Nuclear Operating Company

South Texas Project Electric Generating Station P.O. Box 289 Wadsworth, Texas 77483

July 7, 2010
U7-C-STP-NRC-100155

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
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Rockville, MD 20852-2738

South Texas Project
Units 3 and 4
Docket No. PROJ0772
Responses to Request for Additional Information

Reference: Letter from Tekia Govan to Mark McBurnett, "Request for Additional Information Re: South Texas Project Nuclear Operating Company Topical Report (TR) WCAP-17116-P Revision 0, Supplement 5 – Application to the Advanced Boiling Water Reactor" (TAC No. RG0012), June 7, 2010 (ML101580249)

Attached are the 30-day responses to NRC staff questions included the reference. The responses to the following RAI questions are provided:

RAI-4	
RAI-7	RAI-28
RAI-15	RAI-30
RAI-18	RAI-31

There are no commitments in this letter.

If you have any questions, please contact me at (361) 972-7136, or Bill Mookhoek at (361) 972-7274.

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NRO

STI 32699803

I declare under penalty of perjury that the foregoing is true and correct.

Executed on 7/7/10

Scott Head
Manager, Regulatory Affairs
South Texas Project Units 3 & 4

jet

Attachments:

1. RAI-4
2. RAI-7
3. RAI-15
4. RAI-18
5. RAI-28
6. RAI-30
7. RAI-31

cc: w/o attachment except*
(paper copy)

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RAI-4

QUESTION:

Section I. D.1 of Appendix K to 10CFR50 requires that the most damaging single failure of ECCS be considered. In Section 6.4.1 of WCAP-17116-P, it is stated that the single failure for each location of break was chosen on the basis of which one results in the least transient system inventory. Results of the break spectrum analyses for ABWR as documented in WCAP-17116-P show that there is not necessarily any particular correlation between PCT and minimum system inventory (i.e., some cases with the highest PCT also have higher minimum inventory than other cases). Confirm that the single failures that were chosen for analysis do result in the highest PCT.

RESPONSE:

As stated in Section 2 of the LTR, the highest Peak Clad Temperature (PCT) occurs during the initial coast down of the Reactor Internal Pumps (RIPs) before actuation of the Emergency Core Cooling System (ECCS). Any cladding temperature excursion occurring after actuation of the ECCS did not result in a higher cladding temperature. This was true for all single failures evaluated. Therefore, there is no correlation between the single failure chosen and the resulting PCT.

RAI-7

QUESTION:

In Section 6.3.1.1 of WCAP-17116-P, it is stated that the break spectrum analysis for ABWR includes a series of double-ended guillotine and longitudinal split breaks, in compliance with I.C.1.a of Appendix K. In the text of Sections 4.5 and 4.6 of WCAP-17116-P, some of the break spectrum scenarios were double-ended guillotine breaks and the rest were not identified clearly in this respect. Specify to which class of break each of the break spectrum scenarios in Sections 4.5 and 4.6 belongs.

RESPONSE:

Table 7-1 describes the breaks considered in Section 4.5 and 4.6. The break type is specified as SEG or DEG. A single-ended guillotine (SEG) is intended to represent the situation in which the connecting pipe is completely severed, but only one end of the pipe is left connected to the reactor vessel (e.g., a break in the High Pressure Core Flooder (HPCF) injection line). Any spillage from the other end of the severed line does not impact the loss of inventory from the reactor vessel. A double-ended guillotine (DEG) is used to represent the complete severance of a pipe connected to the reactor vessel in which both ends of the pipe are connected to the reactor vessel (e.g., a break in the steam line after it isolates from the turbine).

The results of longitudinal split breaks were not reported in the LTR. However, a sensitivity study (case mslb6b) was performed for a steam line break wherein a split break was assumed to occur having the same combined break area as the comparable double-ended guillotine break (case mslb6), which is described in Section 4.5.2.1. Figure 7-1 compares the total system mass and the peak cladding temperature predicted by GOBLIN for the hot assembly. As shown, the system responses were essentially identical. This result is expected because the break flow from the reactor vessel is limited by the integral flow restrictors in the steam line nozzles and the flow returning from the intact steam lines is quickly isolated by the Main Steam Isolation Valves (MSIVs).

