WESTINGHOUSE CLASS 3

AMENDMENT 1a TO RESAR-SP/90 PDA MODULE 1
PRIMARY SIDE SAFEGUARDS SYSTEM

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INSTRUCTION SHEET

Replace current pages 440-11 and 440-12 with revised pages 440-11, 440-12, 440-12a and 440-12b, behind Questions/Answers tab.

Replace current pages 440-37 and 440-38 with revised pages 440-37, 440-37a and 440-38, behind Questions/Answers tab.

Replace current pages 440-41 and 440-42 with revised pages 440-41, 440-41a and 440-42, behind Questions/Aswers tab.

Replace current pages 440-45 and 440-46 with revised pages 440-45, 440-45a and 440-46, behind Questions/Answers tab.

Replace current pages 440-79 and 440-80 with revised pages 440-79 and 440-80.

Insert new 440-82a after page 440-82, behind Questions/Answers tab.

Replace current pages 440-83, and 440-84 with revised pages 440-83, 440-84, 440-84a and 440-84b, behind Questions/Answers tab.

Replace current pages 440-91 and 440-92 with revised pages 440-91, 440-91a and 440-92, behind Questions/Answers tab.

RESPONSE:

This was not considered. The primary approach was to provide for the most probable events, such as LOCA, and to provide sufficient equipment and flexibility that the less probable events are covered. Containment spray actually needed is a very unlikely event, and if equipment were provided solely for the purpose of spraying containment, it probably never would be used. This introduces a potential reliability problem. The preferred approach, which has been followed in the SP/90, is to use an item of equipment that is subjected to normal operation and is not needed under the conditions of required use being considered here. An example is the RHR pumps, which are not needed under full power operation conditions, and are made available (and configured) for containment spray when in a power operation mode. This approach has the benefit of allowing one to economically put the investment into equipment that is potentially needed on a probabilistic basis, and to not provide additional investment for equipment that is unlikely to ever be needed, while at the same time making sure the need would be met if it were to occur via application of equipment that is normally used for some other task.

440.40 (p 5.4-1, last line) The reference to Section 6.3.2.2.7 is incorrect.
5.4.7

RESPONSE:

The correct cross-reference is Subsection 6.3.2.2.6. An amended page 5.4-1 is provided as Attachment 440.40.

440.41 (5.4-2, third paragraph) This paragraph contains the statements:
5.4.7 "The heat load handled by the RHRS during the cooldown transient includes residual decay heat from the core, RCS sensible heat, and reactor coolant pump heat. The design heat load is based on the decay heat fraction that exists at 20 hours following reactor

shutdown from an extended run at full power." We have the following questions relative to these statements:

a. Is the hwat generation rate from an extended run at full power the same as from a run for an infinite time at full power?

b. What method was used in calculation of the decay heat generation rate and does it include all contributors to energy production such as the actinides as identified in 10CFR5d App. K, I.A.3?

c. Is the reactor coolant pump (RCP) heat that which is generated from operation of all four RCPs?

d. In computing the RCS cooldown characteristics, is an actual decay heat load used, or is the "constant" design value of 20 hours used?

e. What is the meaning of the design heat load statement with respect to the decay heat rate at 20 hours and where is it and where is it not used?

f. Please provide a summary of the calculations used in determining the characteristics.

<u>RESPONSE</u>:

a & b) The approach taken for the SP/90 decay heat values is consistent with the approach taken in the EPRI ALWR
1a requirements. It is intended that the sizing of decay heat removal equipment which is <u>not</u> affected by Appendix K should be designed using decay heat generation rates from ANS Standard 5.1 (October 1979).

The basis for this is that decay heat generation rates from ANS Standard 5.1 conservatively define the actual decay heat generation rates which would occur, and thus provide an acceptable basis for sizing decay heat removal system equipment.

