AREVA

June 6, 2012
NRC:12:036

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Response to U.S. EPR Design Certification Application RAI No. 515, Supplement 4

Ref. 1: E-mail, Getachew Tesfaye (NRC) to Dennis Williford (AREVA NP Inc.), "U.S. EPR Design Certification Application RAI No. 515 (6041, 6061), FSAR Ch. 6," September 29, 2011.

Ref. 2: E-mail, Dennis Williford (AREVA NP Inc.) to Getachew Tesfaye (NRC), "Response to U.S. EPR Design Certification Application RAI No. 515 (6041, 6061), FSAR Ch. 6," October 27, 2011.

Ref. 3: E-mail, Dennis Williford (AREVA NP Inc.) to Getachew Tesfaye (NRC), "Response to U.S. EPR Design Certification Application RAI No. 515 (6041, 6061), FSAR Ch. 6, Supplement 1," December 14, 2011.

Ref. 4: E-mail, Dennis Williford (AREVA NP Inc.) to Getachew Tesfaye (NRC), "Response to U.S. EPR Design Certification Application RAI No. 515 (6041, 6061), FSAR Ch. 6, Supplement 2," January 23, 2012.

Ref. 5: E-mail, Dennis Williford (AREVA NP Inc.) to Getachew Tesfaye (NRC), "Response to U.S. EPR Design Certification Application RAI No. 515 (6041, 6061), FSAR Ch. 6, Supplement 3," April 2, 2012.

In Reference 1, the NRC provided a request for additional information (RAI) regarding the U.S. EPR design certification application. Reference 2 through Reference 4 provided schedules for responding to the two questions in RAI 515. Reference 5 provided a technically correct and complete response to one of the two questions in RAI 515.

The enclosure to this letter provides a technically correct and complete final response to the remaining question (Question 06.02.01-103). AREVA NP Inc. (AREVA NP) considers some of the material contained in the enclosed response to Question 06.02.01-103 to be proprietary. As required by 10 CFR 2.390(b), an affidavit is enclosed to support the withholding of the information from public disclosure. Proprietary and non-proprietary versions of the enclosure to this letter are provided.

The following table indicates the respective pages in the enclosure that contain AREVA NP's final response to the subject question.

Question #	Start Page	End Page
RAI 515 — 06.02.01-103	2	12

This concludes the formal AREVA NP response to RAI 515, and there are no questions from this RAI for which AREVA NP has not provided responses.

D077
NRO

AREVA INC.
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Tel.: 434 832 3000 www.areva.com

If you have any questions related to this submittal, please contact Mr. Darrell Gardner by telephone at 704-805-2355, or by e-mail to darrell.gardner@areva.com.

Sincerely,

Pedro Salas, Director
Regulatory Affairs
AREVA NP Inc.

Enclosures

cc: G. Tesfaye
Docket No. 52-020

AFFIDAVIT

COMMONWEALTH OF VIRGINIA)
) ss.
COUNTY OF CAMPBELL)

1. My name is Gayle F. Elliott. I am Manager, Product Licensing, for AREVA NP Inc. (AREVA NP) and as such I am authorized to execute this Affidavit.

2. I am familiar with the criteria applied by AREVA NP to determine whether certain AREVA NP information is proprietary. I am familiar with the policies established by AREVA NP to ensure the proper application of these criteria.

3. I am familiar with the AREVA NP information contained in letter NRC:12:036, "Response to U.S. EPR Design Certification Application RAI No. 515, Supplement 4," and referred to herein as "Document." Information contained in this Document has been classified by AREVA NP as proprietary in accordance with the policies established by AREVA NP for the control and protection of proprietary and confidential information.

4. This Document contains information of a proprietary and confidential nature and is of the type customarily held in confidence by AREVA NP and not made available to the public. Based on my experience, I am aware that other companies regard information of the kind contained in this Document as proprietary and confidential.

5. This Document has been made available to the U.S. Nuclear Regulatory Commission in confidence with the request that the information contained in this Document be withheld from public disclosure. The request for withholding of proprietary information is made in accordance with 10 CFR 2.390. The information for which withholding from disclosure is

requested qualifies under 10 CFR 2.390(a)(4) "Trade secrets and commercial or financial information":

6. The following criteria are customarily applied by AREVA NP to determine whether information should be classified as proprietary:

(a) The information reveals details of AREVA NP's research and development plans and programs or their results.

(b) Use of the information by a competitor would permit the competitor to significantly reduce its expenditures, in time or resources, to design, produce, or market a similar product or service.

(c) The information includes test data or analytical techniques concerning a process, methodology, or component, the application of which results in a competitive advantage for AREVA NP.

(d) The information reveals certain distinguishing aspects of a process, methodology, or component, the exclusive use of which provides a competitive advantage for AREVA NP in product optimization or marketability.

(e) The information is vital to a competitive advantage held by AREVA NP, would be helpful to competitors to AREVA NP, and would likely cause substantial harm to the competitive position of AREVA NP.

The information in the Document is considered proprietary for the reasons set forth in paragraph 6(d) above.

7. In accordance with AREVA NP's policies governing the protection and control of information, proprietary information contained in this Document has been made available, on a limited basis, to others outside AREVA NP only as required and under suitable agreement providing for nondisclosure and limited use of the information.

8. AREVA NP policy requires that proprietary information be kept in a secured file or area and distributed on a need-to-know basis.

9. The foregoing statements are true and correct to the best of my knowledge, information, and belief.

SUBSCRIBED before me this 6th

day of June 2012.

