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Your ref: Project Number 740  
Our ref: DCP/NRC2017

October 4, 2007

Subject: AP1000 COL Response to Request for Additional Information (TR 36)

In support of Combined License application pre-application activities, Westinghouse is submitting a response to the NRC requests for additional information (RAIs) on AP1000 Standard Combined License Technical Report 36, APP-GW-GLR-016, Pressurizer Configuration Design Change. This RAI response is submitted as part of the NuStart Bellefonte COL Project (NRC Project Number 740). The information included in the response is generic and is expected to apply to all COL applications referencing the AP1000 Design Certification.

A revised response is provided for RAI-TR36-012. This revision fulfills the commitment made in the original response to perform quantitative analyses. This response completes all requests received to date for Technical Report 36. Revision 0 of RAI-TR36-012 was submitted under Westinghouse letter DCP/NRC1811 dated December 18, 2006.

Pursuant to 10 CFR 50.30(b), the response to the request for additional information on Technical Report 36, is submitted as Enclosure 1 under the attached Oath of Affirmation.

Questions or requests for additional information related to the content and preparation of these responses should be directed to Westinghouse. Please send copies of such questions or requests to the prospective applicants for combined licenses referencing the AP1000 Design Certification. A representative for each applicant is included on the cc: list of this letter.

Very truly yours,

A handwritten signature in black ink, appearing to read 'A. Sterdis'.

A. Sterdis, Manager  
Licensing and Customer Interface  
Regulatory Affairs and Standardization

DD63  
DD79  
N20

/Attachment

1. "Oath of Affirmation," dated October 4, 2007

/Enclosure

1. Response to Request for Additional Information on Technical Report No. 36

cc:	D. Jaffe	- U.S. NRC	1E	1A
	E. McKenna	- U.S. NRC	1E	1A
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	C. Pierce	- Southern Company	1E	1A
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	G. Zinke	- NuStart/Entergy	1E	1A
	P. Keegan	- Westinghouse	1E	1A

ATTACHMENT 1

“Oath of Affirmation”

ATTACHMENT 1

UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

In the Matter of: )  
NuStart Bellefonte COL Project )  
NRC Project Number 740 )

APPLICATION FOR REVIEW OF  
"AP1000 GENERAL COMBINED LICENSE INFORMATION"  
FOR COL APPLICATION PRE-APPLICATION REVIEW

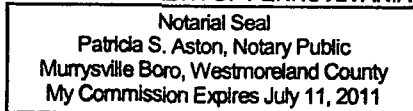
B. W. Bevilacqua, being duly sworn, states that he is Vice President, New Plants Engineering, for Westinghouse Electric Company; that he is authorized on the part of said company to sign and file with the Nuclear Regulatory Commission this document; that all statements made and matters set forth therein are true and correct to the best of his knowledge, information and belief.



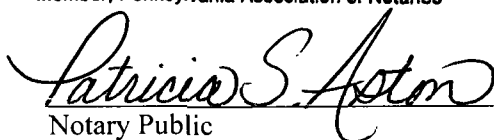
B. W. Bevilacqua  
Vice President  
New Plants Engineering

Subscribed and sworn to  
before me this *4th* day  
of October 2007.

COMMONWEALTH OF PENNSYLVANIA



Member, Pennsylvania Association of Notaries



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ENCLOSURE 1

Response to Request for Additional Information on Technical Report No. 36

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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RAI Response Number: RAI-TR36-012

Revision: 1

### **Question:**

In the request for additional information (RAI) response in the Enclosure I to September 22, 2006 letter, Westinghouse qualitatively discussed the effects of the pressurizer design changes on the depressurization and Automatic Depressurization System (ADS) flow rates, and categorically stated the chapter 15 analysis remains valid and bounding.

The pressurizer changes affect many parameters such as the cross-sectional area of the pressurizer, pressurizer vessel height, initial pressurizer water level, pressurizer setpoints, ADS stages 1, 2, and 3 elevation and pressurizer heater length. We are concerned about the combined effects of the values changed for the above parameters on the thermal hydraulic response during transient and accident conditions. We determined that the qualitative statement in the RAI response is not sufficient to resolve the RAI issue. We request Westinghouse perform the quantitative analyses for the limiting event for each of the following Standard Review Plan chapter 15 event categories:

- (1) increased heat removal from the primary system
- (2) decreased heat removal by the secondary system
- (3) decreased reactor coolant system flow
- (4) reactivity and power distribution anomalies
- (5) increase in reactor coolant inventory
- (6) decrease in reactor coolant inventory including loss-of-coolant accidents
- (7) anticipated transients without scram

and demonstrate that the applicable acceptance criteria for each limiting event are met or the existing analysis is bounding.

### **Westinghouse Response:**

The following presents the results of Westinghouse quantitative analyses for the limiting event for each of the above event categories using the new pressurizer dimensions and attributes. The analyses were performed using methods and computer codes previously reviewed and approved by the NRC in NUREG 1793 (Reference 1). These quantitative analyses support the previous qualitative response.

The analysis results are presented in this response in the following sequence: 1, 2, 3, 4, 5, 7, and 6. Results for Items 6 and 7 are reversed to present all LOCA-related analyses together.

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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The limiting events for each of the above Standard Review Plan Chapter 15 event categories are as follows:

<u>Standard Review Plan Event Categories</u>	<u>Updated Limiting Event Analyses</u>
1 increased heat removal from the primary system	full double ended steam line rupture (DCD Section 15.1.5)
2 decreased heat removal by the secondary system	loss of steam load or turbine trip (DCD Section 15.2.3)
3 decreased reactor coolant system flow	complete loss of forced reactor coolant flow (i.e. four of four reactor coolant pumps coasting down) (DCD Section 15.3.2)
4 reactivity and power distribution anomalies	uncontrolled RCCA bank withdrawal at power (DCD Section 15.4.2)
5 increase in reactor coolant inventory	inadvertent operation of the chemical and volume control system (DCD Section 15.5.2)
7 anticipated transients without scram (ATWS)	complete loss of normal feedwater without scram
6 decrease in reactor coolant inventory including loss-of-coolant accidents	Best Estimate Large Break LOCA, Long Term Cooling (LTC) LOCA, and Small Break LOCA.

The following provides the results for each of these limiting events. The results show that the applicable acceptance criteria for each limiting event are met or the existing analysis is bounding.

### 1. Full Double Ended Steam Line Rupture

A full double ended steam line rupture analysis from hot zero power conditions was performed for the updated AP1000 configuration. A comparison of the results from the updated analysis to those of the analysis for the original AP1000 configuration is shown in Figures 1-1 through 1-10. Table 1-1 provides the sequence of events for the original and the updated AP1000 configuration.