The decay heat generation rates in ANS Standard 5.1 do not contain the conservatisms which have historically been employed by the NRC. For example, the decay heat generation rates in BTP ASP 9.2 include a 20% uncertainty for the first 10^3 seconds following reactor shutdown, and a 10% uncertainty between 10^3 and 10^7 seconds after shutdown. Such conservatisms may have been considered necessary in the past to envelope actual decay heat removal rates, but are unrealistically high based on current knowledge. In particular, to quote from the foreword of ANS 5.1-1979:

"In 1974, new research programs were initiated under the auspices of the Energy Research and Development Administration, Nuclear Regulatory Commission, and Electric Power Research Institute to better quantify decay heat and its uncertainty for short cooling times. The ANS 5.1 Working Group was reconstituted to include those individuals engaged in the new research and representatives from industry and NRC who have knowledge of decay heat from those perspectives. The first objective of the Working Group was defined to be a revision of the ANS 5.1 standard for LOCA applications (cooling time up to 10^4 seconds) in LWRs. The present a revision provides precise results, including detailed evaluation of the influence of neutron capture in fission products for this shutdown time range. It also covers the cooling times up to 10^9 seconds by use of an upper bound for the capture effect." 1a

Thus, the intent of ANS 5.1-1979 was to incorporate the best available knowledge in defining decay heat generation rates suitable for LOCA analyses.

Subsequent evaluations have shown ANS 5.1-1979 to be conservative, compared to the most realistic evaluations of decay heat generation. One widely accepted code for realistic determinations of decay heat generation rates is the ORIGEN* code. A recent comparison** of ANS 5.1 (1979) results to ORIGEN results showed that ANS 5.1 (1979) results were conservative by about 3 to 5% for the first 10^3 seconds following shutdown, and by as much as 18% in the range of 10^3 to 10^6 seconds.

Accordingly, ANS 5.1 (1979) is considered an acceptable basis for design of SP/90 decay heat removal equipment.

1a

*See, for example, Bennet, P. E., Sandia-ORIGEN User's Manual, NUREG/CR-0987, SAND 79-0299, October 1979.

**Memorandum from F. Eric Haskin on "Whole-Core Decay Heat Power," dated January 28, 1986.

1. In Item 5, the motor operated valve failing to open on demand is indicated as detectable via flow indicator FI-920, which as previously identified is not provided according to the information supplied to the staff. Note that if it were provided, there should be a reference to it in the failure to close on demand entry, which appears to indicate an inconsistency within the table.

RESPONSE:

The FMEA (Table 5.4.7-1) will be updated in the FDA submittal, however provided below is a description of the SP/90 single active failure criteria which were applied to the system design.

Active Failure Clarification

Valves - Active failures include the failure of a remotely operated valve to change position on demand. This includes motor-operated valves, air-operated valves and solenoid-operated valves, and excludes check valves and spring-loaded safety valves.

Other Equipment - Active failures also include the failure of a pump, 1a
fan, or diesel which is already operating, as well as failure of one of these components to start on demand. The failure of an already running pump, fan, or diesel is considered as a spurious failure. The failure of a D.C. train is not considered as a single failure.

Spurious Actuation - Another active failure is the spurious actuation of an active component; this includes the closing or opening of an MOV or the starting or stopping of a pump. As a criterion this applies only to active components in mitigating safety systems; however, as a goal it applies to all active components. An exception can be made for active components if specific design features or operating restrictions are provided that can preclude such failures (power lockout, confirmatory safety signals, position alarms, etc.).

Operator Error - A single incorrect or omitted action by a human operator attempting to perform a safety related manipulation in response to an initiating event. The error is limited to the systems utilized in mitigating the initiating event and does not include thought process errors, etc., that would lead to common cause or multiple failures.

1a In addition, the mispositioning of a valve (manual or remote) or the disabling of a powered component (opening a circuit breaker) prior to an event is considered a single failure. An exception can be taken if specific design features are provided that can preclude such failures, such as monitor lights/alarms from limit switches, circuit continuity testing, etc.

1a

440.73 5.4.7 Figure 6.3-1, ISS Piping and Instrumentation Diagram, Sheet 1, shows several pressure relief valves. What indications are to be provided to the operator regarding their status?

RESPONSE:

No direct indications will be provided to the operator. Note TMI item II.D.3 applies only to the RCS.

