Westinghouse
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Energy Systems

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NSD-NRC-97-5146
DCP/NRC0880
Docket No.: STN-52-003

June 2, 1997

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: T. R. QUAY

SUBJECT: REVISED RAI 440.75 RESPONSE FOR PRESSURIZER SAFETY VALVE SIZING

Dear Mr. Quay:

During a February 13, 1997 telecon, Gene Hsii of the NRC requested that Westinghouse revise the response to RAI 440.75 part c, which discusses the pressurizer safety valve sizing analysis. This revision would address the AP600 pressurizer upsizing from 1300 ft^3 to 1600 ft^3, a change which was implemented after the initial RAI 440.75 response was provided. While it was clarified during the telecon that the pressurizer volume change does not invalidate the previous sizing calculation, the NRC has requested this information be provided in a revision to the RAI response to support completion of the Chapter 5 FSER.

Attached are 3 copies of Revision 1 to the RAI 440.75 response. In addition to presenting results considering the upsized pressurizer, this revised response includes the results of evaluating other changes which could affect the pressurizer safety valve sizing calculation. Those include increased full load steam pressure, a slight decrease in full-load Tavg, an increase in the steady-state Tavg uncertainty, and an increased steam generator design pressure (which had no impact since no corresponding change to the main steam safety valve set pressures was required).

The NRC technical staff should review this response as part of their review of the AP600 design. This response closes, from a Westinghouse perspective, DSER open item tracking system (OITS) item 4973. The NRC should inform Westinghouse of the status to be designated in the "NRC Status" field of the OITS. We suggest "Action N" or "Resolved".

If you have any questions regarding this submittal, please contact Robin K. Nydes at 412-374-4125.

Brian A. McIntyre, Manager
Advanced Plant Safety and Licensing

E004

jml

Attachment

cc: Gene Hsii, NRC (w/Attachment)
Bill Huffman, NRC (w/Attachment)
Nick Liparulo, Westinghouse (w/o Attachment)

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Question 440.75

Section 5.2.2.1 of the SSAR states that the sizing of the pressurizer safety valves for over-pressure protection of the RCS during power operation and transients is based on the analysis of a complete loss of steam flow to the turbine, with the reactor operating at 102 percent of rated power.

a. The acceptance criteria in Section 5.2 of the SRP states that the safety valves should be designed with sufficient margin available to account for uncertainties in the design and operation of the plant, assuming that the reactor scram is initiated by the second safety grade signal from the reactor protection system. Have these been included in the analysis?

b. Table 5.4-17 of the SSAR provides the design parameters for the pressurizer safety valve. What are the uncertainties of the set pressures of the pressurizer safety valve?

c. Provide the result of the analysis, including the sequence of events of the design basis incidents for sizing the pressurizer safety valves.

Response ***(Revision 1)***:

a. The safety valves provide margin to account for uncertainties. Reactor trip signals were not explicitly relied upon in the sizing of the pressurizer safety valves. See additional discussions under the response to part c, below.

   Uncertainties explicitly allowed for in the design and operation of the plant in the sizing of the pressurizer safety valves are as follows.

   - 2% uncertainty in nuclear power
   - ~~4~~ *7*°F uncertainty in reactor vessel T_{avg}
   - 10% uncertainty in steam generator secondary side fluid mass
   - Steam generator UA based on 10% of the steam generator tubes plugged
   - Minimum available pressurizer steam space based on statistical combination of control and protection system uncertainties
   - No credit for steam generator secondary side PORV's
   - No relief through steam generator secondary side safety valves until steam generator secondary side pressure reaches 103% of steam generator shell design pressure.
   - Steam generator secondary side safety valve relief capacity at 103% of steam generator shell design pressure was taken to be no greater than the plant rated steam flowrate
   - No credit for plant control systems
   - No credit for power reduction due to reactivity feedback

b. As specified in the AP600 Technical Specifications (T.S. 3.4.~~6~~*7*) the pressurizer safety valve setpoint tolerance is ±1% of set pressure.

c. The pressurizer safety valves are sized to carry the maximum pressurizer volumetric insurge following a complete loss of load and feedwater from 102% of rated power. Following the loss of load and feedwater, reactor power is maintained constant at 102% of rated power. No credit is taken for reactor trip or reactivity feedback during the transient. Credit is taken for actuation of the steam generator ~~secondary side~~ ***main steam*** safety valves, ***for*** which ***the setpoints are provided in T.S. 3.7.1. The main steam safety valves*** are modeled to pass plant rated steam flow at 103% of steam generator shell design pressure. The pressurizer safety valves are modeled to pass a large volumetric steam flow (for example 100 ft^3/sec) at 103% of reactor coolant system design pressure (pressurizer safety valve set pressure plus 3% accumulation) so as to negate compressibility effects during the sizing calculation.

