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October 31, 1985
ST-HL-AE-1492
File No.: G9.17

Mr. George W. Knighton, Chief
Licensing Branch No. 3
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, DC 20555

South Texas Project
Units 1 and 2
Docket Nos. STN 50-498, STN 50-499
Responses to DSER/FSAR Items; Long Term Cooling

Dear Mr. Knighton:

The attachment enclosed provides STP's response to Draft Safety Evaluation Report (DSER) or Final Safety Analysis Report (FSAR) items.

The item numbers listed below correspond to those assigned on STP's internal list of items for completion which includes open and confirmatory DSER items, STP FSAR open items and open NRC questions. This list was given to your Mr. N. Prasad Kadambi on October 8, 1985 by our Mr. M. E. Powell.

The attachment includes mark-ups of FSAR pages which will be incorporated in a future FSAR amendment unless otherwise noted below.

The items which are attached to this letter are:

Attachment	Item No.*	Subject
1	Q440.38, Q440.39	Long Term Cooling

B001
1/1

* Legend
D - DSER Open Item
F - FSAR Open Item
C - DSER Confirmatory Item
Q - FSAR Question Response Item

L1/DSER/a4

If you should have any questions concerning this matter, please contact Mr. Powell at (713) 993-1328.

Very truly yours,

M. R. Wisenburg
Manager, Nuclear Licensing

JSP/bl

Attachments: See above

cc:

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Revised 9/25/85

L1/DSER/a4

QUESTION 440.38
(Section 6.3. & 15.6.5)

ATTACHMENT 1
ST-HL-AE-1492
PAGE 1 OF 6

a. Demonstrate that the STP ECCS meets 10 CFR Part 50.46 criteria for long term decay heat removal in the event of a small break LOCA of a size such that recirculation would be required but the RCS pressure either remains above the low head safety injection (LHSI) pump shutoff head or recovers after loss of the secondary heat sink. An examination of Figures 6.3-1 through 6.3-5 does not indicate that the STP ECCS is designed for high head recirculation combined with decay heat removal by the RHR heat exchangers, i.e., there are no apparent provisions for routing recirculation flow from the RHR heat exchangers to the HHSI pumps. Also, as described in Appendix 5.4A "Cold Shutdown Capability," the steam generators have a limited supply of safety grade secondary water supply, since there is not a safety grade backup to the auxiliary feedwater storage tank (AFST). Therefore, provide long term analyses for a spectrum of small break LOCAs that demonstrate that decay heat can be adequately removed and the RCS depressurized using only safety grade equipment and water sources, assuming loss of offsite power and the most severe single failure. If credit is taken for operator actions, the STP emergency response guideline (ERG) sequence of operator actions should be followed. Justify the timing of operator actions if they are less conservative than those recommended in ANSI N-660 for a condition IV event.

b. In a conference call held on March 8, 1985, the applicant indicated to NRC that for small break LOCAs the combined heat sink capacity of the RWST and the steam generators would provide core cooling for approximately 18 hours, after which the reactor containment fan coolers (RCFCs) would provide an adequate heat sink for decay heat removal. No credit is taken for heat removal by the RHR heat exchangers. Provide a detailed explanation of the mechanism of energy removal from the RCS after loss of the secondary heat sink and supporting analyses that demonstrate that energy can be adequately removed to meet the acceptance criteria of 10 CFR Part 50.46. We are concerned that for very small break LOCAs (e.g., 1 inch) energy would not be adequately removed from the RCS for a considerable period of time after the accident. Thus, WCAP-9600, "Report on Small Break Accidents for Westinghouse NSSS System" June 1979, indicates that for 1 inch breaks the break can remove all the decay heat only after about 24 hours, and that prior to that time, auxiliary feedwater is required to maintain the heat sink.

RESPONSE:

~~This response will be provided later.~~

see response to Question 440.39

QUESTION 440.39
(Section 6.3)

a. It is stated in 10 CFR Part 50.46(b)(5) that, for long term cooling, "the calculated core temperature shall be maintained at an acceptably low value and decay heat shall be removed for the extended period of time required by the long-term radioactivity remaining in the core." In order to assure this, heat removal for this extended period must utilize equipment that is fully qualified for the environmental conditions that prevail during the accident. Please demonstrate that decay heat can be removed from the STP core with qualified equipment only, following all sizes of LOCAs, including all LOCAs which could be subsequently isolated by the operator. Include consideration of the post-LOCA cooldown period in your response, and the fact that for isolated LOCAs, the sump would not be available for long term cooling.

b. Discuss whether the RHR pumps are qualified for the environmental effects of the large and small break LOCAs and steam line breaks. If the RHR pumps are not qualified discuss how long term mitigation of these accidents would be accomplished.

RESPONSE:

This response will be provided later.