440.74 5.4.7 Figure 6.3-1 in part contains the RHR system P&ID. We have the following comments and questions with respect to sheet 1 of the figure:

a. Would a break in the RHR pump suction line cause water to drain from the EWST into an uncontrolled region outside of containment when the containment is at atmospheric pressure? If yes, and the volume into which the water were to be draining were to fill, would the leak then stop? What would be the boundary of the volume under those conditions? Please also address these questions for a condition of elevated pressure in the containment. A portion of the concern addressed by this item is upcoming consideration of severe accident response, precursors to accidents, and decontamination factors that may be applicable for certain accidents involving leakage or bypass of containment.

b. Connections to piping in other drawings are indicated by reference to a drawing number. No drawing numbers are provided on the drawings. The drawings also do not have figure or sheet

j. What is the design pressure of the line between valves 8810 and 8811? The concern is how pressure is relieved when the only relief path is against RCS operating conditions.

k. If valve 8810 is open as opposed to the normally closed position, flow is bypassed when the RHR pump is in operation, and SI injection flow is not as generally planned. What potential problems would this cause in expected operation of the RHR and SI systems, are they considered to be of concern, and if so, how are they to be prevented? Please consider both the normal licensing concerns with respect to this item and the broader concern as discussed in NUREG-1070.

l. We are having difficulty identifying the connections to the test header, test line, and reactor vessel insofar as locating them on the referenced drawings is concerned. This may be due to having to guess at the nomenclature due to the poor quality of the drawing. Please provide the information in a legible form and indicate more specifically which drawings are referenced since the sheet number is not provided on the drawings.

m. Note 3 reads "See system standard design criteria 1.14, containment isolation in reference (illegible)." What is this and where may we find it?

RESPONSE:

It is noted that test connections will be added downsteam of valves 9000A (B,C,D) and 9001A (B,C,D) in the FDA submittal. These test connections will be part of the current check valve leak test system and will be utilized during each plant startup, to positively verify that valves 9000 and 9001 are both fully closed and to detect/ characterize any valve leakage. This test will enable the plant operator to detect degradation of valve isolation capability prior to high pressure power operation. This procedure should minimize the probability of intersystem LOCA by providing a periodic verification of valve integrity. 1a

a. When the containment is at atmospheric pressure the level that compares to the level in the EWST is roughly two to three feet up the door in the pump compartment. As previously discussed, the doors are designed to withstand a head of water. For a condition of elevated pressure in containment, it is not designed to protect against the type of damage that may occur if water is released through a broken pipe at high pressure.

b. Revised drawings with system interconnections will be resubmitted.

c. Revised drawings with system interconnections will be resubmitted.

d. None.

e.(1) Valve response is a function of the differential pressure across the valve. Hence, if there is a significant backpressure, the opening pressure of the valve will be affected accordingly.

e.(2) See above.

e.(3) Deleted by NRC.

e.(4) W considers this to be a generic item. Standard components are used in the SP/90 of the type used in existing W provided plants. They are regulated by the codes, tested, and periodically retested.

e.(5) Almost all were selected in accord with existing practice. They are generally provided for thermal expansion caused pressure release.

f. The pumps are selected to provide a particular flow rate at a selected pressure, and flow rates above that pressure are not of interest with respect to normal plant operation. If one wanted the pump to deliver above that pressure, then the pump selection would have been made so that that would be the case. Hence, actual flow rate in the vicinity of the shutoff head with miniflow is not of interest provided the design criteria are met. In the case of the RHR pump, the normal usage of the pump if for RHR duty, and the assigned duty when the plant is at power is for use as a containment spray pump: Use in an SI mode is a very unlikely backup. With respect to the differences in piping, the RHR pump miniflow always takes place if the pump is in operation, and the flow merely circulates from the discharge side spray headers in addition to the path via the SI lines to the RCS. Some flow would be expected to go to each of the paths. There is a possibility that pump runout would be a potential problem.

This low probability, highly unlikely scenario will however be addressed in the SP/90 Emergency Operating Instructions (EOI's). If one or more RHR/CS pumps were required to be aligned; for example, for safety injection due to the failure of all four HHSI pumps: the EOI's will require that the containment spray flow path be isolated by closing the normally open spray isolation valve and that both spray isolation valves be de-energized. This will prevent a subsequent "P-signal" from opening these valves. Note that with four subsystems, one or more subsystems can be reserved for the spray function while utilizing one or more subsystems for the SI function. 1a

440.78
5.4.7
Please describe the consideration given to loss of water from the EWST and the conclusions with respect to the likelihood of this occurrence in the SP/90 design. (CP Rule (1)(i) and potential with respect to severe accident situations as covered in NUREG-1070.)