Kathleen A. Bennett
NOTARY PUBLIC, COMMONWEALTH OF VIRGINIA
MY COMMISSION EXPIRES: 8/31/2015
Reg. #110864

KATHLEEN ANN BENNETT
Notary Public
Commonwealth of Virginia
110864
My Commission Expires Aug 31, 2015

Response to

Request for Additional Information No. 515, Supplement 4

9/29/2011

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 06.02.05 - Combustible Gas Control in Containment
SRP Section: 06.02.01 - Containment Functional Design

Application Section: chapter 6

QUESTIONS for Containment and Ventilation Branch 1 (AP1000/EPR Projects) (SPCV)

Question 06.02.01-103:

OPEN ITEM

Follow-up to RAI 437 Question 06.02.01-97

In RAI 437 Question 06.02.01-97, the staff requested AREVA to provide evaluations for the first 1200 seconds for DEG-CLPS break and for the first 3600 seconds for a DEG-CLPD break. The Supplement 6 response only provided the evaluation up to 100 seconds for both breaks while the non-condensable gas mass fraction continuously increases at 100 seconds. The response needs to be expanded up to the first 1200 seconds for DEG-CLPS break and for the first 3600 seconds for a DEG-CLPD break. Provide evaluations of the impact on containment pressure and temperature when the non-condensable gases were ingested into the reactor system during these time periods.

Response to Question 06.02.01-103:

The U.S. EPR containment large break loss of coolant accident (LBLOCA) methodology uses a high reverse flow resistance (K=1.5E10) that eliminates potential reverse flows at the break junctions in the RELAP5/MOD2-BW model as demonstrated in Figure 06.02.01-103-1 and Figure 06.02.01-103-1 which shows the mass flow rate is never negative. Sensitivity studies were performed using a nominal reverse flow resistance (K=1.5) to quantify the potential impacts of applying a high reverse break flow resistance for postulated cold-leg breaks at the suction and discharge leg of reactor coolant pump.

Sensitivity results from RELAP5/MOD2-BW calculations showed that small reverse steam break flow spikes occurred mostly on the reactor vessel-side (RV-side) at the end of blowdown phase and occasionally during the post-reflood phase. Figure 06.02.01-103-1 and Figure 06.02.01-103-2 compare the RV-side steam break mass flow rates between a nominal reverse flow resistance (K=1.5) case and a high reverse flow resistance (K=1.5E10) case for the DEG-CLPS and DEG-CLPD scenario, respectively. Figure 06.02.01-103-3 and Figure 06.02.01-103-4 compare the steam generator-side (SG-side) steam break mass flow rates between the two cases.

Figure 06.02.01-103-5 and Figure 06.02.01-103-6 compare the RV-side liquid break mass flow rates for the DEG-CLPS and DEG-CLPD scenarios, respectively. The large spike in mass flow rate at approximately 3500 seconds is the result of water packing in one of the RELAP5/MOD2-B&W control volumes. In the absence of forced flow, water packing tends to occur in RELAP5/MOD2-B&W as the break control volumes approach the containment pressure. These instantaneous spikes are included in the total mass flow rate that is applied as a boundary condition to the GOTHIC cases in this study.

[

] Instead, in order to demonstrate the magnitude and maximum impact of the reverse flow on containment peak pressure response, the instantaneous break release flow rates are presented here. Figure 06.02.01-103-7 and Figure 06.02.01-103-8

compare the SG-side liquid break mass flow rates for the two scenarios. As shown, there was no reverse liquid break flow in either scenario.

The fraction of non-condensables in the containment dome, or accessible space, calculated by GOTHIC was found to be less than two percent during the refill/reflood phase and then increased to around 35 and 45 percent for the DEG-CLPS and DEG-CLPD cases, respectively, as shown in Figure 06.02.01-103-9 and Figure 06.02.01-103-10 for the RV-side, and Figure 06.02.01-103-11 and Figure 06.02.01-103-12 for the SG-side.

Table 06.02.01-103-1 compares the GOTHIC containment dome blowdown peak pressure and vapor temperature results for the DEG-CLPS sensitivity cases. The table shows results from the nominal resistance case showed practically no change (-0.03 psi) in the peak containment pressure and a slightly lower peak temperature (-0.07°F) as compared to those of the high resistance case. At the end of 1200 seconds, both pressure and temperature were slightly lower for the nominal resistance case, (-0.56 psi) and (-0.38°F), respectively. The containment dome pressure and vapor temperature responses during the 1200-second time period are shown in Figure 06.02.01-103-13 and Figure 06.02.01-103-14, respectively.

Table 06.02.01-103-2 compares the GOTHIC containment dome blowdown peak pressure and vapor temperature results for the DEG-CLPD sensitivity cases. The table shows results from the nominal resistance case showed a small increase in peak pressure (+0.8 psi) and a slight increase in peak vapor temperature (+0.07°F) as compared to those of the high resistance case. At the end of 3600 seconds for the nominal resistance case, both peak pressure and vapor temperature were slightly lower, (-0.4 psi) and (-0.13°F), respectively. The pressure and temperature responses during the 3600 second time period are shown in Figure 06.02.01-103-15 and Figure 06.02.01-103-16, respectively.

Results from the sensitivity study show that using a nominal flow resistance (K=1.5) at the break with RELAP5/MOD2-BW allows ingestion of steam into the RCS during steam break flow reversal. However, any potential ingestion of non-condensables would be small and have only minimal impacts on the containment dome blowdown peak pressure (less than ±1 psi or ±1.2 percent) and temperature (less than ±0.5 °F or ±0.2 percent).

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question.

