. This was done in the refueling outages of 1977 and 1986 and is scheduled for the refueling of 1996. The containment vessel equipment door is opened for a period of approximately 1 day to accomplish this operation. The equipment door could also be opened to provide access for removal or replacement of any large parts or equipment in containment which required unscheduled maintenance. If the equipment door was open and containment closure would be required, it has been estimated that the containment equipment door could be closed in less than 4 hours.

The KNPP containment vessel has two personnel airlocks, normal and emergency. The containment vessel normal and emergency personnel airlocks have no Technical Specifications or USAR requirements for containment integrity during mid-loop operation. The emergency airlock is normally open 1-2 days each refueling outage. It is estimated that one door of the emergency airlock could be closed within one-half hour. It is not uncommon to have both doors of the normal personnel airlock opened and a walkway installed during mid-loop operation. It is estimated that the walkway could be removed and both doors closed in less than one-half hour.

The large diameter containment purge and vent system is only used when the reactor is at or below the hot shutdown operating condition, and is normally in-service during mid-loop operation. The purge and vent valves will automatically close in the event of high radiation in containment as signaled by radiation monitors R11, R12, or R21.

The Steam Generators secondary-side condition upstream of the isolation valves would need to be evaluated for containment closure at the time it was required. This is due to the many ongoing maintenance projects in this area. The main steam isolation valves are normally closed when the RCS is partially filled.

The piping and electrical containment penetrations may have one containment integrity barrier available unless local leak rate testing or penetration maintenance is being done during mid-loop operation. The Integrated Leak Rate Test (ILRT) penetration may be used as a cable penetration when the RCS is partially filled. This cable penetration is accompanied by a water column seal to provide containment closure. Individual situations of penetration maintenance and local leak rate testing would need to be examined on a case-by-case basis to determine if a containment isolation barrier exists, or if other downstream/upstream system valves, flanges, etc. can be utilized as a containment isolation barrier. It should be noted that this situation warrants little concern due to the relatively small size of the potential release pathway and the short time required to establish an isolation barrier.

NRC 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 drain-down 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).

WPSC RESPONSE

The bases for the original operating procedures at KNPP were developed from existing procedures for plants operating before KNPP and from information WPSC employees learned in a Westinghouse Electric Corporation design lecture series as part of the original reactor operator training program. The employees who went through this training authored the original operating procedures. Since then, all of the operating procedures have been updated frequently based on our past operating experience and recommendations from sources such as NRC and INPO. In addition, not all of the operating procedures require an analytical basis. Instead they are developed by need and based on past operational experience.

NRC Question 5 Part A

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.

WPSC RESPONSE

Four procedures describe the operation of the plant while the RCS is partially filled. They are:

N-RC-36E	Draining the Reactor Coolant System
N-RHR-34	Residual Heat Removal System Operation
N-CVC-35B	Charging and Volume Control
A-RHR-34	Loss of Residual Heat Removal Cooling

N-RC-36E describes the steps taken to drain the RCS using either the RHR System or the Waste Disposal System (WDS). In addition, it describes final conditions after draindown is complete. The precautions include pump flow limitations, cautions to compare the readings on the different instruments measuring RCS parameters and steps to ensure that the CVC and RHR systems are operating correctly. The procedure also includes guidance and limits on RCS pressure, temperature and level during mid-loop; e.g., temperature is not to exceed 200°F and level is to be maintained between 10.2% and 11.2% on the reactor coolant refueling level indicator. This procedure and the draindown process are described in greater detail in our response to question 5 part B.

Procedure N-RHR-34 describes the method of operation of the RHR system for plant cooldown, decay and residual heat removal during heatup and refueling which includes RCS mid-loop operations. Procedure N-CVC-35B describes using the CVCS to maintain the correct inventory of reactor coolant. Both procedures include precautions, RCS parameter guidances and the instrumentation used to monitor or control these parameters. They also help describe their appropriate systems during RCS mid-loop operations since both systems are in operation while the RCS is partially filled. Abnormal procedure A-RHR-34 describes operator actions required upon the loss of RHR cooling capability. The operator actions described in this procedure are applicable over a range of conditions including when the RCS is at mid-loop and the RHR system function is lost.

Construction pre-operation functional tests of the systems and components confirmed the operability and ability of all equipment and instrumentation to meet their design basis requirements. This information provided the guidance for development of the original operating procedures. All of these procedures have been revised numerous times due to operating experience and plant modifications, and have been proven to be effective in the plant's past operating history.

NRC Question 5 Part B

Treatment of draindown to the condition where the RCS is partially filled and treatment of vortexing at the connection of the RHR suction line(s) to the RCS.