RESPONSE:

This is considered to be very unlikely. If it were to occur, two general types of paths would be followed. One would be a leak into the pump compartments, and the other a path via a small line such as a flow purification line. The latter, of necessity, would have to be small since it would be restricted by line size. Further, the line elevation is such that the line goes above the level of the EWST. The first path would provide leakage into one of the pump compartments. If small, this leakage would be pumped out of the compartment by the sump pumps and the operators would be alerted to a problem. If large and for some reason it could not be controlled, the leak would fill the compartment, as discussed in the response to 440.74a, and then would stop. Also note the EWST is provided with multiple level measurement devices, and alarms are sounded if the level does not meet requirements.

440.79 5.4.7 Was consideration given to a means for reducing RCS pressure to significantly below the RHR initiation point (such as a large blowdown valve)? Please discuss in light of the guidance to consider past experience that is provided in NUREG-1070.

RESPONSE:

Yes. Three PORV's and two blowdown connections are provided which essentially lead from the RCS to the EWST. Connections are also provided which lead from the steam generator secondary side to the

EWST which could be useful for this purpose, although their primary function is to provide a backup means for control of steam generator inventory under steam generator tube rupture conditions.

440.80
5.4.7 A recent paper on improvement of light water reactors in Japan contained the statement "Operability will be improved by separation of systems and equipment by function through such measures as discontinuing the common use of the ECCS for the containment cooling system and the shutdown cooling system. This will also contribute to improvement of reliability." Please comment with respect to the SP/90 design, CP Rule (1)(i), and the reasons for going in the selected direction as opposed to the above recommendation.

RESPONSE:

See the prior discussion in regard to selection of equipment. W does not agree that the equipment should not have multiple uses and that setting up equipment for only one usage leads to better reliability. In the case of the ISS, the SI pumps are assigned to essentially that duty. The containment spray function is considered to be a far less likely event, and use of the RHR pumps for this purpose (the only assignment for these pumps when the reactor is at power) is considered to be sufficient. Note also that few operations are required for the safety functions to be met, as contrasted to existing plants, where more operations are required for satisfactory long term operation of the systems.

440.81
5.4.7 We note that all of the large lines penetrating containment have valves that are remotely operated that are located outside of containment... except for the four RHR suction lines. Was consideration given to providing such a valve in each of the suction lines as a means of isolation which would provide backup for isolation? Please discuss with respect to past experience as outlined in NUREG-1070 and the reasons for the approach followed in the SP/90 design.

f. Discussed previously.

g. These have not really been addressed yet. Note that running the test lines should provide mixing. This will be covered in Module 13.

h. The EWST is not considered to break.

i. Total cross sectional area has not yet been determined. The selection will comply with the applicable regulations. The mesh size for the fine screens in the EWST will be sized to prevent passage of particles greater than 3/8-inch in diameter. This is consistent with the fine screens in existing plants. 1a

j. W will comply with the applicable Regulatory Guides. This is covered in Module 2.

k. There are eight large diameter pipes provided in containment which lead water into the EWST. Each of the high head SI pumps and each of the RHR pumps has a separate pipe connection to the EWST to supply water for the safeguards operation.

l. Some of this material is discussed in Module 4. The ISSS design is such that, in the long term, only a small portion of the equipment is needed for cooling. The remainder can be held in reserve and applied if what is being used is worn out due to erosion from debris. When the SI pumps are "used up" one can apply each of the RHR pumps in turn, which can also be configured for SI duty. In addition, the separation of components allows one to work on portions of the system while other portions of the system are in use to cool the RCS.

m. There are no such pipe runs.

n. Connections are provided between the steam generators and the EWST. See Module 6/8.

o. Spargers will be used for pipes which connect equipment to the EWST. Flow from containment will be relatively low velocity flow and the impingement on the surface is not expected to cause any difficulty.