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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The transients results of the updated plant configuration during a steam line break are very similar to those of the original plant configuration. Core state parameters (inlet temperature, pressure, flow) remain essentially the same. The return to criticality occurs at essentially the same time in the updated AP1000 configuration. Following the return to criticality, the core power is slightly less for the updated AP1000 (see Figures 1-1 and 1-2). Early core makeup tank flow is slightly improved with the updated AP1000 plant configuration which yields a slightly lower core power. Based on these results, the existing steam line break analysis is bounding for the updated AP1000 plant configuration.

### 2. Loss of Steam Load or Turbine Trip

A turbine trip analysis for the updated AP1000 configuration was performed. A total of eight cases were analyzed. Cases were analyzed for minimum and maximum reactivity feedback, with and without the pressurizer pressure control system operable and with and without offsite power.

The most limiting case with respect to maximizing reactor coolant pressure occurs without the pressurizer pressure control system available, with minimum reactivity feedback and without offsite power available. Results for this case are shown in Figures 2-1 through 2-6. A sequence of events for this case is provided in Table 2-1 and is identified as Case C.2. The maximum reactor coolant pressure for the updated AP1000 configuration is 2642.36 psia [182.2 bar] as compared to 2693.65 psia [185.7 bar] in the original AP1000 plant configuration. The over pressurization results are less severe for the updated AP1000 plant.

The most limiting case with respect to minimizing the core DNB ratio is the case with the pressurizer pressure control system available, with minimum reactivity feedback and without offsite power available. Results for the limiting DNB ratio case are shown in Figures 2-7 through 2-12. A sequence of events is provided in Table 2-1 and is identified as Case A.2. The minimum DNB ratio for the updated AP1000 is 1.589 as compared to a value of 1.57 for the original AP1000 plant configuration. The existing turbine trip analysis is bounding for the updated AP1000 configuration.

### 3. Complete Loss of Forced Reactor Coolant Flow

A complete loss of reactor coolant flow analysis due to the simultaneous loss of electrical power to four reactor coolant pumps was performed. Following the loss of power to the reactor coolant pumps, a reactor trip is actuated by the reactor coolant pump underspeed function.

Results from the analysis for the updated AP1000 configuration are shown in Figures 3-1 through 3-7. A sequence of events for the analysis is summarized in Table 3-1. Also included with these results are analysis results for the AP1000 configuration in Revision 15 of the DCD.



# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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With the updated AP1000 configuration, the results have improved slightly. This is principally due to a slight increase in the reactor coolant pump inertia when compared to the previous DCD analysis. The increased inertia, which is consistent with the AP1000 ITAACs, results in a slightly slower reactor coolant pump coast down (see Figure 3-1). With a slower reactor coolant pump coast down, the time of reactor trip is delayed slightly. However at the time of minimum DNBR, reactor coolant flow is slightly higher and minimum DNBR is higher. The DNBR safety analysis limit is 1.5. The original AP1000 configuration had a minimum DNBR of 1.505 for the complete loss of flow. The updated AP1000 configuration results in a minimum DNBR of 1.510. The existing complete loss of reactor coolant flow analysis is bounding for the current AP1000 configuration.

#### 4. Uncontrolled RCCA Bank Withdrawal at Power

Quantitative analyses of the RCCA bank withdrawal event were performed using the updated AP1000 configuration. The analyses were performed at full power and with a spectrum of part power initial conditions. Cases were performed for minimum and maximum reactivity feedback to bound the expected core conditions.

The new analyses incorporated the reconfigured Overtemperature  $\Delta T$  (OTDT) reactor trip function (see Reference 2). The OTDT reactor trip function prevents the plant from exceeding core thermal limits. As the OTDT reactor trip function was configured originally on the AP1000 and on operating Westinghouse plants, a conservative linear relationship is used in setting the setpoints of the trip function. With the improved digital OTDT trip function, setpoints can be selected to match the non-linear characteristics of the core thermal limits. For this analysis, OTDT setpoints were chosen to give the same trip characteristics as the original OTDT function. Differences can be seen in the analysis results for cases that trip on OTDT, but these are principally due to the refined dynamic compensation (filters, lead/lag functions) used with the new OTDT reactor trip.

The transient results are provided for two of the RCCA bank withdrawal cases which were analyzed. Figures 4-1 through 4-6 compared the results of the original AP1000 configuration to the updated configuration for a high reactivity insertion rate (75 pcm/s) from full power. A sequence of event for this case is provided in Table 4-1. The high reactivity insertion rate case trips the reactor on a high nuclear flux signal. The trends and timing for high reactivity insertion rate case is not significantly changed from the original AP1000 configuration. As shown in Figure 4-6, the DNB ratio is maintained above the safety analysis limit value of 1.5 for this case.

Figures 4-7 through 4-12 compare the results of the original AP1000 plant configuration to the updated configuration for a low reactivity insertion rate (3 pcm/s) from full power. A sequence of events for the low reactivity insertion rate is also provided in Table 4-1. This case trips the reactor when the OTDT reactor trip setpoint is exceeded. As previously noted, due to the

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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refined dynamic compensation on the updated OTDT reactor trip function some differences in the timing of the reactor trip are expected for this case. As shown in Figure 4-12, the DNB ratio is maintained above the safety analysis limit of 1.5 for this case.

Cases were analyzed for the updated AP1000 configuration at initial power levels of 100%, 60% and 10% power. Cases were analyzed over a wide spectrum of reactivity insertion rates. Cases were also run using minimum and maximum reactivity feedback to bound the expected core conditions. The minimum DNB ratios for all these cases are shown on Figures 4-13 through 4-15. The minimum DNB ratio for all cases was above the safety analysis limit value of 1.5. These results demonstrate that the applicable acceptance criteria for this event continue to be met for the updated AP1000 configuration.

### 5. Chemical and Volume Control System Malfunction That Increases Reactor Coolant Inventory

A chemical and volume control system malfunction that increases reactor coolant inventory (also called an inadvertent operation of the chemical and volume control system and CVS malfunction) analysis was performed for the updated AP1000 configuration. A comparison of the results from the updated analysis to those of the analysis for the original AP1000 configuration is shown in Figures 5-1 through 5-6. Table 5-1 provides the sequence of events for the original and the updated AP1000 configuration.

The transient results of the updated plant configuration during a CVS malfunction are very similar to those of the original plant configuration. The pressurizer water volume transient remains essentially the same relative to the total transient time (36,000 seconds). The "S" signal is obtained on a low  $T_{\text{cold}}$  signal about 25 seconds earlier for the updated AP1000 configuration. As a result, the subsequent reactor trip and the time that the core makeup tanks and passive residual heat removal heat exchanger are aligned occur about 25 seconds earlier. Thirty minutes after the reactor trip, the pressurizer water volume is about 30 cubic feet less for the updated AP1000 configuration than for the original AP1000 plant configuration. Although the peak pressurizer water volume occurs over 7 minutes sooner for the updated AP1000 plant configuration, the peak volume attained throughout the transient is only 6 cubic feet greater. Based on these results, 1) the existing CVS malfunction analysis presented in DCD Revision 15 bounds the updated AP1000 plant configuration and 2) the case presented in DCD Revision 15 continues to bound all cases that model explicit operator action 30 minutes after reactor trip.