WPSC RESPONSE

Procedure N-RC-36E, "Draining the Reactor Coolant System," describes the steps to be taken by the control room staff to drain down the RCS using either the RHR System or the Waste Disposal System. Section 4.2 of N-RC-36E describes RCS draining using the RHR System which is the preferred method. The steps are:

1) Check PRT hydrogen concentration. If greater than 2% by volume, then purge the PRT of hydrogen.

2) Open and DANGER CARD the Pressurizer Heater and RXCP Breakers for RCS draining.

3) Ensure that the pressurizer spray valves are open.

4) Cut in nitrogen to the pressurizer relief tank and pump it down to approximately 50%. Maintain PRT Pressure at 0 PSIG. Secure Nitrogen to PRT when the draining operation is completed.

5) Secure the operating charging pump, close the charging and letdown line, and seal water return isolation valves. Divert letdown from the VCT to CVC holdup tank.

6) Draining with LD-60

a. Draining thru RHR/CVC Cross-Connect.

(Note: Refer to system sketch for system inter-relationship.)

1. CVC demineralizers should be in service.

2. The spectacle flange to RHR/CVC cross-connect is open and LD-10 (letdown line pressure control valve) is closed.

3. Open manual valves RHR-210 and RHR-211 at RHR-CVC cross-connect spectacle flange.

NOTE: The LD flow and RHR flow total must not be greater than 2D00 gpm for one RHR pump.

4. Commence draining RCS by opening LD-10 and adjusting for proper flow rate. The RHR heat exchanger bypass valves are adjusted to assist draining and maintain core cooling.

b. Commence depressurizing and draining the RCS by opening the RHR discharge to the CVCS letdown line valve LD-60, and controlling the letdown flow with the letdown low pressure control valve LD-10. RHR-11 may also be cycled closed to assist draining and opened for core cooling, maximum is 200°F on highest core exit thermocouple.

7) Open PR-2A or PR-2B to the PRT for a vent path at approximately 21 psig RCS pressure as indicated on the plant process computer.

8) With H.P. coverage vent the RCS and PRT to Containment by opening pressurizer vent valves.

9) Place the reactor remote and local level indication in service by opening RC-5202 and RC-200A when at 50% pressurizer level (LI-433) (*) (**).

10) Continue draining to the desired water level (**).

11) Isolate the vent path to the PRT by closing PR-2A/2B (the pressurizer power operated relief valves).

12) If possible open charging isolation valve and start a charging pump, and maintain letdown flow through CVCS demineralizer via RHR-CVC cross-connect for RCS cleanup.

13) Steady state RCS temperature is maintained at the desired value using one RHR pump and controlling the flow through the RHR heat exchangers.

*NOTE: This step may be omitted if deemed necessary by the shift supervisor.

**NOTE: Any pressure above or below atmospheric in the RCS will affect the reading of the level D/P cell or level on the Tygon Tube and will have to be compensated for by the operator. See reference sheet (response to NRC question 8).

Other sections in the procedure include precautions and limitations, initial conditions (see response to question 1 part A), a reactor vessel level reference sheet and a past experience sheet (see question 8). This procedure has been revised frequently since plant startup based on past operational experience and plant modifications.

Procedure N-RC-36E treats RHR pump cavitation in two separate steps. The first step is on page 2 of the reference sheet which provides this note to the operators during RCS draindown:

NOTE: Monitor the RHR pump(s) for cavitation; if cavitation becomes apparent, stop draining and refill the primary system.

The other place is step 4.4.2 of the procedure which states:

4.4.2 If suction is lost, or the RHR pump starts cavitating:

a. If charging pumps are operating, increase pump speed and fill from the VCT or open CVC-301 and fill from RWST.

b. If charging pumps are idle, insure charging line valves CVC-7 and CVC-11 are open. Then open CVC-301 to gravity fill from the RWST.

Operators are able to recognize pump cavitation by either rapid swings on the pump ammeters and/or increased noise at the pump. Other indications could include RCS level, VCT level fluctuations and an increase in RCS temperature.

The basis for this information is past experience at KNPP and lessons learned from pump cavitation occurrences at other nuclear plants.

NRC Question 5 Part C

Treatment of minor variations from expected behavior such as caused by air entrainment and de-entrainment.

WPSC RESPONSE

Venting is covered on page 2 of the past experience reference sheet in procedure N-RC-36E. The procedure describes the draindown process and has been revised numerous times because of experience gained by past operations. The procedure covers the replacing of water with air in the steam generator tubes and the pressurizer. It also has a caution concerning RHR pump cavitation and other steps leading to RCS level at mid-loop. This section of the procedure is described in detail in our response to NRC question 8.