Table 06.02.01-103-1—DEG-CLPS Containment Dome Pressure and Vapor Temperature Comparisons

Case	Blowdown Peak Pressure (psia)	Blowdown Peak Temperature (°F)	Pressure (psia) at 1200 sec.	Temperature (°F) at 1200 sec.
K=1.5 E10	64.82	304.28	61.00	278.52
K=1.5	64.79	304.21	60.45	278.14
Delta[(1)] (%)[(2)]	-0.03 (-0.05%)	-0.07 (-0.02%)	-0.56 (-0.92%)	-0.38 (-0.14%)

1. Delta = nominal resistance – high resistance; or value (K=1.5) – value (K=1.5 E10).
2. % = (value (K=1.5) – value (K=1.5 E10))/ value (K=1.5 E10) %

Table 06.02.01-103-2—DEG-CLPD Containment Dome Pressure and Vapor Temperature Comparisons

Case	Blowdown Peak Pressure (psia)	Blowdown Peak Temperature (°F)	Pressure (psia) at 3600 sec.	Temperature (°F) at 3600 sec.
K=1.5 E10	67.53	316.79	66.56	275.86
K=1.5	68.33	316.86	66.16	275.73
delta[(1)] (%)[(2)]	+0.80 (+1.18%)	+0.07 (+0.02%)	-0.40 (-0.06%)	-0.13 (-0.05%)

1. Delta = nominal resistance – high resistance; or value (K=1.5) – value (K=1.5 E10)
2. % = (value (K=1.5) – value (K=1.5 E10))/ value (K=1.5 E10) %