### 7. Complete Loss of Normal Feedwater Without SCRAM

A deterministic analysis of the loss of normal feedwater event without SCRAM was performed. This transient was performed using assumptions compatible with analyses of Westinghouse plants in determining the ATWS rule (References 3 and 4).

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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The acceptance criteria assumed for ATWS transient is that ASME Service Level C is not exceeded. A pressure of 3200 psig corresponds to the maximum allowable pressure for the weakest component in the reactor coolant system. Mitigation of the event is provided by activation of pressurizer and steam generator safety valves, actuation of the Passive Residual Heat Removal (PRHR) system, and opening of the Core Makeup Tank (CMT) release valve. The Diverse Actuation System (DAS) is assumed to operate to actuate the PRHR, CMTs and trip the turbine. DAS also includes a diverse reactor trip function which de-energies power to the RCCA motor-generator set. However, credit for the diverse reactor trip function is not credited in the analysis presented here.

Analysis results are provided for the original AP1000 plant configuration in Revision 15 of the DCD. Results are also provided for the current AP1000 plant configuration which includes the modified pressurizer design. Figures for both cases are provided in Figures 7-1 through 7-5. A sequence of events is provided for both cases in Table 7-1.

The results show that the thermal hydraulic response trend remains unchanged. With the original AP1000 plant configuration a maximum reactor coolant pressure of 2712.19 psia is reached. The updated AP1000 configuration results in a maximum reactor coolant pressure of 2752.10 psia which is well below the acceptance criteria of 3200 psig.

### 6. Decrease in Reactor Coolant Inventory Including Loss-of-Coolant Accidents

The response to Item 6 is divided into three sections: 6.1 Best Estimate Large Break Loss of Coolant Accident (BELOCA), 6.2 Long-Term Cooling (LTC) LOCA; and 6.3 Small Break LOCA.

#### 6.1 Best Estimate Large Break LOCA

The impact of the pressurizer change is evaluated as follows:

##### Pressurizer Vessel

The design changes to the pressurizer reduce the pressurizer height (outside surface of lower head to outside surface of upper head) by 17% and increase the pressurizer inside diameter by 11% (cross sectional area increases by 23%) such that the total internal volume of the pressurizer is maintained unchanged.

The pressurizer design change specifies further details of the surge line nozzle design, and the BELOCA impact is addressed below. There are no other changes to the pressurizer surge line. The pressurizer design change also specifies that the initial liquid volume in the pressurizer (1000 cubic ft) is unchanged.

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## Response to Request For Additional Information (RAI)

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The increase in cross sectional area in the pressurizer and subsequent decrease in initial water level for the same initial liquid volume increase the initial interfacial area between the liquid and vapor space in the pressurizer and decrease the initial gravitational driving head from the pressurizer into the hot leg. However, for a large break LOCA, the rapid primary system depressurization is the dominating force acting to flash liquid in the pressurizer to steam and drain the pressurizer into the hot leg. Assuming that the initial liquid volume in the pressurizer is unchanged, the same fluid volume must drain from the pressurizer during a large break LOCA.

Section 15.6.4.A.6 of the DCD Revision 15 indicates that the pressurizer drains completely approximately 25 seconds into the transient; at approximately the same time, accumulator injection begins to penetrate into the lower plenum. Reflood of the core does not begin until 70 seconds into the transient and the hot rod peak cladding temperature was calculated to occur 109.6 seconds into the transient. The accumulator injection is the dominant water source available to recover and quench the core. Any change in how the pressurizer liquid rapidly drains after break due to the geometric changes described will therefore have a negligible impact on the large break LOCA results.

The effects of the increase in cross sectional area and decrease in initial water level in the pressurizer have an insignificant effect on how liquid drains from the pressurizer and enters the upper plenum or is entrained into the steam generator as compared to the effects of the rapid primary system depressurization.

### Pressurizer 14 inch ADS Safety Nozzles ADS 1, 2, & 3 Piping and Piping Supports

During a large break LOCA, the primary system rapidly depressurizes. Section 15.6.5.4.A.3 of Revision 15 of the DCD describes the signal logic for large break LOCA. As stated in the DCD:

'The accumulator flow diminishes core makeup tank delivery to such an extent that the core makeup tank level does not approach the ADS Stage 1 valve actuation point until after the accumulator tank is empty. The accumulator empties long after the blowdown portion of the large-break LOCA transient is complete. Actuation of the ADS on CMT water level does not occur until long after the AP1000 PCT is calculated to occur'

Therefore, the above ADS changes are insignificant as the ADS 1, 2, and 3 stage valves and associated components including the piping and safety nozzles do not impact the LBLOCA analysis conclusions presented in Chapter 15 of Revision 15 of the DCD.

### Pressurizer Spray Nozzle Pressurizer Manway Pressurizer Instrumentation Nozzles Pressurizer Supports Module Q6-01 Structural Steel Framing

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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Pressurizer Compartment Concrete Walls and Platform  
Pressurizer Heaters and Heater Wells  
Pressurizer Trunnions  
Hydrogen Igniters

The BELOCA analysis methodology does not include modeling of these components or structures. No significant impact to the LBLOCA analysis conclusions presented in Chapter 15 of Revision 15 of the DCD will occur due to changes to these components and structures.

### Pressurizer Surge Nozzle

The BELOCA analysis does not model the surge line to the level of detail provided in the drawing revisions associated with the pressurizer change and therefore there is no impact on the LBLOCA analysis conclusions presented in Chapter 15 of Revision 15 of the DCD.

### Tier 1 and Tier 2 Table Revisions

The control systems modeled in the BELOCA analysis do not model trips, actuation, or isolation based on high pressurizer water level. There is no impact on the LBLOCA analysis conclusions presented in Chapter 15 of DCD Revision 15.

### Conclusion

As discussed above, the effects of the pressurizer changes to the AP1000 large break LOCA analysis presented in Chapter 15 of DCD Revision 15 are insignificantly small. The Chapter 15 DCD Revision 15 large break LOCA analysis is bounding and remains valid for the pressurizer changes.

## 6.2 Long-Term Cooling (LTC) LOCA

The impact of the pressurizer change is evaluated as follows:

### Pressurizer Vessel

The design changes to the pressurizer reduce the pressurizer height (outside surface of lower head to outside surface of upper head) by 17% and increase the pressurizer inside diameter by 11% (cross sectional area increases by 23%) such that the total internal volume of the pressurizer is maintained unchanged.