An entrainment and de-entrainment have not been observed at KNPP, and are not covered in the procedures; however, there is a danger card in the control room which states, "with the RCS drained down to the center of the hot leg do not exceed 3100 gpm RHR flow to prevent pump cavitation" (Danger card No. 1403-1). A maximum RHR flow limit will be added to the draindown procedure (see response to question 9).

NRC Question 5 Part D

Treatment of boiling in the core with and without RCS pressure boundary integrity.

WPSC RESPONSE

Procedure N-RC-36E contains numerous precautions and descriptions on how to avoid boiling in the core. The initial conditions require that the RHR system is in service to maintain the RCS temperature below 200°F (step 3.3). Also, vent paths are provided at various points during the draindown (steps 4.2.7 and 4.2.10).

Procedure Section 4.4 discusses steady state or loss of RHR suction pressure. If RHR is operating, the RCS temperature is controlled using one RHR pump and the RHR heat exchangers (step 4.4.1). If RHR is lost, the RWST could be used to provide RCS cooling to avoid boiling in the core (steps 4.4.2.a and b). This is described completely in procedure A-RHR-34 section 4.5. This section describes operator actions to provide an alternate decay heat removal source. The procedure calls out for the operators to first open both pressurizer PORVs to provide a pressure vent path. Then the suction and discharge paths are aligned for the selected SI pump and the pump is started to provide core cooling (see response to NRC question 5 part I for complete description of this procedure). The same steps performed to avoid boiling in the core are applicable to terminate boiling in the core should that condition be present and have gone undetected until that time.

NRC Question 5 Part E

Calculation of approximate time from loss of RHR to core damage.

WPSC RESPONSE

No references to the amount of time available from loss of RHR to eventual core damage are given in the procedures. This is due to the large number of variables that may be present, and the large number of corrective actions that may be taken by the operators which would drastically change the amount of time it would take to reach core damage if it would occur at all. Instead, inherent in the procedures is the urgency in which attention to the situation is required by the operators to take appropriate corrective action. Using data from the KNPP Updated Safety Analysis Report, Reactor Data Manual and System Descriptions, two conservative analyses were performed to calculate this time. The first analysis used the 1987 refueling outage data (i.e., mid-loop operations 85 hours after shutdown), and the second analysis used the minimum time (44.5 hours) for mid-loop operations to begin (see our responses to question 1 part B). A conservative time estimate from loss of RHR while the plant is operating at RCS mid-loop to core damage for the two cases would be 7½ and 6½ hours respectively. This time is conservative because core heat up without coolant was considered to occur as soon as the top of the core is uncovered.

NRC Question 5 Part F

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.

WPSC RESPONSE

Several steps in procedure N-RC-36E cover the effects caused by level differences and venting of the tubes on instrumentation and the NSSS. The precautions and limitations prior to RCS draindown are:

- RCS level indication is not accurate unless RCS pressure is equalized with containment pressure (step 2.2.9).

- Water level in the pressurizer surge line should not be allowed to decrease to the point where air will enter the reactor coolant piping unless the proposed maintenance operations require it. This will ensure that the steam generator tubes remain essentially full of coolant (Step 2.2.3).

A detailed description of air entering the steam generator tubes and replacing the coolant is in the past experience reference sheet. This section is detailed in our response to NRC question 8.

NRC Question 5 Part G

Analytic basis support of procedure guidance pertinent to timing of operations, required instrumentation indications, cautions and critical parameters.

WPSC RESPONSE

In addition to the analytic basis under which the original procedures (see response to question 5) were developed, the operating procedures at KNPP are frequently updated based on past plant operating experience, past industry experience and engineering judgment. In addition, NRC orders and guidance are also used in modifying procedures as are plant modifications that enhance instrumentation or other equipment. All of these sources form the bases for the development, continued updating and implementation of our operating procedures. The timing of all operations during refueling is controlled by a shutdown schedule prepared by the Refueling Outage Coordinator with much input from the operations group. Each day of the outage has its own daily activity list which helps with the timing of the day's operations, testing and maintenance. All of the cautions in the procedures are at their appropriate places with most being precautions found at the beginning of each procedure. As an example, the precautions for procedure N-RC-36E include:

- The water level in the reactor vessel must be at least 6 inches below the reactor vessel flange before unbolting the reactor vessel head.

- The Reactor Vessel Head must be evacuated of all radioactive gases using the "RAP" pump, prior to removing the instrumentation port conoseals or the Reactor Vessel Head.

- The pressurizer heater and reactor coolant pump breakers shall be tagged open prior to commencing actual RCS draining.

- Do not exceed 2000 gpm for a single RHR pump or RHR heat exchanger (rated conditions).