See attached response.

Response to Question 440.39A

Large Break LOCA

For large break LOCA (breaks greater than 1 sq. ft.) the break will cause a significant Reactor Coolant System (RCS) depressurization. Breaks of this size are not isolatable so the sump is used for long term cooling and makeup. All breaks considered large breaks will have sufficient energy removal through the break to sump flow path to remove decay heat energy. Sufficient make-up capability to keep the core adequately cooled and to meet 10CFR Part 50.46 (b) (5) requirements is provided. Containment heat removal will be provided in the STP design by both containment fan coolers and low head safety injection (LHSI) recirculation flow which is cooled by the RHR heat exchangers. All equipment relied upon is fully qualified for the environmental conditions that prevail during the accident.

Small Break LOCA

As result of the accident at Three Mile Island, Unit 2, Westinghouse performed extensive analyses that focused on the behavior of small break loss of coolant accidents (SBLOCA) for the Westinghouse NSSS. The purpose of the analyses was to demonstrate adequacy of the Westinghouse NSSS design in mitigation and long term recovery from a range of breaks classified as small breaks (less than 1 sq. ft. area).

The results of the analyses were reported in WCAP-9600, "Report on Small Break Accident for Westinghouse NSSS System," dated June 1979. The "Small Break Evaluation Model" at that time consisted of the WFLASH thermal-hydraulic code and the LOCTA fuel rod model. The analyses were performed for generic application using a standard 4-loop Westinghouse design, a standard 3 loop and standard 2 loop depending on the nature of the study and which plant type was expected to be bounding. The conclusions are applicable for all Westinghouse designs.

STP SBLOCA Design Features

STP has a three train low pressure SI system consisting of three HHSI pumps, three LHSI pumps, and three accumulators. Each train is aligned to a separate RCS loop. The pressure ranges for the SI pumps follow:

HHSI: 0 - 1445 PSIG
LHSI: 0 - 283 PSIG

For recirculation, the LHSI and HHSI pumps take suction directly from the sump. The LHSI pump flow passes through the RHR heat exchanger and is cooled before entering the RCS.

The plant has three motor driven auxiliary feedwater pumps and one turbine driven auxiliary feedwater pump (AFW). The normal system alignment connects each AFW pump directly to one steam generator. The system does not have a common header, but cross connections exist in the AFW lines. The valves in the cross connections remain closed normally.

The limiting single failure for the STP design will result in the loss of one train of safety injection (1 LHSI and HHSI pump) and one AFW pump. Since one AFW pump is allowed out-of-service for maintenance, this will result in the ability to feed two steam generators, even though successful cooling can be accomplished by feeding one steam generator.

The STP design provides means to remove energy through the steam generators (long term AFW), through Containment steam condensation (fan coolers) and through the RHR heat exchangers (LHSI). In this way energy is removed from containment atmosphere (primarily steam condensation) and containment sump water (RHR heat exchangers) so that relatively cool water will be continued to be supplied as make-up and for decay heat removal.

For all break sizes, heat is removed from the core by the break and steam generators. AFW is required for secondary inventory and heat removal until the break is able to remove all the decay heat. The break removes energy from the RCS because the makeup water from the RWST is relatively cold and can absorb energy before exiting the RCS. The WCAP-9600 analyses with consideration of STP design features demonstrate decay heat removal capability for SBLOCA.

SBLOCA Response

The initiating event is the break. If the break is 3/8" or less equivalent diameter and the charging system and feedwater system are available, the event is classified as a leak since normal charging flow would be sufficient to keep up with leak flow without a significant RCS depressurization. There would not be an automatic reactor trip or safety injection signal.

For breaks larger than 3/8", automatic reactor trip and safety injection will occur due to RCS depressurization caused by the loss of primary inventory. [illegible]er reactor trip and safety injection initiation, safety injection pump [illegible] provides make-up to the RCS pressure and maximum peak clad temperatures will remain below 10CFR50.46 Appendix K criteria.

For all breaks greater than 3/8" and less then 1 inch, SI flow can match break flow so no significant RCS depressurization or core uncovery will occur. At the point where SI flow matches break flow the mitigation phase of the accident ends and a long term stable condition is reached.

The long term stable condition is that the steam generators provide heat removal capability in conjunction with break flow. Heat removal from the steam generators occurs through the safety valves. A supply of auxiliary feedwater is available for the long term.