The pressurizer design change specifies further details of the surge line nozzle design, and the BELOCA impact is addressed below. There are no other changes to the pressurizer surge line.

The LTC analyses presented in Section 15.6.5.4.C of the DCD Revision 15 presume that the pressurizer has drained completely prior to the LTC period of all LOCA transients; therefore,

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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any change in how the pressurizer liquid drains during a LOCA event due to the geometric changes described above can be stated to have a negligible impact on the predicted LOCA LTC results.

Therefore, the effects of the increase in cross sectional area and decrease in initial water level in the pressurizer have an insignificant effect on predicted behaviors during the LTC period, which occurs after liquid has completely drained from the pressurizer.

### Pressurizer 14 inch ADS Safety Nozzles ADS 1, 2, & 3 Piping and Piping Supports

During a large break LOCA, the primary system rapidly depressurizes. For smaller LOCA break sizes, the primary system depressurization to achieve IRWST injection is due to ADS stage 4 operation, and the LTC phase of LOCA events in AP1000 commences when a quasi-steady-state condition exists in the RCS in which the IRWST injection flow rate and the rate of mass venting through the ADS system are about the same. Per AP600 analyses, only a minor amount of flow passes through ADS stages 1, 2, and 3 during LTC in the AP600 design. With this being the case, the flow through ADS stages 1, 2, and 3 was not modeled in subsequent AP1000 design basis LTC analyses. Therefore, the details of the ADS 1/2/3 layout design associated with the revised pressurizer design are not relevant for the LOCA LTC analysis period.

In conclusion, the above ADS changes are insignificant as the ADS 1, 2 and 3 stage valves and associated components including the piping and safety nozzles do not impact the LOCA LTC analysis conclusions presented in Chapter 15 of the DCD Revision 15.

Pressurizer Spray Nozzle  
Pressurizer Manway  
Pressurizer Instrumentation Nozzles  
Pressurizer Supports  
Module Q6-01 Structural Steel Framing  
Pressurizer Compartment Concrete Walls and Platform  
Pressurizer Heaters and Heater Wells  
Pressurizer Trunnions  
Hydrogen Igniters

Since the pressurizer is not considered in the AP1000 LOCA LTC analyses, the above components or structures are not modeled. Therefore, changes in the above have no impact to the LOCA LTC analysis conclusions presented in Chapter 15 of the DCD Revision 15.

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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### Pressurizer Surge Nozzle

The AP1000 LOCA LTC analyses do not model the surge line; therefore, there is no impact on the LOCA LTC analysis conclusions presented in Chapter 15 of the DCD Revision 15.

### Tier 1 and Tier 2 Table Revisions

The control systems modeled in the LOCA LTC analysis do not model trips, actuation, or isolation based on high pressurizer water level. Therefore there is no impact on the LOCA LTC analysis conclusions presented in Chapter 15 of the DCD Revision 15.

### Conclusions

As discussed above, the effects of the pressurizer changes to the AP1000 LOCA LTC analyses presented in Chapter 15 of DCD Revision 15 are insignificantly small. The Chapter 15 DCD Revision 15 LOCA LTC analyses remain valid for the pressurizer changes.

## 6.3 Small Break LOCA

This evaluation determines the impact of the design changes to the pressurizer and ADS Stage 1-3 downstream piping on the Small Break Loss of Coolant Accident (SBLOCA) Double-Ended Direct Vessel Injection (DEDVI) and 2-inch Cold Leg Break analyses presented in Chapter 15 of the DCD Revision 15.

The design changes to the pressurizer reduce the pressurizer height and increase the pressurizer inside diameter such that the total internal volume of the pressurizer is maintained unchanged. Additionally, the design changes provide new pressurizer surge line drawings. The AP1000 SBLOCA re-analyses considered the pressurizer nozzle changes.

The SBLOCA analyses presented in Chapter 15 of the DCD Revision 15 do not model trips, actuation, or isolation based on high pressurizer water level and are therefore not impacted.

The DEDVI SBLOCA analysis presented in Section 15.6.5.4B.3.5 and the 2-Inch Cold Leg Break analysis presented in Section 15.6.5.4B.3.4 of the DCD Revision 15 were re-performed with the revised pressurizer design and corresponding downstream ADS stage 1-3 piping. The DEDVI line break represents the limiting break in terms of available injection capacity (i.e. one Direct Vessel Injection (DVI) line failed; therefore, only one DVI line available for RCS makeup) while the 2-Inch Cold Leg Break demonstrates the response to a smaller break class.

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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### DEDVI Line Break Analysis (Limiting Break Analysis)

Table 6.3-1 and Figures 6.3-1 through 6.3-9 present a comparison of the DEDVI line break simulations. The results demonstrate the effect of the change in the pressurizer tank diameter, that being the decrease in both the Pressurizer Mixture Level (Figure 6.3-4) and Pressurizer Void Fraction (Figure 6.3-5). This subsequently reduces the Automatic Depressurization System (ADS) Stage 1-3 liquid discharge (Figure 6.3-6) and increases the ADS 1-3 vapor discharge (Figure 6.3-7). The overall effect is that slightly more Reactor Coolant System (RCS) inventory remains in the RCS for a majority of the transient simulation period (Figure 6.3-9). No significant changes in the RCS Pressure (Figures 6.3-1 and 6.3-2), Core Mixture Level (Figure 6.3-3) and DVI injection characteristics (Figure 6.3-8) are observed as a result of the design change implementation.

### Two Inch Cold Leg Break Analysis (Smaller Break Class)

Table 6.3-2 and Figures 6.3-10 through 6.3-19 present a comparison of the 2-Inch Cold Leg break simulations. The results again demonstrate the effect of the change in the pressurizer tank diameter, that being the decrease in both the Pressurizer Mixture Level (Figure 6.3-13) and Pressurizer Void Fraction (Figure 6.3-14). This subsequently reduces the Automatic Depressurization System (ADS) Stage 1-3 liquid discharge (Figure 6.3-15) and increases the ADS 1-3 vapor discharge (Figure 6.3-16). The overall effect being slightly more Reactor Coolant System (RCS) inventory in the RCS for a majority of the transient simulation period (Figure 6.3-19). No significant changes in the RCS Pressure (Figures 6.3-10 and 6.3-11), Core Mixture Level (Figure 6.3-12) and DVI injection characteristics (Figure 6.3-17 and 6.3-18) are observed as a result of the design change implementation.

### Conclusion

As discussed above, the effects of the pressurizer changes to the AP1000 SBLOCA analyses presented in Chapter 15 of DCD Revision 15 are observed to be small. As a result, the Chapter 15 DCD Review 15 SBLOCA analyses remain valid for the pressurizer changes.