- Starting or stopping an RHR pump with LD-60 open as well as opening or closing LD-60 with an RHR pump running can cause pressure variations in the RCS equal to the pump head (Approximately 125 psig). Therefore these operations must be accompanied by appropriate readjustment of the control point of LD-10/CV-31099.

- RCS level indication is not accurate unless RCS Pressure is equalized with Containment Pressure.

- During any draining operation, compare RCS Pressure, Pressurizer Relief Tank Pressure, CVCS Holdup Tank Level, Local Tygon Level, and the Reactor Vessel Level Indicator to ensure proper system response.

- Ensure PRT H_2 concentration is < 2% by volume prior to venting the PRT and pressurizer to atmosphere.

Thus initial conditions prior to initiating a sequence of steps is stressed and even verified through procedure steps. This ensures proper availability of equipment and proper conditions prior to enacting a sequence of events.

All refueling work activities are coordinated by the Refueling Outage Coordinator and a shutdown schedule is issued as is a shift activity list for each shift of the outage. All of these controls and lists have been developed and refined from experience gained in our past 13 years of operation.

NRC Question 5 Part H

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.

WPSC RESPONSE

Activities that could effect operation that involve the NSSS are normally performed under one of the following administrative programs:

(1) Operations Procedures, (2) Design Changes, (3) Work Requests, (4) Surveillance Procedures, (5) Preventative Maintenance Procedures, or (6) Instrument Control Procedures.

No other activities are allowed which would effect operations involving the NSSS. All of these activities are strictly controlled by directives and procedures. The shift supervisor authorizes all work requests and procedures, and the operations group is directly involved in the planning of design changes that could affect the operation of the plant.

In addition, Administrative Control Directive (ACD) 4.3, "Tagout Control," controls any activities which require equipment to be removed from service or altered in any way to disturb its normal function. Included in the purpose of the ACD are to identify equipment in a controlled status for reactor safety, to avoid unauthorized operation of equipment and to protect equipment. The shift supervisor is responsible for the authorization and removal of equipment for service and it's subsequent return to service. Thus in every situation there is at least one pre-reviewed and operationally tested mechanism to control particular evolutions to equipment that may perturb the NSSS.

NRC Question 5 Part I

Response to loss of RHR, including regaining control of RCS heat removal and operations involving the NSSS if RHR cannot be restored.

WPSC RESPONSE

In the development of the RCS draindown procedure, N-RC-36E, provisions for providing operators guidance for loss of RCS heat removal were included. Specifically, if RHR is lost during the RCS draindown process, the operators are referred to section 4.4 of the draindown procedure, N-RC-36E, which has them fill the RCS from the RWST.

In the development of procedures for the operation of the RHR system, provisions for providing guidance to operators in case of the loss of RHR flow were included. Specifically, if the RHR is lost at any time, including RCS draindown or operating with the RCS partially filled, the operators are directed to procedure A-RHR-34, "Loss of Residual Heat Removal Cooling." The steps of action for the operators include:

1) Check for possible RCS overpressurization source (SI pump start, RXCP start, RCS heatup).

2) If it is evident that an RHR pipe break has occurred, perform the following:

   NOTE: This step isolates the Low Temperature Overpressure Protection function. Manual action may be required to control RCS pressure within the limits of Fig. RD-11.1.

   a. Stop the RHR Pump(s).

b. Close:

1. RHR-11, RHR Return Isolation Valve
2. RHR-1A/B, 2A/B, Inlet Isolation Valves
3. LD-60, RHR to Letdown Line
4. RHR-210 or 211, RHR Cross Connection to CVCS
5. Check RCS pressure; if increasing rapidly, open RHR-1A/2A/1B/2B and investigate for source of RCS overpressurization.

c. Establish alternate decay heat removal with the Steam Generator or if the RCS is depressurized, with Step 8.

d. Contact plant engineering staff for an alternate vent path for LTOP.

3) If the operating RHR pump trips, start the standby RHR pump and check for satisfactory operation.

4) If a Plant cooldown is in progress and one or both trains of RHR are inoperable, Plant Temperature should be maintained at the lowest practical level using the Steam Generators until the RHR can be placed in service.

CAUTION: The Steam Generators shall be used to remove core decay heat until both trains of RHR are available for cooling.

5) Attempt to restore cooling capability to the RHR Heat Exchangers.

6) If an improper RHR valve lineup is found, correct it and check that system operation returns to normal.

7) Until alternate decay heat removal is established, monitor RCS hot leg temperature in both loops and core exit thermocouples.

8) <u>Alternate Decay Heat Removal - Reactor Coolant System De-Pressurized</u>

When core cooling is lost and the RHR System cannot be returned to service:

a. Evacuate the containment.

b. If a discharge path is not available from the Reactor Coolant System (head removed, primary manway removed, etc.) open both pressurizer PORVs.

c. Open a suction path from the RWST to the suction of one SI pump.