Figure 06.02.01-103-1—DEG-CLPS RV-Side Steam Mass Flow Rates

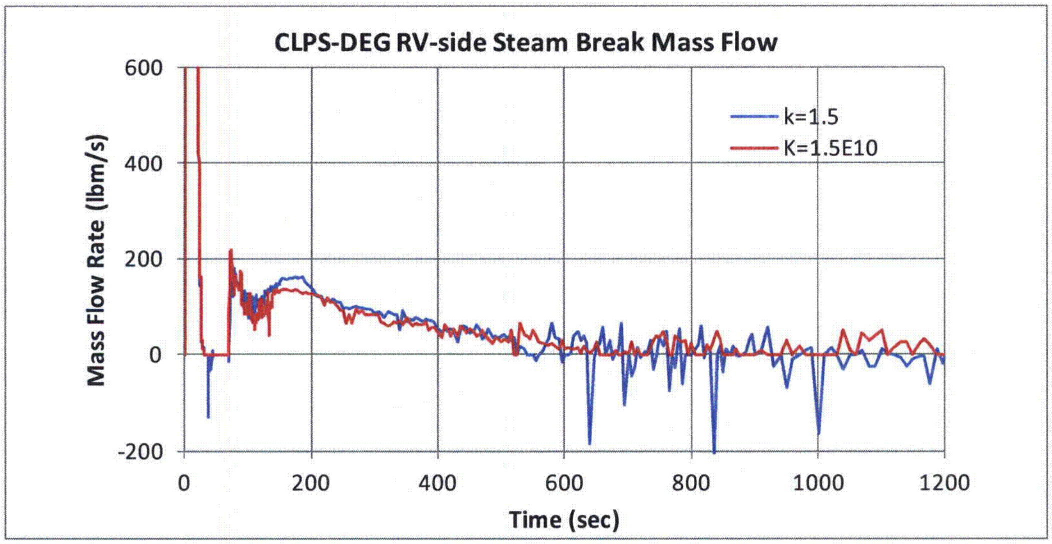

Figure 06.02.01-103-2—DEG-CLPD RV-Side Steam Mass Flow Rates

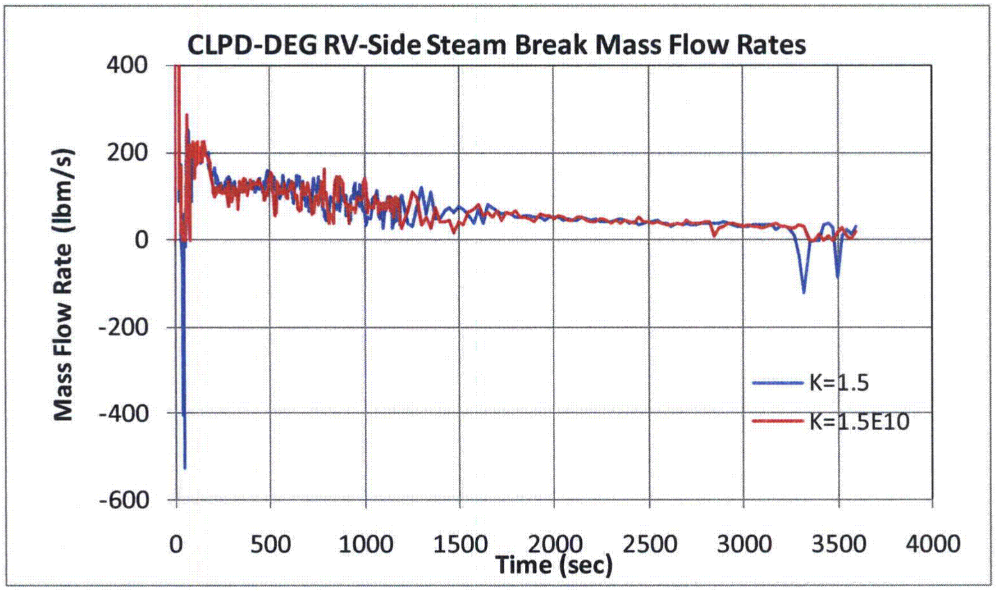

Figure 06.02.01-103-3—DEG-CLPS SG-Side Steam Mass Flow Rates

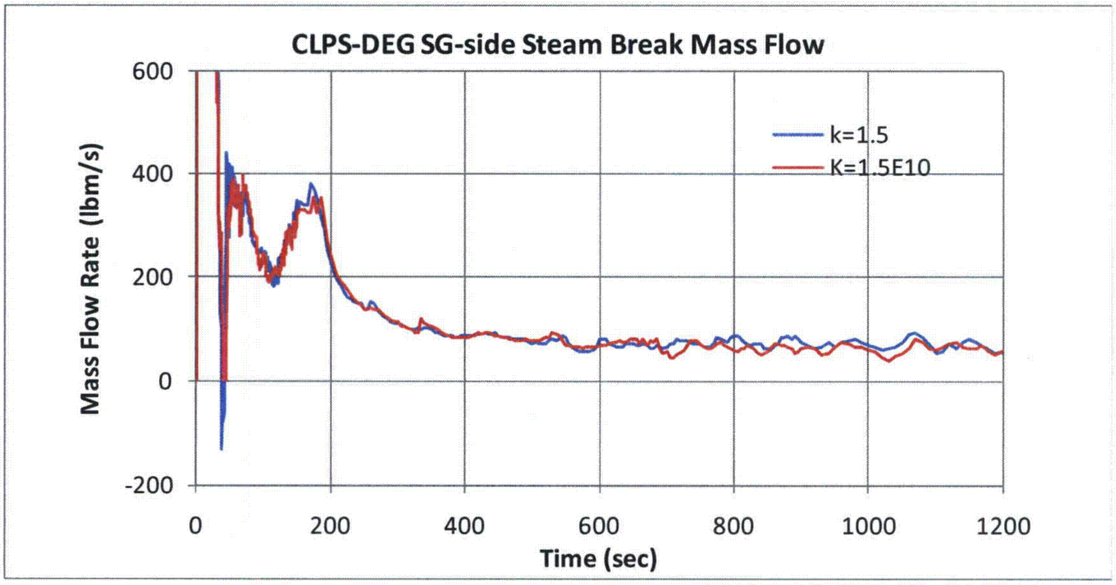

Figure 06.02.01-103-4—DEG-CLPD SG-Side Steam Mass Flow Rates