### **REFERENCES:**

1. NUREG 1793, NRC "Final Safety evaluation Report for AP1000 Design", September 2004.
2. APP-GW-GLN-075 Revision 0, "AP1000 Standard Combined License Technical Report TR-74C AP1000 Generic Technical Specifications for Design Changes", March 2007.
3. WCAP-8330, "Westinghouse Anticipated Transients Without Trip Analysis", August 1974.
4. NS-TMA-2182, "ATWS Submittal", December 30, 1979.



# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

Table 1-1 Sequence of Events for Full Double Ended Steam Line Break		
Event	Time (sec)	
	Original AP1000	Updated AP1000
Break initiated, startup feedwater system started, PRHR started	0.0	0.0
Low steam line pressure setpoint reached	1.4	1.4
Reactor coolant pumps tripped on low steam line pressure signal	7.4	7.4
Main feedwater isolation valves and main steam line isolation valves close on low steam line pressure signal	13.4	13.4
Low cold leg temperature setpoint reached	18.1	17.6
Core Makeups Tanks (CMT) actuated on low steam line pressure signal	18.4	18.4
Criticality reached	28.0	27.0
Startup feedwater isolated on low cold leg temperature signal	30.1	29.6
Boron begins reaching the core	30.2	35.3
Pressurizer empties	58.2	53.3
Accumulators begin injecting	259.6	277.9

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

Table 2-1 Sequence of Events for Turbine Trip			
Accident Case	Event	Time (sec)	
		Original	Updated
Case C.2  Without pressurizer control, minimum reactivity feedback, without offsite power available	Turbine Trip; loss of main feedwater	0.0	0.0
	Offsite power lost, reactor coolant pumps begin coasting down	3.0	3.0
	Reactor coolant pump underspeed reactor trip point reached	3.472	3.526
	Rods begin to drop	4.239	4.264
	Peak RCS pressure occurs	6.300 (2693.65 psia, 185.7 bar)	6.500 (2642.36 psia, 182.2 bar)
	Initiation of steam release from steam generator safety valves	14.000	11.700
Case A.2.  With pressurizer control, minimum reactivity feedback, without offsite power available	Turbine Trip; loss of main feedwater	0.0	0.0
	Offsite power lost, reactor coolant pumps begin coasting down	3.0	3.0
	Low reactor coolant pump speed reactor trip setpoint reached	3.468	3.522
	Rods begin to drop	4.235	4.289
	Minimum DNBR occurs	6.000 (1.57)	6.300 (1.589)
	Initiation of steam release from steam generator safety valves	18.700	15.300

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

Table 3-1 Sequence of Events for Complete Loss of Forced Reactor Coolant Flow		
Event	Time (sec)	
	Original AP1000	Updated AP1000
Reactor coolant pumps lose power and begin coasting down	0.0	0.0
Reactor coolant pump under speed trip setpoint reached	0.47	0.526
RCCAs begin to drop	1.24	1.326
Minimum DNBR occurs	3.0	3.3
Peak reactor coolant pressure occurs	3.9	4.5
Peak pressurizer pressure occurs	4.3	4.6

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

Table 4-1

Sequence of Events for Uncontrolled RCCA Bank Withdrawal at Power  
Full Power, Maximum Reactivity Feedback

Accident Case	Event	Time (sec)	
		Original AP1000 Design	Updated AP1000 Design
High Reactivity Insertion Rate (75 pcm/s)	Initiation of uncontrolled RCCA withdrawal	0.0	0.0
	Power range high neutron flux high setpoint reached	6.6	6.6
	Rods begin to fall into core	7.5	7.5
	Minimum DNBR occurs	7.7	7.7
	Loss of ac power occurs	10.2	15.2
Low Reactivity Insertion Rate (3 pcm/s)	Initiation of uncontrolled RCCA withdrawal	0.0	0.0
	Overtemperature $\Delta T$ setpoint reached	508.1	524.4
	Rods begin to fall into core	510.1	526.4
	Minimum DNBR occurs	510.4	526.7
	Loss of ac power occurs	512.8	534.1

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

Table 5-1 – Sequence of Events for a Chemical and Volume Control System Malfunction That Increases Reactor Coolant Inventory

Event	Time (sec)	
	Original AP1000	Revised AP1000
Transient Started. Spurious "CVS" starts injecting borated water	10.0	10.0
"S" Signal - Low $T_{cold}$ Setpoint reached	1,088	1,063
Reactor Trip - RCCA insertion begins	1,090	1,065
Turbine Trip begins	1,090	1,065
Loss of offsite power and reactor coolant pumps start to coastdown	1,093	1,068
CVS, main steam and feed lines are isolated - CMT Valves fully open	1,100	1,075
PRHR actuated on "S" signal (valve fully open)	1,105	1,080
Pressurizer safety valves open	1,424	1,268
Pressurizer water volume 30 minutes after reactor trip	1,415 ft <sup>3</sup> (2,900 sec)	1,385 ft <sup>3</sup> (2,865 sec)
Hi-2 Pressurizer Level Setpoint reached (CVS isolation)	3,720	3,866
Pressurizer safety valves close	15,088	15,024
Peak pressurizer water volume occurs	2,140 ft <sup>3</sup> (15,262. sec)	2,146. ft <sup>3</sup> (15,676. sec)
PRHR matches decay heat	14,720	15,300
CMTs stop recirculating	20,200	20,968

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

Table 7-1 Sequence of Events for Loss of Normal Feedwater With Failure to SCRAM (ATWS)		
Event	Time (sec)	
	Original AP1000	Revised AP1000
All feedwater flow to steam generators is lost	0 to 4	0 to 4
Pressurizer safety valves open	50.0	45.0
Reactor coolant pumps tripped on DAS signal	66.1	62.7
Turbine is tripped on DAS signal	70.1	66.7
PRHR actuated on DAS signal	74.1	70.7
CMTs actuated on DAS signal	74.1	70.70
Pressurizer fills	92.0	88.0
Maximum reactor coolant pressure reached	132.0 (2712.19 psia)	124.0 (2752.10 psia)
Pressurizer safety valves close	197.0	196.0

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

Table 6.3-1

### DOUBLE-ENDED INJECTION LINE BREAK SEQUENCE OF EVENTS – 20 psia

Event	AP1000 Original Time (seconds)	AP1000 Revised Time (seconds)
Break opens	0.0	0.0
Reactor trip signal	13.1	13.1
Steam turbine stop valves close	19.1	19.1
“S” signal	18.6	18.6
Main feed isolation valves begin to close	20.6	20.6
Reactor coolant pumps start to coast down	24.6	24.6
ADS Stage 1	182.5	182.6
ADS Stage 2	252.5	252.6
Intact accumulator injection starts	254	254
ADS Stage 3	372.5	372.6
ADS Stage 4	492.5	492.6
Intact accumulator empties	600.0	595.4
Intact loop IRWST injection starts*	1470	1520
Intact loop core makeup tank empties	2123	2118