   1. Open SI-4A or B.
   2. Open SI-5A or B.

d. Align the pump discharge to one of the cold legs.

   1. Close SI-9B.
   2. Open SI-9A.
   3. Open SI-11A or B.

e. Start the selected SI pump.

f. Throttle SI-7A or B to reduce flow but still maintain adequate core cooling.

g. Correct the problem with the RHR System before the RWST is empty.

The analytical basis for the procedures is continually reviewed every time changes are made to the procedures. Specific steps are added or changed using KNPP operating experience and industry experience as the bases to revise the analytical basis, expand its scope, emphasize certain key points and ensure that proper operational guidance is provided to the operators.

NRC Question 5 Part J

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.

WPSC RESPONSE

Procedure A-RC-36D, "Reactor Coolant Leak," describes the actions to be taken when a minor RC leak is suspected. The purpose of the procedure is to locate the source of the leakage, to determine its severity and to minimize its consequences.

The containment purge and vent valves close automatically when the containment system vent (R-11, R-12 or R-21) high radiation alarms actuate. Containment isolation would be provided by:

- The automatic closure of the containment purge and vent system.

- Installation of the equipment hatch if it was off.

- Close the containment vessel personnel hatch.

- Any piping or electrical penetrations undergoing maintenance would be analyzed on a case-by-case basis to see if anything needs to be done.

NRC 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.

WPSC RESPONSE

The personnel that would be involved in the response to a loss of RHR event would initially consist of the control room staff. Depending on the severity of the event, members of the plant management, technical support, health physics, and maintenance staffs, and the outage coordinator and containment coordinator (if there is one), may also be called upon to perform their appropriate support activities.

The shift supervisor and control room supervisor (the latter is normally on shift, but is not required when the RCS is below 200°F) hold an SRO license, the reactor operators an RO license, the auxiliary operator and health physics personnel are qualified via an INPO accredited program. Normally, although not a requirement, the outage coordinator, containment coordinator, and the majority of the plant management and technical support staff have SRO and/or STA experience.

Both the SRO and STA training programs have academic and systems phases. The academic training phase includes the topics of thermodynamics, heat transfer and piping and pump fluid mechanics. The systems training phase covers the design and operation of the RHR system under normal, emergency and cooldown conditions. A loss of RHR cooling event and a loss of coolant in the RHR system are performed on the plant simulator, but not during a partially drained down condition due to simulator modeling limitations. However, the operator responses, e.g., establishing an alternate source of decay heat removal, monitoring RCS temperature and refilling from the RWST if needed, are still reinforced during this simulator exercise. The auxiliary operator training program covers performing RHR system line-ups for the different operating modes, monitoring the system, performing leakage checks, and reviewing the procedure for a loss of RHR cooling event.

A review of industry events pertaining to loss of RHR function has been completed in the recent licensed operator requalification training. The references for this session include: INPO Significant Operating Experience Report 85-4, "Loss or Degradation of Residual Heat Removal Capability in PWRs," IEIN 86-101, "Loss of Decay Heat Removal Due to Loss of Fluid Levels in Reactor Coolant System," IEIN 87-23, "Loss of Decay Heat Removal During Low Reactor Coolant Level Operation," NUREG-1269, "Loss of Residual Heat Removal System," and NSAC/52, "RHR Experience Review and Safety Analysis." This information will be covered in a later STA requalification program. (Although STAs are not required below 200°F).

To date, several of the maintenance personnel have received a general systems overview course which included a functional description of the RHR system though not specific for midloop operation. As a part of the INPO accreditation effort all maintenance personnel will receive systems overview training and generic information on pump performance and fluid mechanics.

NRC 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.

WPSC RESPONSE

The operators at the KNPP are provided with additional resources not only while the RCS is partially filled, but throughout a scheduled shutdown. These resources include additional personnel, instrumentation, and information channels.

The additional personnel available to provide information and assistance to the operators while the RCS is partially filled may include, but are not limited to, the following:

Containment Coordinator - Cognizant of all major activities being done inside containment during the refueling outage. Possesses current information on status of containment projects. This position was created due to the amount of containment projects being done and may not be required in the future.

Refueling Outage Coordinator - Schedules and tracks all activities and projects being done at the KNPP during refueling outage.

Extra Auxiliary Operator - Assumes the same responsibilities as the normal on-shift Auxiliary Operator. Put on-shift dependent upon personnel availability, due to the added amount of activities that the Auxiliary Operator must monitor during the refueling outage.