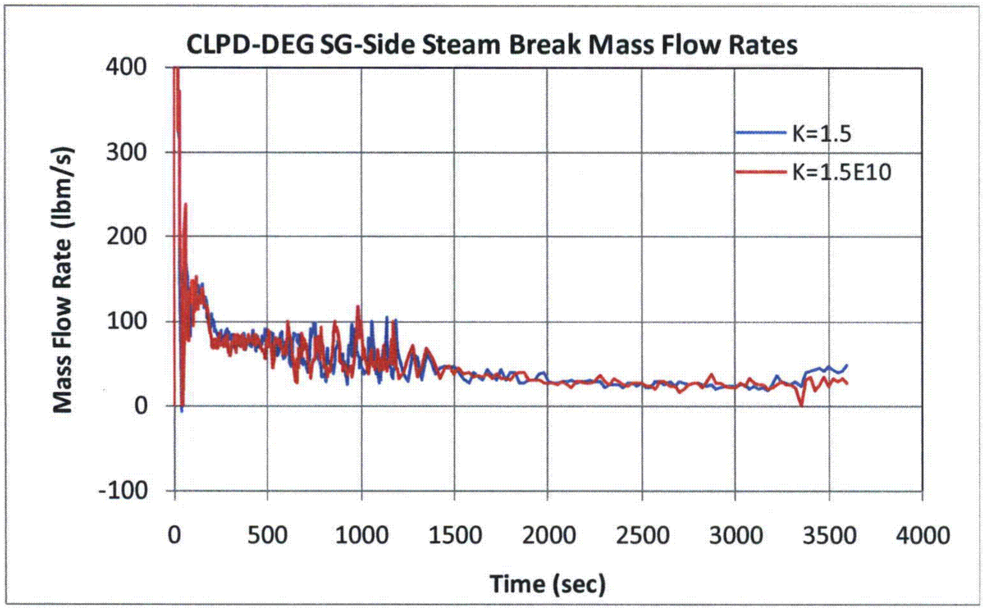

Figure 06.02.01-103-5—DEG-CLPS RV-Side Liquid Mass Flow Rates

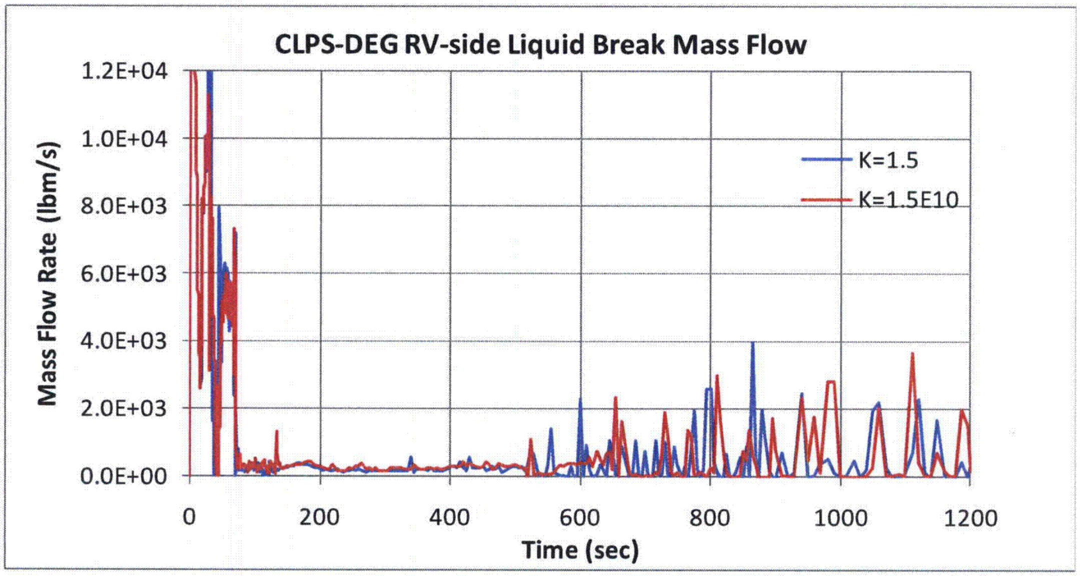

Figure 06.02.01-103-6—DEG-CLPD RV-Side Liquid Mass Flow Rates

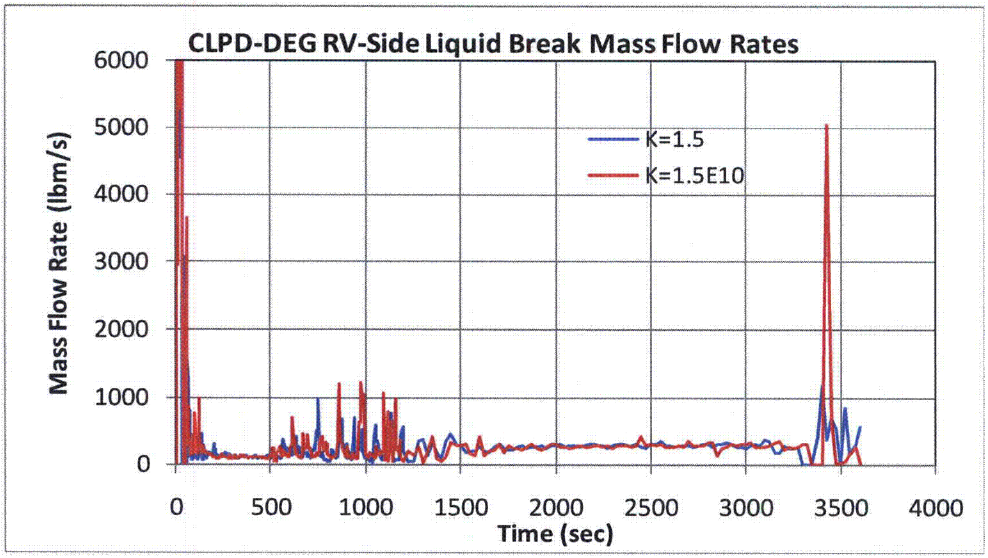

Figure 06.02.01-103-7—DEG-CLPS SG-Side Liquid Mass Flow Rates

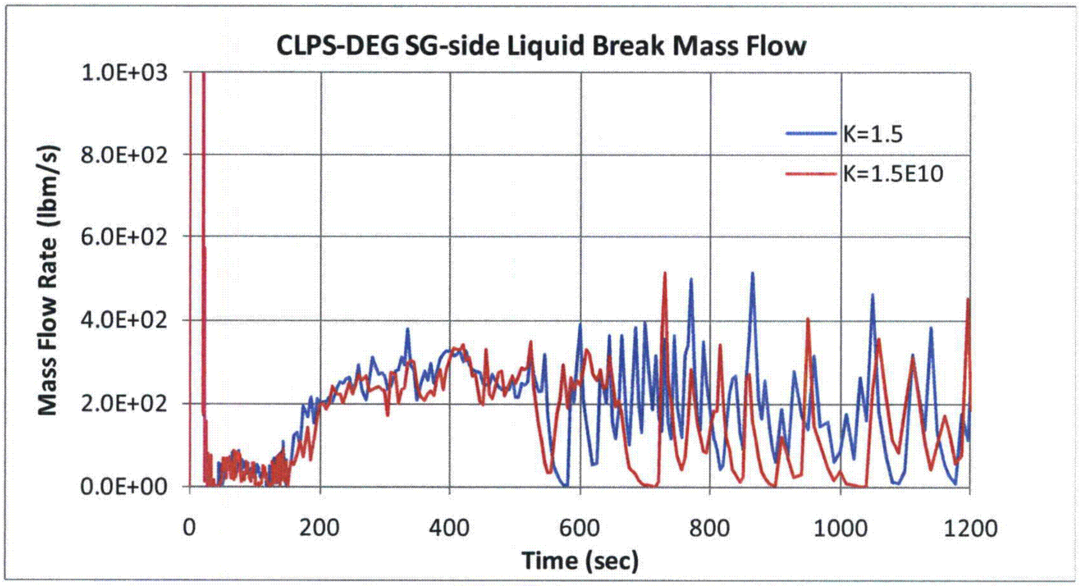

Figure 06.02.01-103-8—DEG-CLPD SG-Side Liquid Mass Flow Rates