**Note:**

\*Continuous injection period

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

Table 6.3-2

### 2-INCH COLD LEG BREAK IN CLBL LINE SEQUENCE OF EVENTS

Event	AP1000 Original Time (seconds)	AP1000 Revised Time (seconds)
Break opens	0.0	0.0
Reactor trip signal	54.7	55.2
Steam turbine stop valves close	60.7	61.2
“S” signal	61.9	62.5
Main feed isolation valves begin to close	63.9	64.5
Reactor coolant pumps start to coast down	67.9	68.5
ADS Stage 1	1334.1	1340.4
ADS Stage 2	1404.1	1410.4
Accumulator injection starts	1403	1407
ADS Stage 3	1524.1	1530.4
Accumulator empties	1940.2	1943.7
ADS Stage 4	2418.6	2422.5
Core makeup tank empty	2895	2898
IRWST injection starts	3280	3303



# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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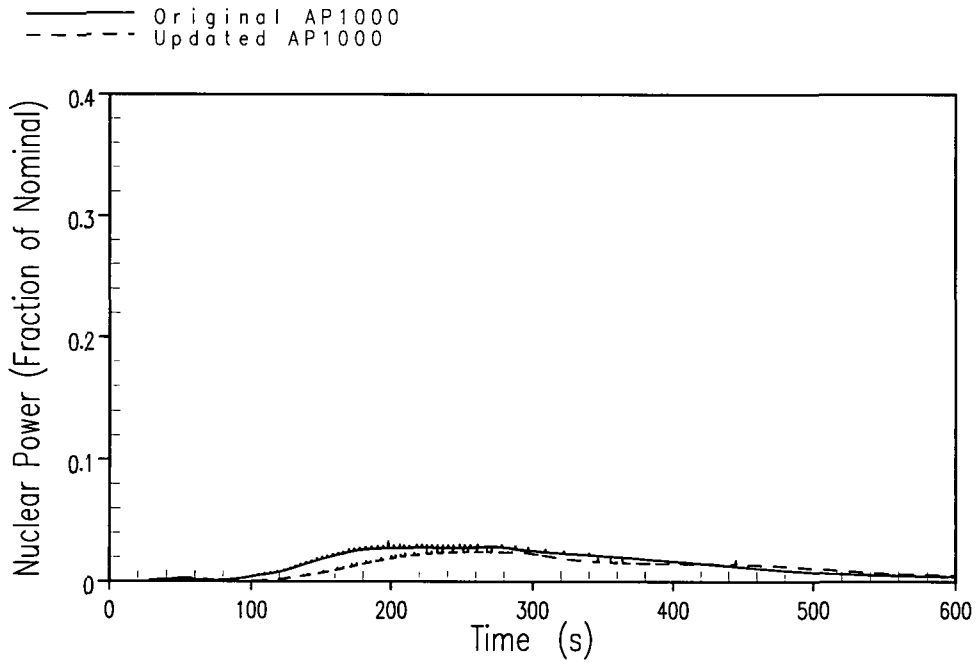


Figure 1-1  
Steam Line Break

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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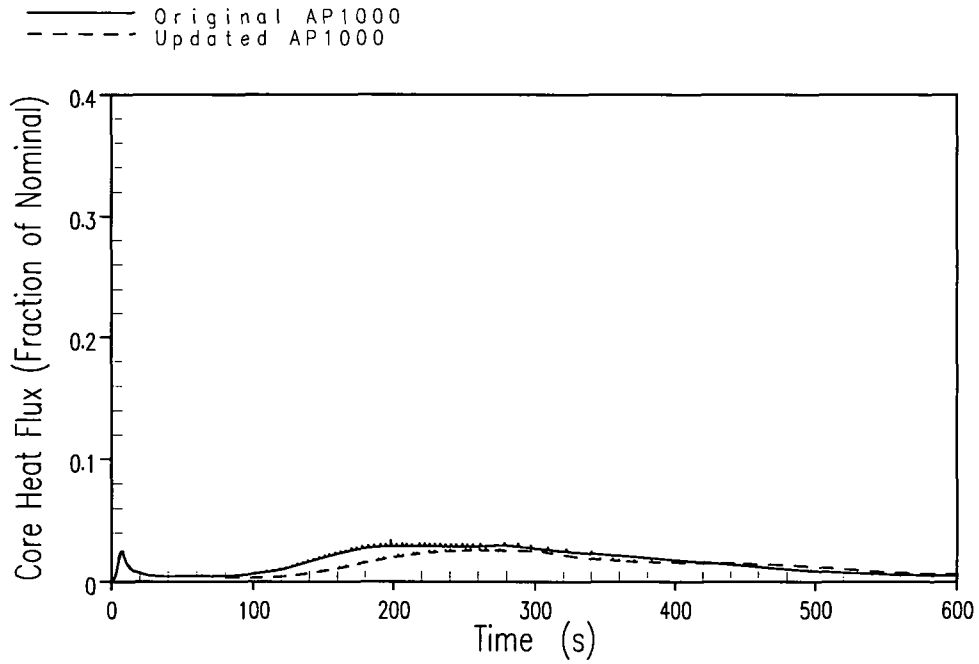


Figure 1-2  
Steam Line Break

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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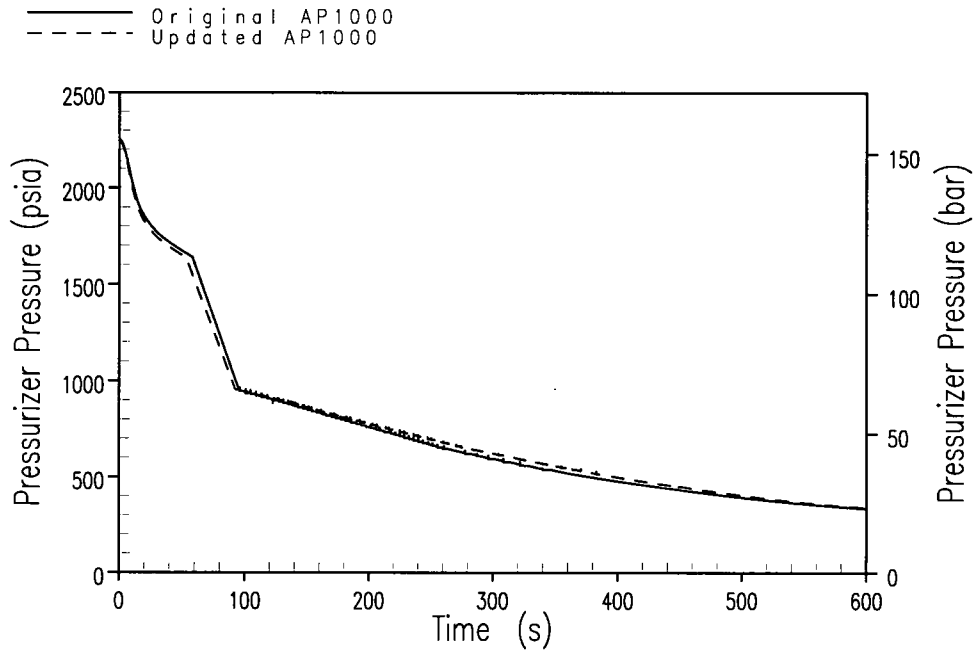