<u>Extra Operator for Tag-Outs</u> - An extra operator may be provided to assist the Control Room personnel with the Tag-Out procedure. This position is also dependent upon personnel availability and refueling outage workload.

<u>Health Physics Personnel</u> - Assigned to assess radiological conditions inside containment during the normal refueling outage shifts.

It should also be noted that engineering and plant management staff are on site to provide operator assistance nearly 24 hours per day during a scheduled outage.

Additional instrumentation is provided to the Control Room personnel to monitor the condition of the RCS while it is partially filled. The tygon tube in containment provides a manometer indication of the reactor vessel level. The Auxiliary Operator reads this level periodically as part of the normal rounds or as requested by Control Room personnel. The auxiliary operators training program, lesson plan O-AO-LP section 1.5.19 provides instruction on the correct location and connection of this tygon tubing. The Reactor Coolant Refueling Level transmitter is also available during the refueling outage and provides control room indication of the reactor vessel level. The control room operators also have access to the refueling screens of the Honeywell plant process computer. These screens provide graphic information on the RCS system, including level as shown on the attached computer printouts.

Additional information channels are also provided to the control room while the RCS is partially filled. Two of these are the Shift Work List and the Refueling Outage Schedule. The Shift Work List is available at the start of each shift to keep personnel aware of the work going on that day. All work to be done during the refueling outage is coordinated prior to shutdown and incorporated into the Refueling Outage Schedule. This schedule provides an overall view of refueling activities to employees and contractors.

3010

REFUELING LEVEL

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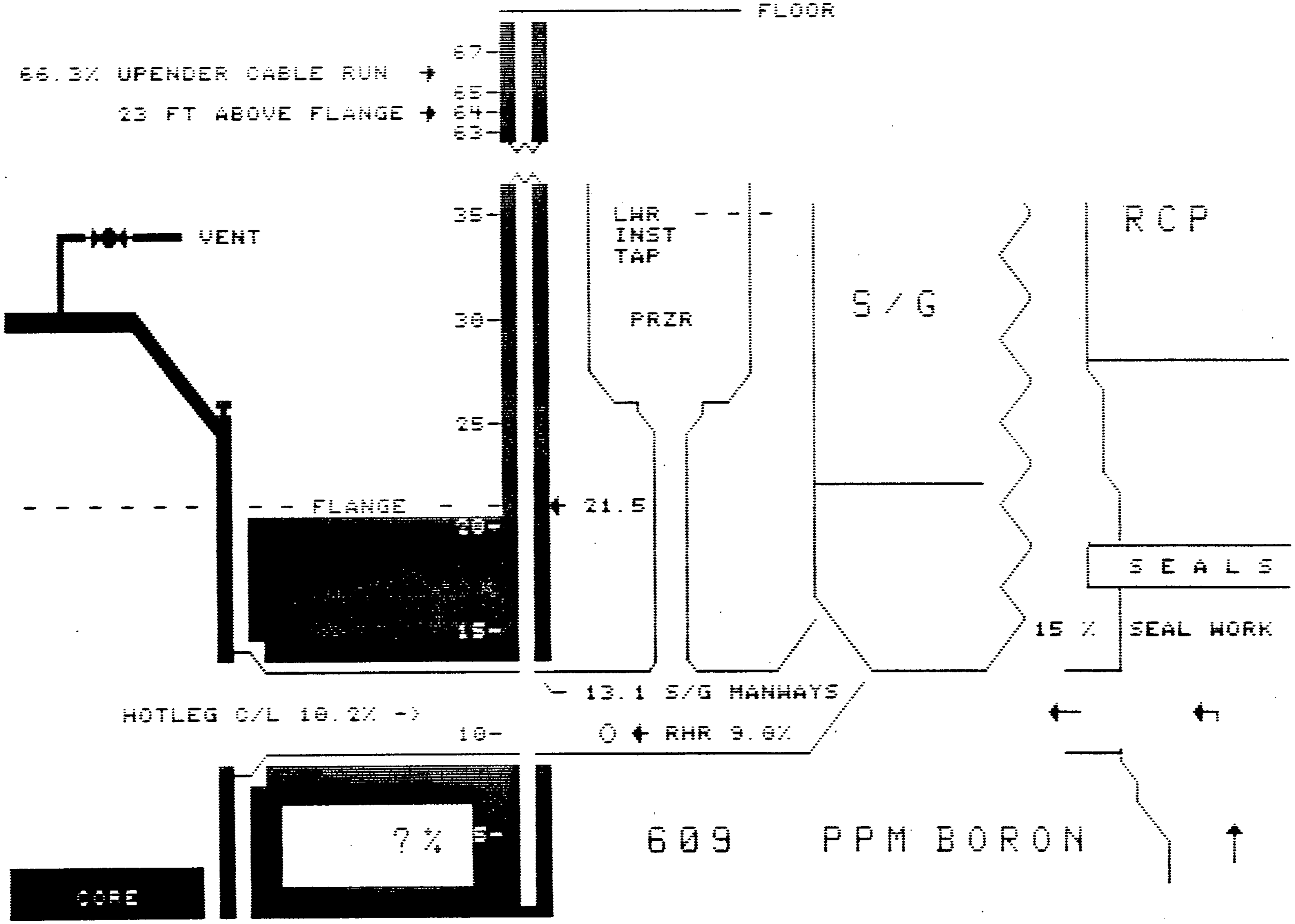