Table 7-1 Breaks Types Considered

Case	Break Location	Break Type	Comment
hpcf3	HPCF Line	SEG	Break location disable 1 HPCF pump
hpcf4	HPCF Line	SEG	Break location disable 1 HPCF pump
hpcf5	HPCF Line	SEG	Break location disable 1 HPCF pump
hpcf7	HPCF Line	SEG	Break location disable 1 HPCF pump
hpcf8	HPCF Line	SEG	Break location disable 1 HPCF pump
hpcf9	HPCF Line	SEG	Break location disable 1 HPCF pump
mslb6	main steam line	DEG	Break location disables RCIC turbine
mslb6a	main steam line	DEG	Break location disables RCIC turbine
mslb7	main steam line	DEG	Break location disables RCIC turbine
mslb8	main steam line	DEG	Break location disables RCIC turbine
fwlb3	feedwater line	SEG	Break location disables 1 RCIC pump
fwlb4	feedwater line	SEG	Break location disables 1 RCIC pump
fwlb5	feedwater line	SEG	Break location disables 1 RCIC pump
fwlb6	feedwater line	SEG	Break location disables 1 LPFL pump
fwlb7	feedwater line	SEG	Break location disables 1 RCIC pump
fwlb8	feedwater line	SEG	Break location disables 1 RCIC pump
fwlb9	feedwater line	SEG	Break location disables 1 RCIC pump
rhrlb3dlb	RHR suction line	DEG	Connected to bottom drain
rhrlb4dlb	RHR suction line	DEG	Connected to bottom drain
rhrlb5dlb	RHR suction line	DEG	Connected to bottom drain
rhrlb7dlb	RHR suction line	DEG	Connected to bottom drain
rhrlb8dlb	RHR suction line	DEG	Connected to bottom drain
rhrilb3	RHR injection line	SEG	Break location disables 1 LPFL
rhrilb4	RHR injection line	SEG	Break location disables 1 LPFL
dlb	drain line break	DEG	Connected to RHR suction line