Figure 1-3  
Steam Line Break

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

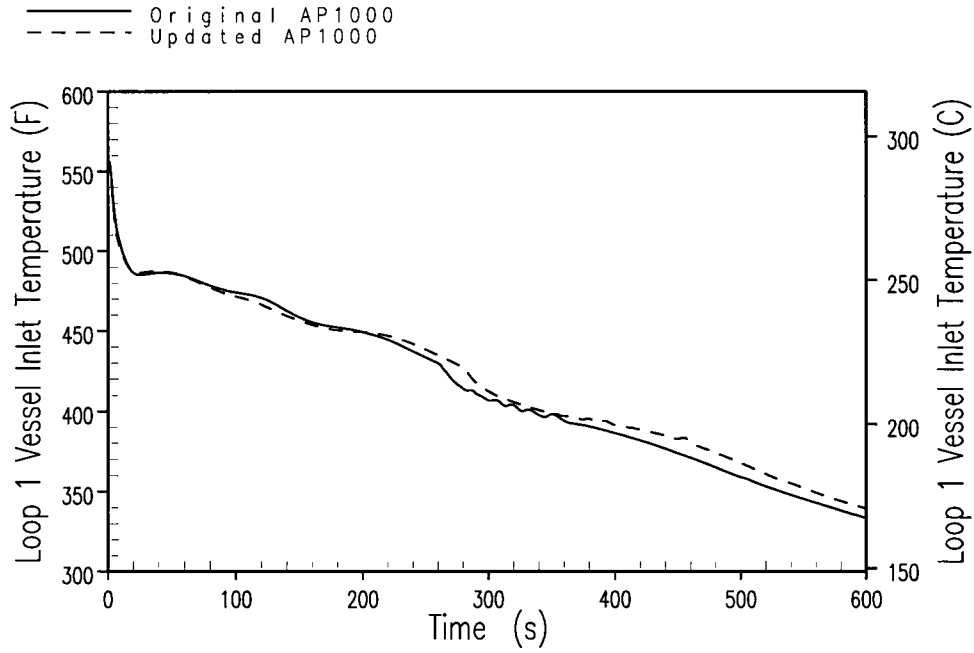


Figure 1-4  
Steam Line Break

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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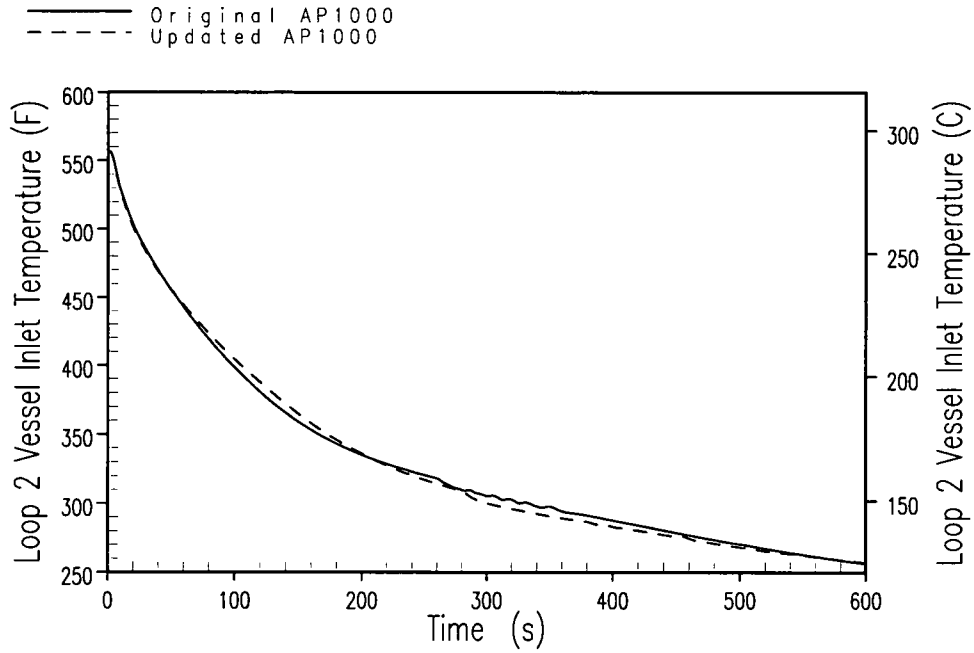


Figure 1-5  
Steam Line Break

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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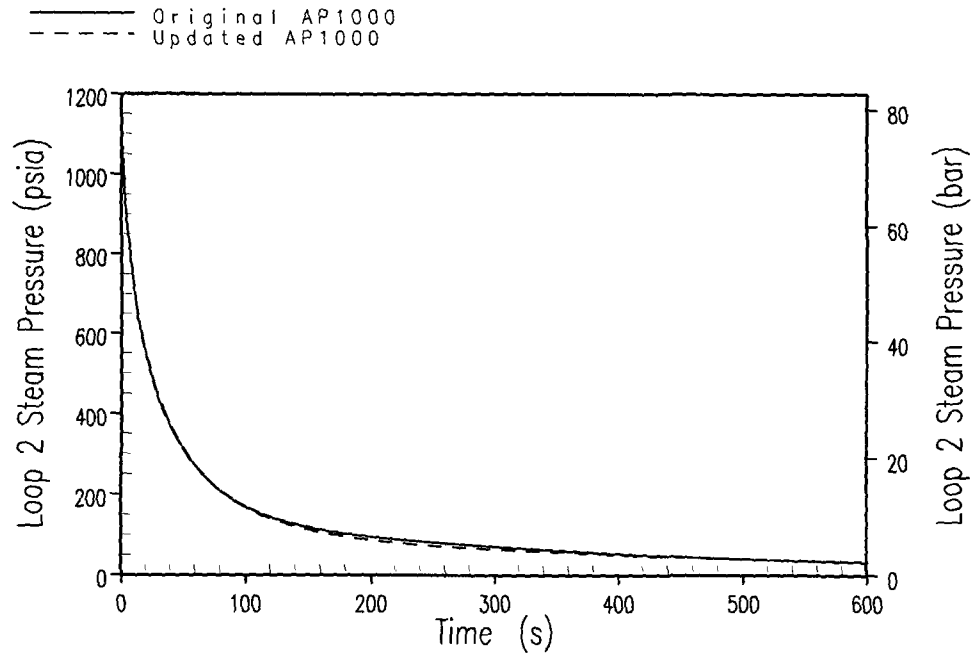