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HEATUP / COOLDOWN

NORM	R1000G	HEAT UP RATE- AVERAGE TC	0	F/HR
NORM	R1002G	PRZR HEAT UP RATE [1]	-2	F/HR
NORM	T0419A	RCLA HOT LEG (WR) TEMP	590.1	DEGF
NORM	T0439A	RCLB HOT LEG (WR) TEMP	581.1	DEGF
GOOD	T0406A	RCLA COLD LEG (WR) TEMP	528.3	DEGF
GOOD	T0426A	RCLB COLD LEG (WR) TEMP	531.3	DEGF
NORM	T0480A	PRESSURIZER WATER TEMP	653.1	DEGF
NORM	T0481A	PRESSURIZER STEAM TEMP	652.3	DEGF
GOOD	P0823G	RMP-PRZR PRESSURE [1]	2240	PSIG
NORM	T0630A	RHR PUMP SUCT HDR TEMP	88.6	DEGF
NORM	T0627A	RHR HX OUT LOOP HDR TEMP	93.1	DEGF
NORM	T0616A	COMP CLG PUMP SUCT HDR T	100.7	DEGF
NORM	T0621A	COMP CLG HX OUT LOOP T	93.2	DEGF

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REFUELING SHUTDOWN

NORM	N8031G	SR N-31 COUNTS	0	DKCS
NORM	N8032G	SR N-32 COUNTS	0	DKCS
NORM	T0630A	RHR PUMP SUCT HDR TEMP	88.6	DEGF
NORM	T0627A	RHR HX OUT LOOP HDR TEMP	93.1	DEGF
GOOD	F0626G	LO HEAD TRN A RHR TO RCS	122	GPM
NORM	T0616A	COMP CLG PUMP SUCT HDR T	100.7	DEGF
NORM	T0621A	COMP CLG HX OUT LOOP T	93.1	DEGF
GOOD	F0619G	COMP COOLING HX OUT LOOP	1505.5	GPM
NORM	R8100G	RCS BORON CONC CALC	601	PPM
NORM	L0112A	VOLUME CONTROL TANK LVL	33.7	PCT
OVFL	L9053A	REFUELING WATER LEVEL	? N	PCT
NORM	P0420A	RCLA SYSTEM PRESS (WR)	2235.7	PSIG
NORM	R1000G	HEAT UP RATE- AVERAGE TC	0	F/HR

NRC 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.

WPSC RESPONSE

KNPP, not being a Standard Technical Specification plant, defines the following conditions of operation: cold shutdown when reactivity is ≤ -1% and the average coolant temperature is 200°F, Refueling Shutdown when the average coolant temperature is 140°F and reactivity is ≤ -10%, and Refueling Operation as any operation involving movement of Reactor Vessel internal components (those that could affect the reactivity of the core) within the containment when the vessel head is unbolted or removed.

When the plant is in a cold shutdown condition with the reactor head installed containment integrity is not required by Technical Specifications. However, both trains of RHR and one boric acid injection flow path to the core must be available when there is fuel loaded (see response to Question No. 3).

During a normal plant cooldown evolution, by the time cold shutdown is reached, the RCS is solid, the RHR system is in service to maintain the cooldown rate and overpressure protection, and the system is cross-tied to the Chemical and Volume Control System (CVCS) to allow for coolant purification. RCS pressure is controlled by the CVCS letdown line low pressure control valve, LD-10, and one charging pump is normally in service. During the period of solid plant operation the RHR system requirement is to not exceed 2000 gpm flow for a single RHR pump or heat exchanger including any flow directed to the CVCS letdown line.

When desired, the RCS is normally drained using the RHR system letting down through the CVCS cross-connections to the CVC Holdup Tank(s). Operating Procedure N-RC-36E "Draining the Reactor Coolant System," is followed for this evolution. The typical initial conditions for the drain down are specified in our response to Question No. 1.