440.113 (6.3-15, Section 6.3.2.2.8, Valves) The June 1983 version of this
6.3 document contained the following: "Inadvertent mispositioning of a motor operated valve due to a malfunction in the control circuitry in conjunction with an accident has been analyzed and found not to be credible for consideration in design." This statement is not contained in the more recent version. Please explain.

RESPONSE:

The SP/90 PSSS is designed to be unaffected by any single failure, including inadvertent mispositioning of valves.

440.114 Insofar as not provided in the response to 440.85, please provide a
6.3 list of all valves associated with the systems discussed in Section 6.3 which might have their motors (drivers), electrical connections, or controls flooded following an accident. If any are flooded, please provide an evaluation of the consequences for both short and long term ECCS functions. Also list all control room instrumentation loss following accidents which result in flooding and evaluate the consequences of failures and malfunctions. Further provide similar information, as applicable, with respect to valves for which manual operation would normally be considered as a backup mode of operation, but which may not be accessible due to flooding.

RESPONSE:

As previously discussed (440.85), this is not considered to be a problem. With respect to the control room instrumentation and manual operation, the intent of the design process is to prevent difficulties of this type. Curbs, flow paths, and elevations, for example, are used to control flooding.

As Class 1 components, these valves are analyzed to be consistent with the ASME code for faulted conditions which include the overstress conditions due to ATWS events. Note that these valves are hydrotested to ~ 3109 psig during the plant cold hydrotest. 1a

440.119 There are a number of valves associated with the primary side safeguards systems that are normally in a ready position (either open or closed) for which no movement is necessary if the primary side safeguards equipment is needed. Will the SP/90 have a monitoring system which checks the position of all of the valves and indicates an "OK" status if all are in the proper position, with a corresponding indication and perhaps alarm if any valve is mispositioned? Section 6.3.5.2.6, which provides a discussion of this type of monitor, appears to be specific to "... valves that are required to function...." Please discuss.

6.3

RESPONSE:

Monitoring capability in the advanced control room will continuously evaluate all critical MOV's, whether they are required to move or not.

440.120 Closely related to the above question is the overall question of automatic monitoring of components for which unique lineups are necessary which depend upon the plant operational status, including shut down operations, start up operations, and cold shutdown (with such activities as refueling). Is there a plan for coverage of these situations with a single "OK" indication if everything is aligned properly, and with a suitable indication if a component is not aligned properly or otherwise unavailable? Is there a plan for automatic following of plant response under these offpower conditions and with more specific indication of plant condition tuned to the different needs associated with the different conditions? Again, Section 6.3.5.2.6 touches on this topic, but appears oriented toward power operation or specific phases of the ECCS emergency response as opposed to different normal operational situations of the plant other than power operation. Please discuss.

6.3

RESPONSE:

With respect to the first half of the item, there is a plan for automatic monitoring with a single "OK" indication. With respect to the second half of the item pertaining to the different needs associated with the different conditions, this will be covered in Module 16.

440.121 (6.3-19, Section 6.3.2.5, System Reliability) "The system has been
6.3 designed and proven by analysis to withstand any single credible active failure during injection or any single active or passive failure during recirculation or operator error and maintain the performance objectives ..."

a. Has the analysis referred to above been completed?

b. In general, what is the W position with respect to active vs. passive failures and when is one to be considered vs. allowing for both? What types of passive failure are considered and what types are not?

c. What is the definition of "operator error" as used in the above? Will this definition apply to all of the SP/90 documentation?

RESPONSE:

a. Yes. It is presented in Chapter 15.

b. This question is considered to be of a generic type. In general, the classic definitions and practice of past W designed plants are applicable. With respect to the PSSS and the SP/90 plant, a failure can be tolerated regardless of timing.

c. Operator error means an operator can make a single incorrect or omitted action. This definition will apply to all aspects of the SP/90 program.

Passive Failure Clarification:

Leakage - A leak of 50 gpm must be assumed as a possible single failure. This leakage is not assumed to occur until 24 hours afterwards or whenever reactor coolant is recirculated outside containment. This leak would continue until the operator takes action which is assumed to be 30 minutes for this situation.

As a goal, a leakage flow area of .3 in^2 should be assumed; this is equivalent to the break of 3/4" line which results in a 500 gpm leak of water at 2,000 psig.