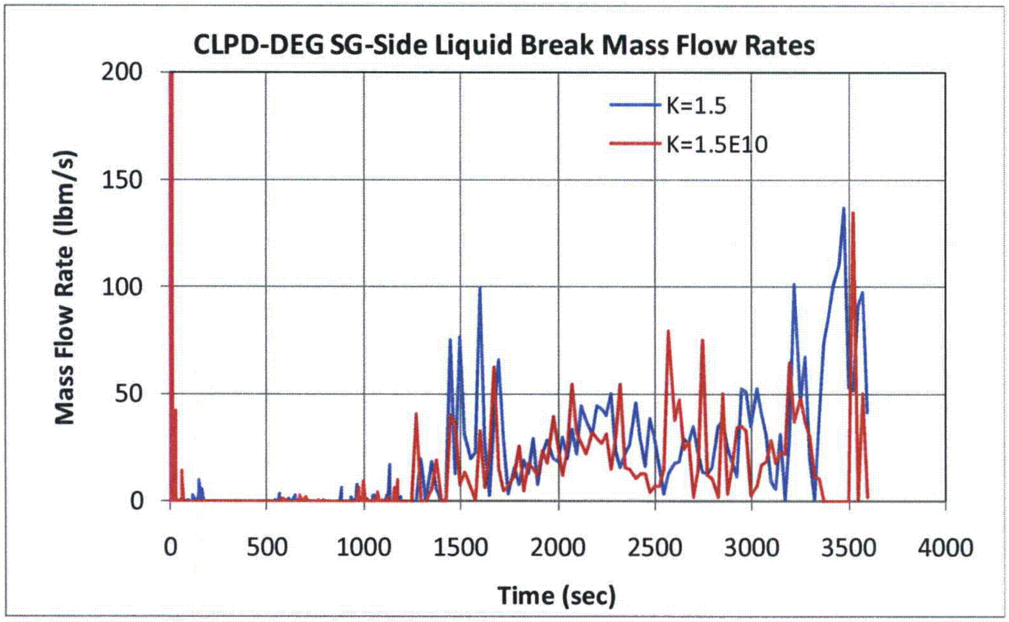

Figure 06.02.01-103-9—DEG-CLPS RV-Side Steam Flow vs. Gas Fractions (K=1.5)

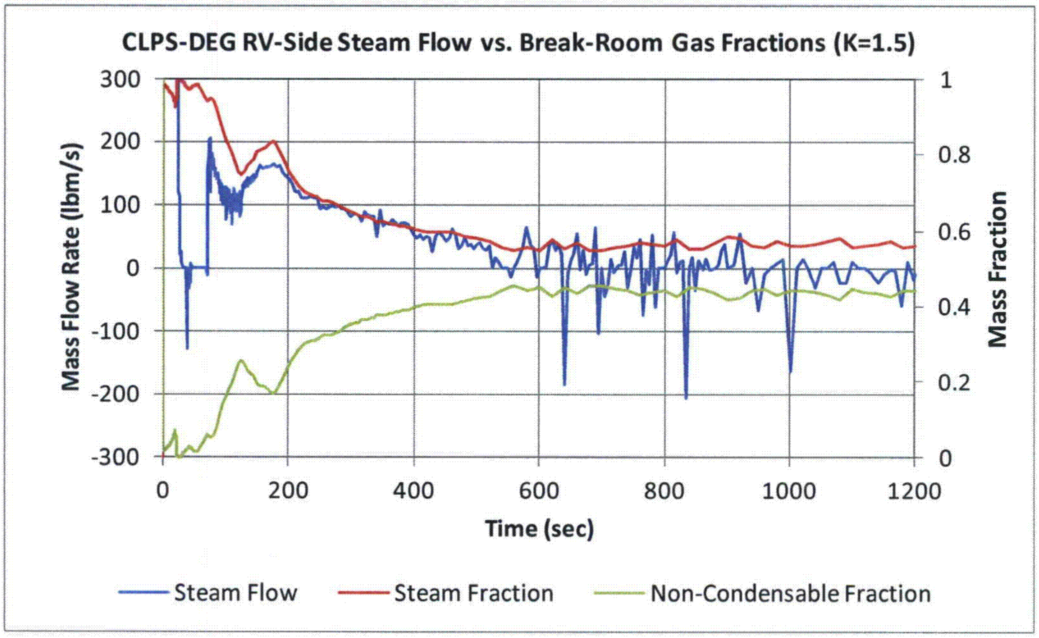

Figure 06.02.01-103-10—DEG-CLPD RV-Side Steam Flow vs. Gas Fractions (K=1.5)

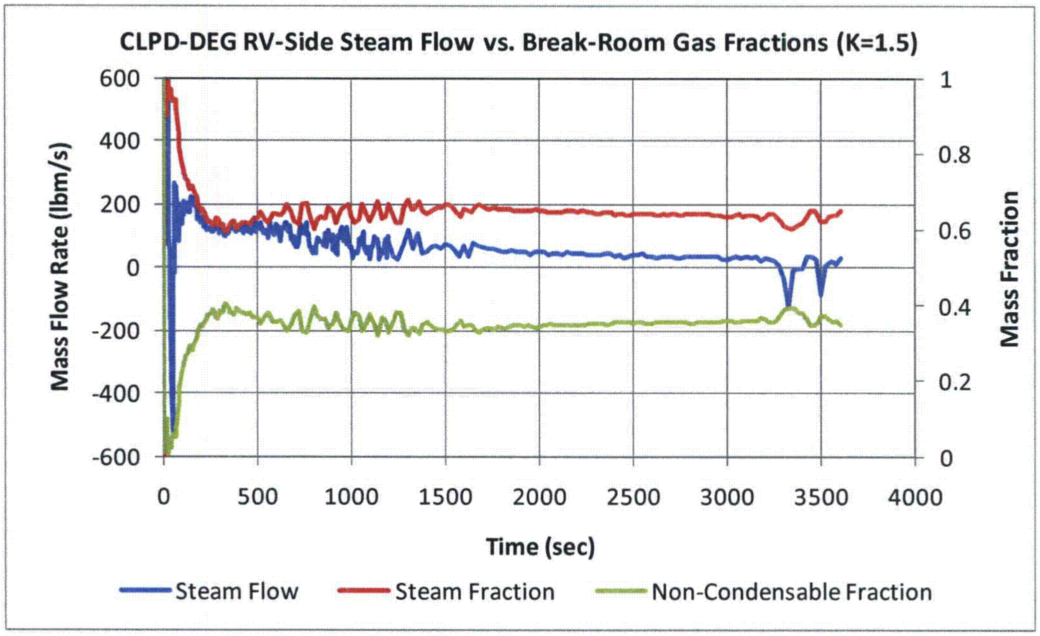

Figure 06.02.01-103-11—DEG-CLPS SG-Side Steam Flow vs. Gas Fractions (K=1.5)