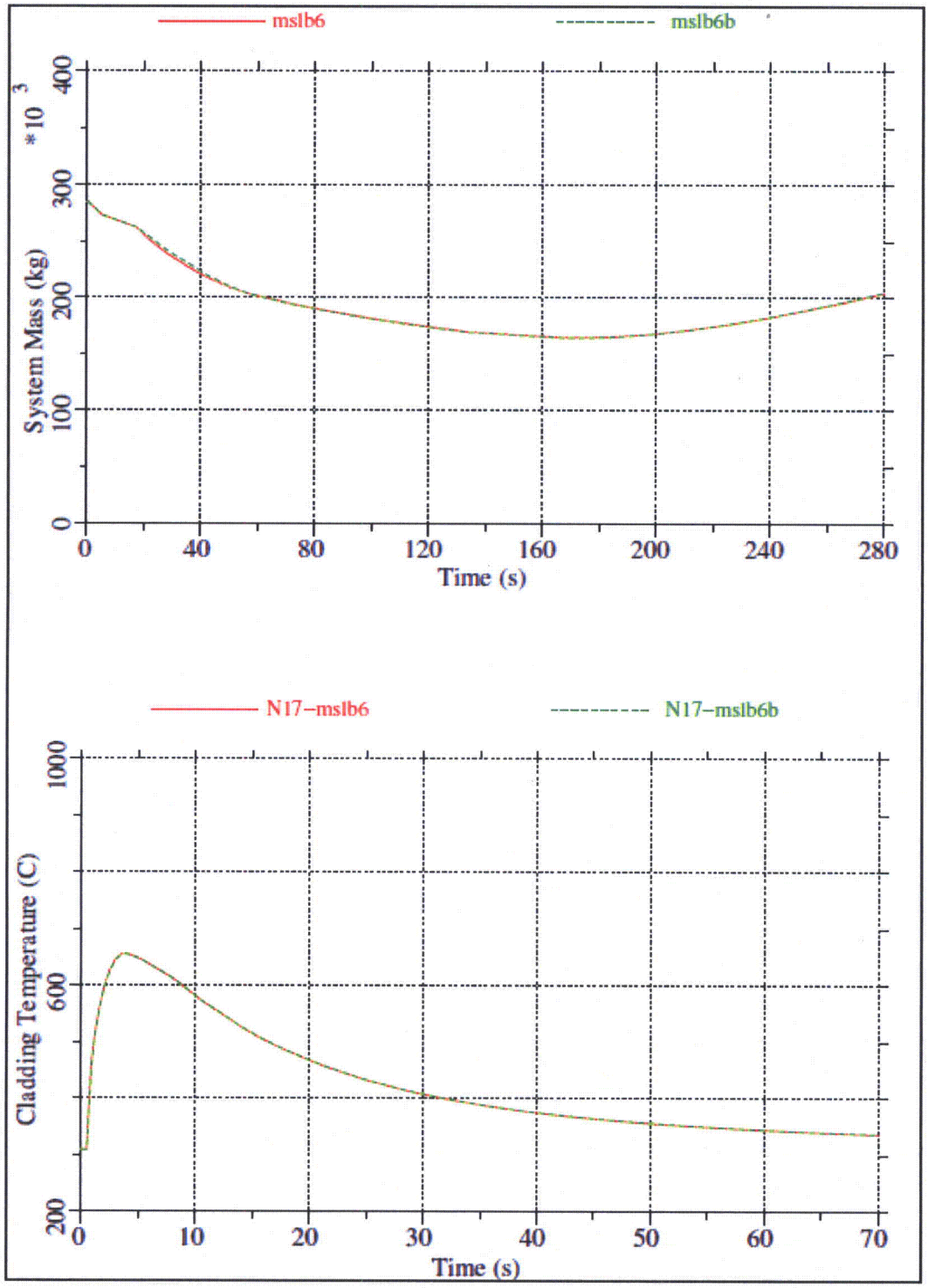

Figure 7-1 Comparison of Responses for DEG and Split of the Same Area (Steam Line Break)