The RCS draindown is initiated by opening LD-10. When the pressurizer level reaches 50% the local and remote reactor level indication systems are valved into service. During the process a vent path is provided from the pressurizer to the PRT for monitoring pressure during the drain down and at lower levels the Reactor Vessel Head is vented to the containment atmosphere. Equalizing RCS pressure with the containment pressure is necessary in order to ensure an accurate response of the RCS level indicating instruments. Other precautions included in the draindown procedure are specified in our response to Question 1.

At steady state partially filled RCS conditions the procedure directs the operators to:

- Control RCS temperature as desired using one RHR pump and controlling the flow through the RHR heat exchangers.

- If suction is lost, or the RHR pump starts to cavitate.

  a. If charging pumps are operating, increase pump speed* and fill from the VCT or open the RWST to charging pumps suction isolation valve and fill from the RWST.

* KNPP has three positive displacement charging pumps.

b. If charging pumps are idle, open the charging line isolation and RWST suction isolation valves and gravity fill from the RWST.

Based on several years of operating experience, knowledge on the system's hydraulic behavior when draining down to the centerline of the hot leg has been gained. This information has been summarized and included as an attachment to Operating Procedure N-RC-36E. This information is as follows:

<u>Guidance Provided for Draining to the Centerline of the Hot Legs</u>

(1) A substantial amount of water is trapped in the Steam Generator tubes. This water cannot be completely drained until the pressurizer surge line is uncovered. This allows air to replace the water in the tubes. It is necessary to drain RCS to the centerline of the hot leg nozzles to ensure that the Steam Generator tubes are empty.

(2) Level will decrease at a steady rate. When the pressurizer empties, a rapid drop in level will occur as the surge line empties. Check level on Tygon Tube to verify this.

(3) Continue to drain. Level again will decrease at a steady rate until the top of the surge line penetration to B RCS loop is reached. At this point level will remain almost constant. It will decrease slightly and increase slightly as the water in the S/G tubes is replaced by air.

NOTE: Monitor the RHR Pump(s) for cavitation, if cavitation becomes apparent, stop draining and refill the primary system per step 4.3.2.*

(4) Continue to drain. Level will indicate a very slow downward trend as the S/G tubes empty. When the tubes are empty, level will again decrease at a steady rate. Drain to the center line of the hot leg vessel penetrations. Verify level by observing level on Tygon Tube (10.2% on Reactor Level Indicator).

(5) Maintain level between 10.2% and 11.2% on Reactor Level Indicator.

When refueling operations are in progress a different set of requirements exist as defined by our Technical Specifications section 3.8.

In summary, the requirements implemented while the RCS is partially filled versus the requirements imposed for the other shutdown modes are governed by Operating Procedure N-RC-36E and the associated guidance document based on past operating experience.

* See directions for steady state operation for this reference.

NRC 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.

WPSC RESPONSE

As a result of the numerous communications involving loss of RHR events during mid-loop operations, especially NUREG-1269 and the issues raised in Generic Letter 87-12, WPSC has made several commitments to improve operations while the RCS is partially filled. These commitments are:

- The abnormal procedure for loss of RHR, A-RHR-34, will be revised to include:

  1. cautions for not attempting to start the second RHR pump if the operating pump is showing indications of experiencing cavitation or vortexing until the cause of cavitation or vortexing has been investigated and corrected.

  2. initiate actions to close the major pathways out of containment, including personnel airlocks and the equipment door, upon the loss of RHR.

These changes to the procedure will be made prior to the 1988 refueling outage (March).

- The procedure for draining the RCS, N-RC-36E, will be revised to include:

  1. a limitation on the maximum RHR flow rate to reduce the likelihood of pump cavitation (currently we have a danger card in the control room, see response to question 5 part C).

2. verification that the containment equipment door is closed before the RCS is drained to a level below 12" below the flange, and that it is not opened during mid-loop operation.

3. a change to keep the core exit thermocouples connected as long as practical while the RCS is in mid-loop operation during a refueling outage.

These changes to the procedure will be made prior to the 1988 refueling outage.

The following changes are being made to further strengthen our existing program.

- The flexible tygon tubing used for measuring RCS refueling level will be replaced with piping or rigid tubing, and the level markings will be etched in stainless steel or by some other permanent method. This design change will be completed by the end of the 1988 refueling outage.

- A design change has been initiated to install a second independent refueling level indication in the control room. This will be a narrow range transmitter which will provide greater accuracy near mid-loop level. Installation of this has been scheduled for the 1989 refueling outage, but is contingent on further analysis and availability of material.

- A review of industry events pertaining to loss of RHR function has been completed in the recent licensed operator requalification training (see response to question 6). In addition, information on pump cavitation and vortexing will be added to the permanent programs for initial and requalification license training.