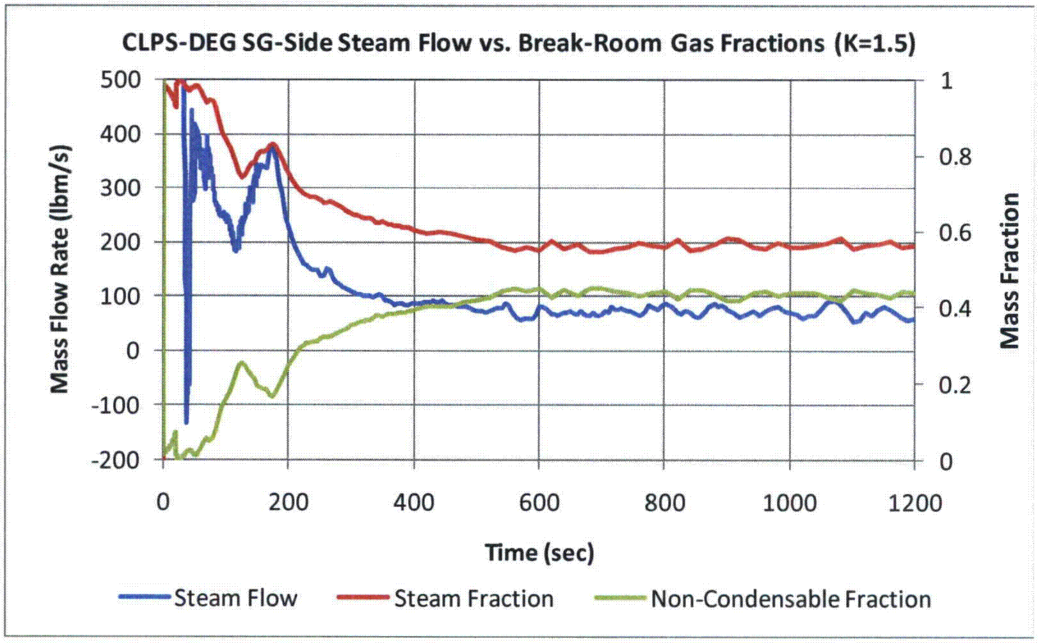

Figure 06.02.01-103-12—DEG-CLPD SG-Side Steam Flow vs. Gas Fractions (K=1.5)