Break sizes between 1 and 4 inches reach an equilibrium RCS pressure above the shutoff pressure of the LHSI pumps (283 psig). Steam generator heat removal is necessary until the break can remove all decay heat. For a one inch cold leg break, the break can remove all decay heat approximately 24 hours after the accident is initiated (WCAP-9600, Sec 3.1). For a four inch cold leg break all decay heat can be removed in less than 300 seconds into the transient (WCAP-9600, Section 3.2). Energy is removed through the break to containment where containment fan coolers remove energy to component cooling water. If containment sump recirculation is established, the HHSI pumps are

available for makeup. The water used by the HHSI pump will be at sump temperature and the break alone may not be able to remove all decay heat depending on decay heat levels at sump recirculation switchover time. If the break cannot remove all decay heat, the steam generators would be relied upon until the break can remove all energy.

For breaks greater than 4", the RCS will depressurize to below the LHSI shutoff pressure and all decay heat will be removed from the RCS through the break. The RHR heat exchangers will be sufficient to provide cooled make-up water to the RCS via LHSI pump flow.

For isolatable break cases, the steam generators would be relied upon to provide decay heat removal for an extended period following termination of the break.

By providing a safety grade supply of make-up to the AFW storage tank, decay heat can be removed from the STP core with qualified equipment only, following all sizes of LOCAs and including all LOCAs which could be subsequently isolated by the operator. STP has committed to provide make-up from the essential cooling pond (ECP) utilizing hose connections from the ECP ECW system to the AFW storage tank. ECW make-up to the AFST entails physically routing a dedicated make-up hose from the hose connection in the DGB wall to the AFST. This hose is comprised of ten 50 foot lengths stored in a commercial grade hose cabinet located adjacent to the AFST level instrument cubicle. There are no high energy systems or non-seismic structures in the vicinity. The hose cabinet is lock-wired and sealed but is not locked. The seal will be periodically checked. It takes two men no more than two hours to assemble this hose from the DGB wall to the AFST. At the AFST the hose is inserted through the roof manway and then securely attached to the platform.

When ECW make-up to the AFST is determined necessary, an operator inside the DGB connects a section of hose from the operating ECW train piping to the hose connection in the DGB wall. This short length of hose is kept in the DGB (one for each ECW train). It takes two men, no more than 30 minutes to assemble this hose for the ECW system to the DGB wall. STP will ensure that appropriate operator procedures and training are established prior to fuel load.

The most limiting scenario for depleting the available auxiliary feedwater supply would be a feedline break, with a coincident, extended loss of offsite power, and the unavailability of other water sources. This unlikely event would cause the fastest depletion of the AFST because the steam generators would be the source of decay heat removal and one line of auxiliary feedwater would be spilling until operator action terminates flow to that steam generator.

The AFST has a minimum useable capacity of 445,000 gallons. Thirty minutes of spillage at 675 gpm has been included in calculation of water available. With this information, the AFST would be depleted in 22 hours.

Non-safety grade sources of condensate grade make-up to the AFST are

- o Demineralized Water Storage Tank - One 1,000,000 gallon storage tank shared between units.

- Secondary Make-up Tank - One 300,000 gallon storage tank per unit
- Condenser Hotwell - about 100,000 gallons per unit

While these tank volumes are not covered by Technical Specifications or other administrative controls, it would be very improbable to have less than 500,000 gallons of condensate grade water available for each unit.

The hose connections are to be utilized temporarily (through STP's initial 2 refueling outages) until qualification of the Residual Heat Removal System (RHRS) can be completed. The qualification of the RHR system is expected to require up to 3 years and is currently in process. The RHRS will be qualified for environmental conditions resulting from LOCA and MSLB. In the event that the RHRS cannot be qualified to accident conditions, STP will install hard piping in addition to the hose reels. The following discussion describes the SBLOCA response when RHRS is available.

For breaks greater than 4" the decay heat will be removed by the break to the containment for coolers and the RHR heat exchangers via LHSI pumps. No operator action is required.

For breaks from 1" to 4", the operator will cool down and depressurize the RCS to a pressure below the cut-in pressure of the LHSI. This will be accomplished using the steam generator PORVs for cooldown and pressurizer PORVs in combination with HHSI flow termination for depressurization. The detailed actions will be provided in the STP Emergency Procedures which are based on the WOG Emergency Response Guidelines, Revision 1. The combined heat sink capacity of the Refueling Water Storage Tank and the steam generators would provide core cooling for approximately 27 hours, after which the containment fan coolers and the RHR heat exchangers via LHSI pumps will provide an adequate heat sink for decay removal.

For breaks between 3/8" to 1", the operator will cool down and depressurize to below the cut-in pressure of the LHSI pumps (283 psig). The RHRS will be available to provide heat removal at RCS pressures below 400 psig and temperatures below 350°F. Adequate long term decay heat removal will be provided by LHSI pump flow through an RHR heat exchanger in addition to RHRS operation.

For isolable breaks, the operator will cool down and depressurize the RCS via a sufficient quantity of auxiliary feedwater to RHRS cut in, below 400 psig and 350°F. Adequate long term decay heat removal will then be provided via the Residual Heat Removal System.