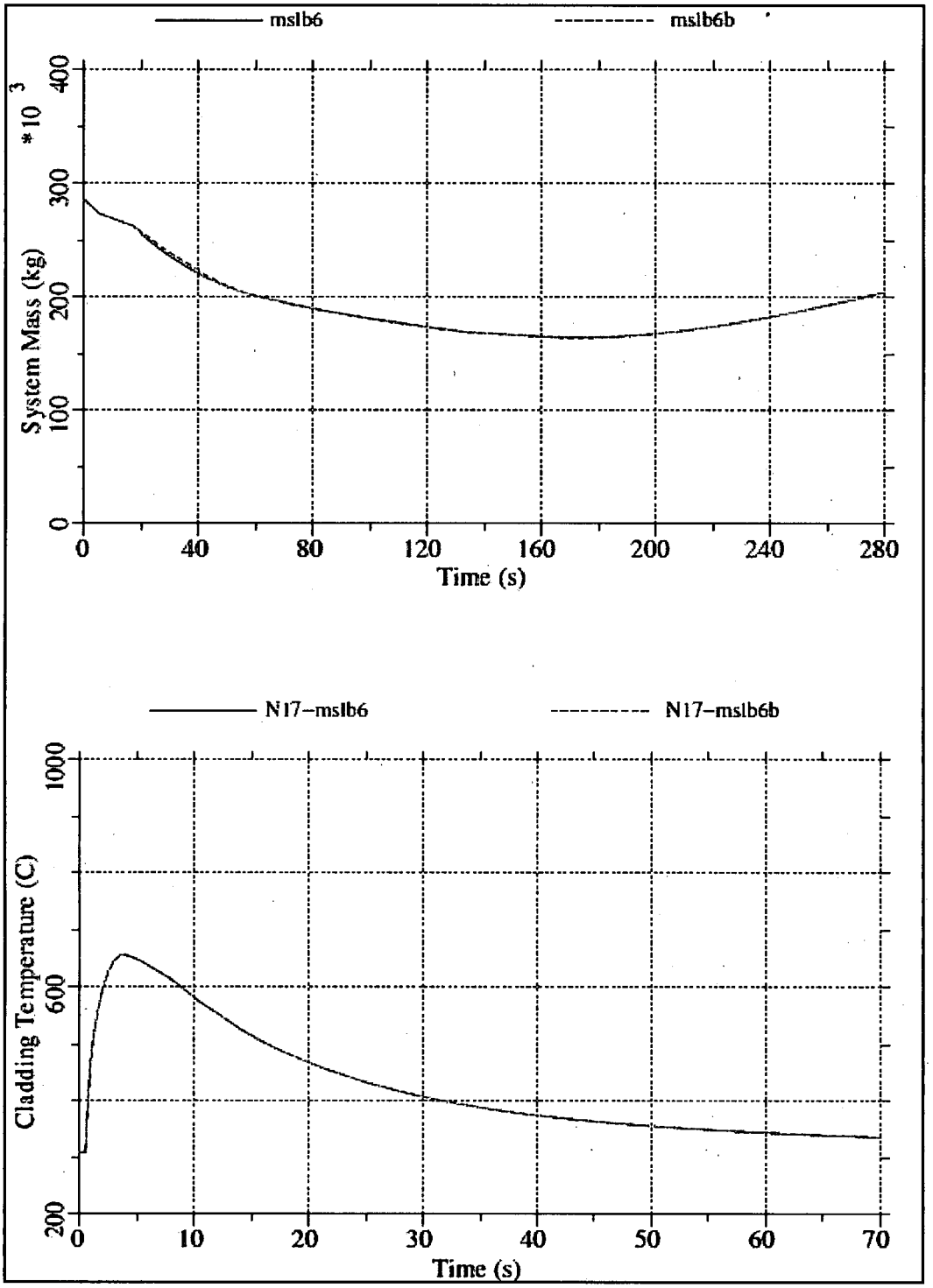

Figure 7-1 Comparison of Responses for DEG and Split of the Same Area (Steam Line Break)

RAI-15

QUESTION:

The ADS is comprised of eight safety relief valves (SRVs) with a rated flow capacity of 220 lbs/sec at a rated pressure of 1140 psid. Actuation of the ADS will remove mass and energy from the system. To ensure a correct understanding of the analysis calculation framework for the input parameters, the following information would be useful:

a) When ADS is assumed to be activated, is it correct to assume that flow is removed from the Steam Dome (node volume 1, 1) at the node enthalpy?

b) Is it correct to assume that the flow through the ADS is a linear function of differential pressure; 0 flow at 0 psid, and 1,763.7 lbs/second at 1140 psid?

RESPONSE:

a) The Automatic Depressurization System (ADS) valves are not connected to the steam dome. The ADS valves are located in the steam line upstream of the first MSIV. As shown in Figure 4-3, the four steam lines are represented by two lines in the ABWR evaluation model. One line represents a single steam line, which would contain a break (sub-volumes 9,2 and 9,3). The other line represents the 3 steam lines (sub-volumes 13,2 and 13,3). Six of the eight ADS valves are connected to sub-volume 13,2 and two are connected to sub-volume 9,2.

b) It is not correct to assume the flow through the ADS depends on differential pressure. The flow through the ADS valves is determined by a critical flow model, which is dependent on upstream stagnation conditions.

RAI-18

QUESTION:

As noted in Section 4.2 of WCAP-17116-P, the ECCS system activation signals are initiated based on the RPV water level.

a) Describe how the water level used for the generation of ECCS system activation signal is calculated. Which water level is used for the ECCS activation (i.e., two-phase mixture level or the collapsed water level)?

b) Which RPV control volume water level is used for the generation of ECCS actuation signals?

c) Discuss the effects of activation or deactivation of the two-phase level tracking model in the RPV control volumes on initiation of ECCS system.

RESPONSE:

a) The ECCS is activated by indications from the wide-range water level instrumentation, which measures the pressure drop between two elevations. As such, a collapsed water level is used to actuate the ECCS.

b) The pressure taps for the wide range level instrumentation are located at 16.342 m and 8.978 m. The higher tap is located in sub-volume 1,1; the lower tap is located in sub-volume 2.4 as described in Figure 4-3.

c) The two-phase level tracking model has no effect on initiation of the ECCS system.

RAI-28

QUESTION:

WCAP-17116-P states that "[t]he GOBLIN code has what is referred to as the 'DRAGON' option that can be driven by boundary conditions supplied by the GOBLIN system analysis calculation."

What is the relevance of 'DRAGON' option to the ABWR LOCA analysis?

RESPONSE:

The DRAGON option of GOBLIN was not used in the ABWR LOCA analysis.

RAI-30

QUESTION:

Is the void fraction shown in Figure 4-6 the void fraction in upper plenum fluid node 5, 1, 5, 2, 5, 3 or some combination of these nodes?

RESPONSE:

The average void fraction in the upper plenum shown in Figure 4-6 of the LTR is the average for all upper plenum nodes. It was calculated by determining the quantity 1 minus the volume fraction of water in upper plenum as shown in the following expression:

$$\overline{\alpha} = 1 - \frac{\sum m(i) \times (1 - x(i)) \times v_f(i)}{V_{total}}$$

where m is the total mass in each sub-volume, x is the quality of fluid in each sub-volume, v_f is the specific volume of liquid in each sub-volume and V_{total} is the total volume of the upper plenum.

RAI-31

QUESTION:

Regarding the break flow in Figure 4-8, is the flow through the ADS included in this figure?

RESPONSE:

Figure 4-8 shows the total leakage from the upper plenum, which includes the flow through the broken HPCF line, and the flow out of the steam lines. The flow out of the steam lines includes any flow that would go to the Safety Relief Valves (SRVs) and the ADS.