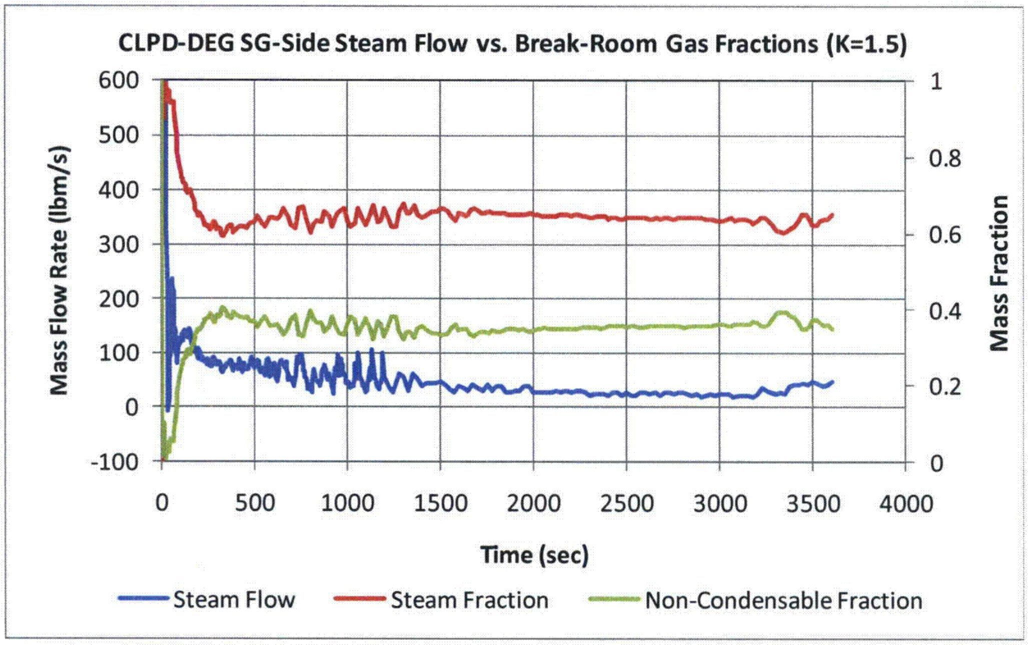

Figure 06.02.01-103-13—DEG-CLPS Containment Dome Peak Pressures

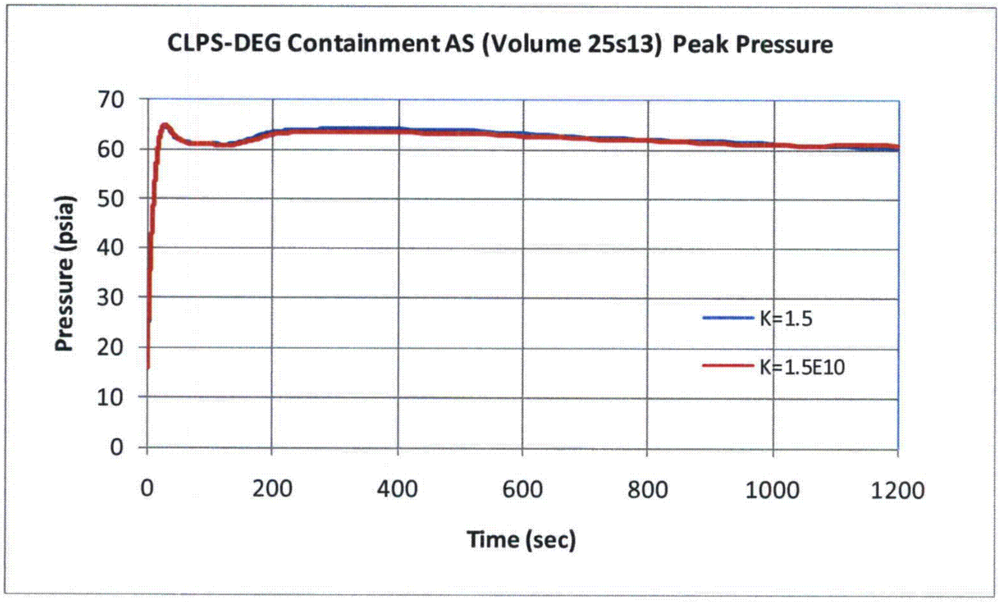

Figure 06.02.01-103-14—DEG-CLPS Containment Dome Peak Temperatures

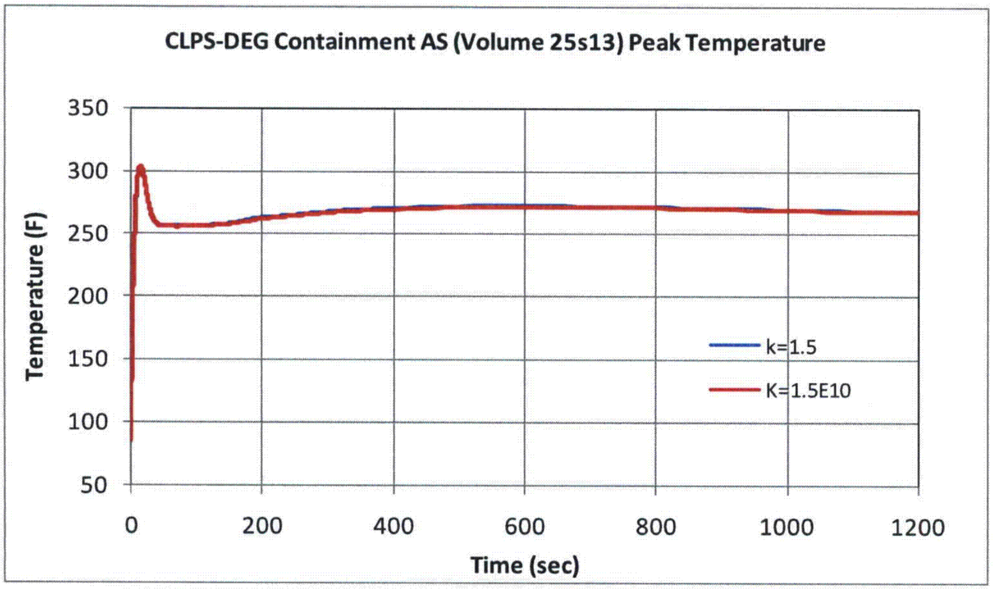

Figure 06.02.01-103-15—DEG-CLPD Containment Dome Peak Pressures

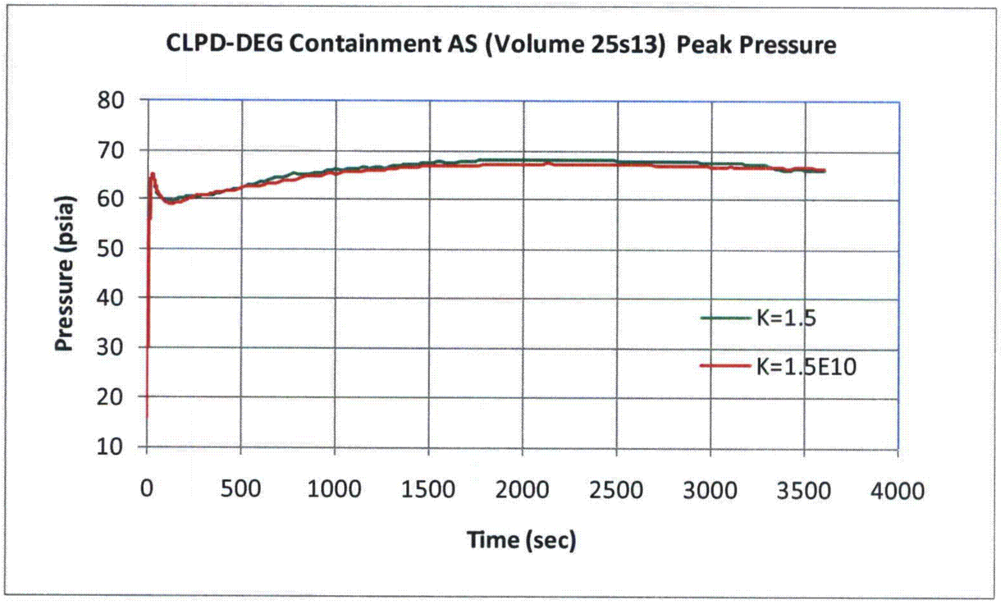

Figure 06.02.01-103-16—DEG-CLPD Containment Dome Peak Temperatures