For the limiting ~~transient~~ ***case*** evaluated, the loss of load and feedwater ***transient*** was simulated to occur at 10 seconds. Primary and secondary temperatures then increased and the steam generator ~~secondary side~~ ***main steam*** safety valves opened at ~~24~~ ***15.5*** seconds into the transient. The pressurizer insurge rate peaked at this time at ~~25.7~~ ***26.8*** ft^3/sec. The peak discharge rate for the steam generator ~~secondary side~~ ***main steam*** safety valves occurred at the time of termination of the transient simulation, ~~30~~ ***37*** seconds which corresponds to ~~20~~ ***27*** seconds after initiation of the loss of load and feed***water***, and did not exceed 85% of plant rated steam flow. This is well below the actual capacity of the steam generator secondary side safety valves.

The specific volume of saturated steam at 2575 psia (103% of RCS design pressure) is 0.12346 ft^3/lbm.

(~~25.70~~ ***26.8*** ft^3/sec) * (3600 sec/hr) / 0.12346 ft^3/lbm = ~~749,393~~ ***782,000*** lbm/hr

The required valve capacity was then conservatively established at ~~750,000~~ ***800,000*** lbm/hr at 2575 psia.

SSAR Revision: See attached markups.

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.7 Pressurizer Safety Valves

BASES

BACKGROUND

The two pressurizer safety valves provide, in conjunction with the Protection and Safety Monitoring System (PMS), overpressure protection for the RCS. The pressurizer safety valves are totally enclosed, spring loaded, self actuated valves with backpressure compensation. The safety valves are designed to prevent the system pressure from exceeding the system Safety Limit (SL), 2733.5 psig, which is 110% of the design pressure.

Because the safety valves are totally enclosed and self-actuating, they are considered independent components. The minimum relief capacity for each valve, ~~375~~ 400,000 lb/hr, is based on postulated overpressure transient conditions resulting from a complete loss of steam flow to the turbine. This event results in the maximum surge rate into the pressurizer, which specifies the minimum relief capacity for the safety valves. The pressurizer safety valves discharge into the containment atmosphere. This discharge flow is indicated by an increase in temperature downstream of the pressurizer safety valves

Overpressure protection is required in MODES 1, 2, 3, 4, 5, and 6 when the reactor vessel head is on; however, in MODE 4 with the RNS aligned, MODE 5, and MODE 6 with the reactor vessel head on, overpressure protection is provided by operating procedures and by meeting the requirements of LCO 3.4.15, "Low Temperature Overpressure Protection (LTOP) System."

The upper and lower pressure limits are based on the ± 1% tolerance requirement (Ref. 1) for lifting pressures above 1000 psig. The lift setting is for the ambient conditions associated with MODES 1, 2, and 3. This requires either that the valves be set hot or that a correlation between hot and cold settings be established.

The pressurizer safety valves are part of the primary success path and mitigate the effects of postulated accidents. OPERABILITY of the safety valves ensures that the RCS pressure will be limited to 110% of design pressure.

(continued)

Table 5.4-17

PRESSURIZER SAFETY VALVES - DESIGN PARAMETERS

Number	2
Minimum required relieving capacity per valve (lb/hr)	400 ~~375~~,000
Set pressure (psig)	2485
Design temperature (°F)	680
Fluid	Saturated steam
Backpressure	
Normal (psig)	3 to 5
Expected maximum during discharge (psig)	500
Environmental conditions	
Ambient temperature (°F)	50 to 120
Relative humidity (percent)	0 to 100

Residual Heat Removal Relief Valve - Design Parameters

Number	1
Nominal relieving capacity per valve,ASME flowrate (gpm)	555
Nominal set pressure (psig)	563*
Design temperature (°F)	400
Fluid	Reactor coolant
Backpressure	
Normal (psig)	3 to 5
Expected maximum during discharge (psig)	200
Environmental conditions	
Ambient temperature (°F)	50 to 120
Relative humidity (percent)	0 to 100

* See text (5.4.9.3) for discussion of set pressure

AP600 Open Item Tracking System Database: Executive Summary

Selection: [item no] between 4973 And 4973 Sorted by Item #

Item No.	Branch	DSER Section Question	Type	Title/Description Detail Status	Resp Engineer	(W) Status	NRC Status	Letter No. /	Date
4973	NRR/SRXB	5	TEL-OI	Revise RAI 440.75 response to address affect of change in pressurizer volume from 1300 ft3 to 1600 ft3, based on 2/13 telecon Revised RAI response and letter to typing 5/19/97. rkn In mgt review 5/22. Letter finished 5/28 (DCP/NRC0880). Statused Closed. rkn 6/2/97	Nydes/Corletti/Abedin	Closed	Action W	NTD-NRC-97-5146	

Total Records: 1