Consequential effects of a pipe leak such as flooding and jet impingement must be considered. Although a leak is not assumed to occur in a valve body, if it occurs adjacent to a valve the consequential failure of the valve must be considered. Either the valve must be specifically designed to meet its functional requirements in this condition or, preferably, it should be assumed to consequentially fail. 1a

Line Blockage - not considered.

Operator Action:

During design basis events credit may be taken for the plant operators to mitigate the consequences of an initiation event within the following criteria:

- o Assuming the operator has safety grade inputs indicating a need to act, the minimum response time shall be 10 minutes. This assumes only simple actions; if the actions are complex, then more time must be allowed. Note that this is not a restriction placed on the operators and operating procedures but rather on the system designers.

As a goal, the minimum operator action times should be 30 minutes. Should overly conservative licensing criteria be forced on the APWR then times as short as 10 minutes may be assumed; in such cases it should be shown that 30 minutes is acceptable assuming reasonable criteria.

1a As a goal, requirements for operator action should be minimized (time, complexity).

o It should not be necessary for the operator to leave the control room following a design basis event except for PC-4.8 Control Room Evacuation, to operate equipment, correct failures, bypass interlocks, etc., for 2 hours. In the longer term any operator action outside the control room must be compatible with the radiation fields, effort involved, and time available.

440.122 (6.3-20, second paragraph) "The preoperational testing program
6.3 ensures that the systems as designed and constructed will meet the functional requirements as calculated in design." Is something left out of this sentence and, if so, what?

440.133 (6.3-25, second paragraph) "Following this type of small RCS leak,
6.3 ....The operator should therefore use the charging system to its maximum capability, if required, to maintain water in the pressurizer."

a. What is the anticipated amount of water that would be added to the containment following this procedure for a small break inside containment?

b. What water level will this cause inside containment?

c. What are the implications of this level inside containment, if any, and would it be better to use the SI system which would draw water from containment?

RESPONSE:

a. On the order of 100,000 gallons.

b. Question withdrawn by NRC.

c. Question withdrawn by NRC.

440.134 (6.3-26, top of page) This switchover procedure from hot leg to cold
6.3 leg injection appears to result in the complete removal of injection to the RCS prior to initiation of hot leg injection. If this is correct, why was this route selected as contrasted to one in which RCS injection would be maintained?

RESPONSE:

This is not correct. The switchover would take place one subsystem at a time, and injection therefore would not be terminated.

1a Also, since the flow delivered by one HHSI pump exceeds the core decay heat boil-off rate, the switchover of one HHSI to hot leg injection will ensure sufficient flow to effect boron dilution in the reactor vessel. At the same time the continued injection of one HHSI pump via the cold leg side of the reactor vessel will insure that the core remains covered with water.

440.135 (6.3-26, third paragraph) "After several hours of hot leg injection;
6.3 one or more of the high head pumps would be realigned to deliver directly to the reactor vessel injection nozzles, thus establishing a

simultaneous flow to the reactor vessel downcomer and the RCS hot legs." This process, as described in the switchover procedure, has the operator first going completely to hot leg injection from cold leg injection, and then switching partially back. Why was this selected as contrasted to only switching partially to hot leg injection and leaving a portion of the cold leg injection alone, thereby reducing the number of operator actions as well as reducing the number of operations required of the equipment?

RESPONSE:

The selected procedure is felt to be simpler on an overall basis due to the exclusion of branch paths in the procedures that would otherwise be necessary.

440.136 The staff position concerning boron dilution has been previously out-
6.3 lined as follows (See, for example, Q 440.33 for Millstone Nuclear Power Station Unit No. 3):

a. The boron dilution function shall not be vulnerable to a single active or limited passive failure (i.e., leakages of seals). Specifically, the limiting single active failure should be considered during the short-term period of cooling. During the long-term period of cooling, the limiting single active failure should be considered and so should a limited passive failure be considered, but not necessarily in conjunction with each other.

b. The inadvertent operation of any motor operated valve (open or closed) shall not compromise the boron dilution function, nor shall it jeopardize the ability to remove decay heat from the primary system.

c. All components of the system which are within containment shall be designed to Seismic Category I requirements and classified Quality Group B.