Figure 1-6  
Steam Line Break

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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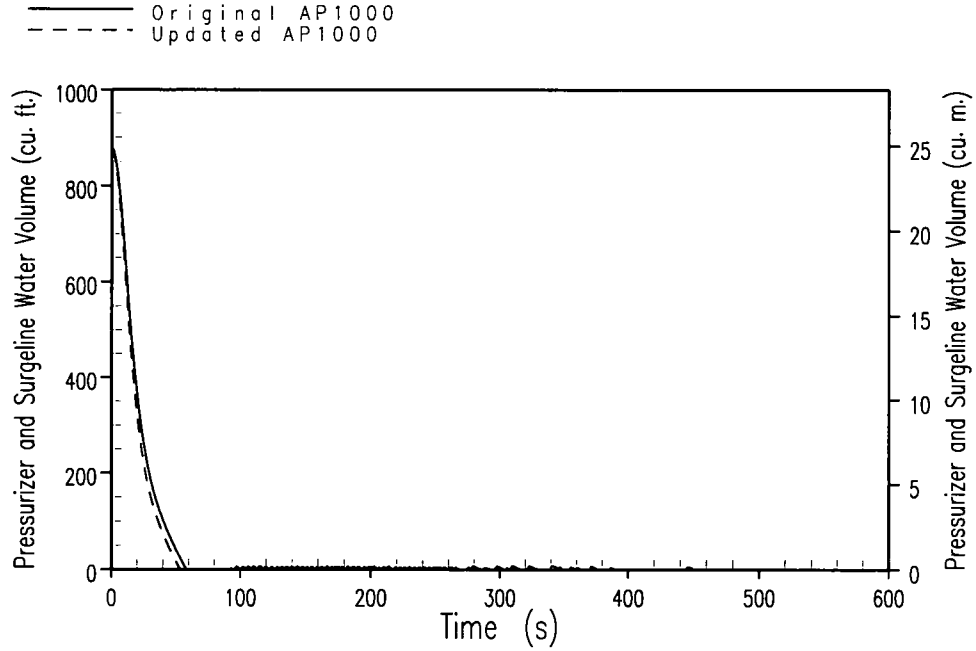


Figure 1-7  
Steam Line Break

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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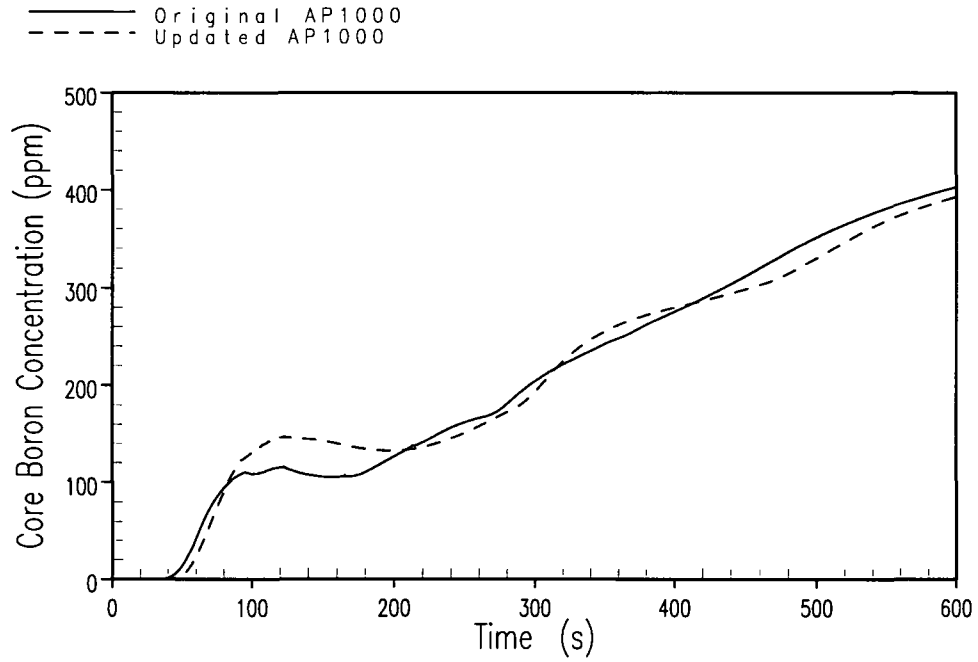


Figure 1-8  
Steam Line Break



# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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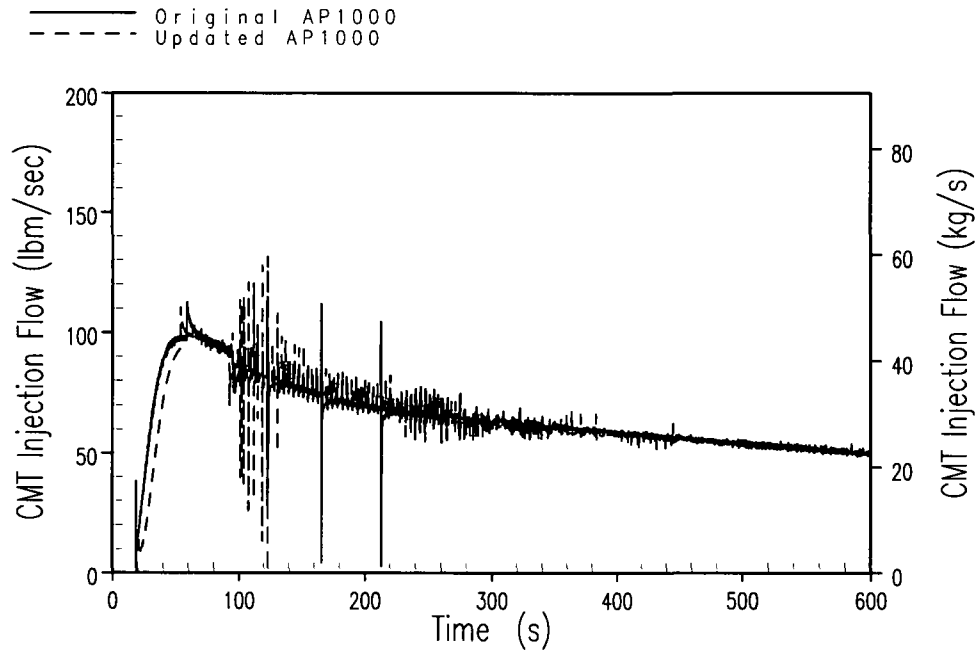


Figure 1-9  
Steam Line Break

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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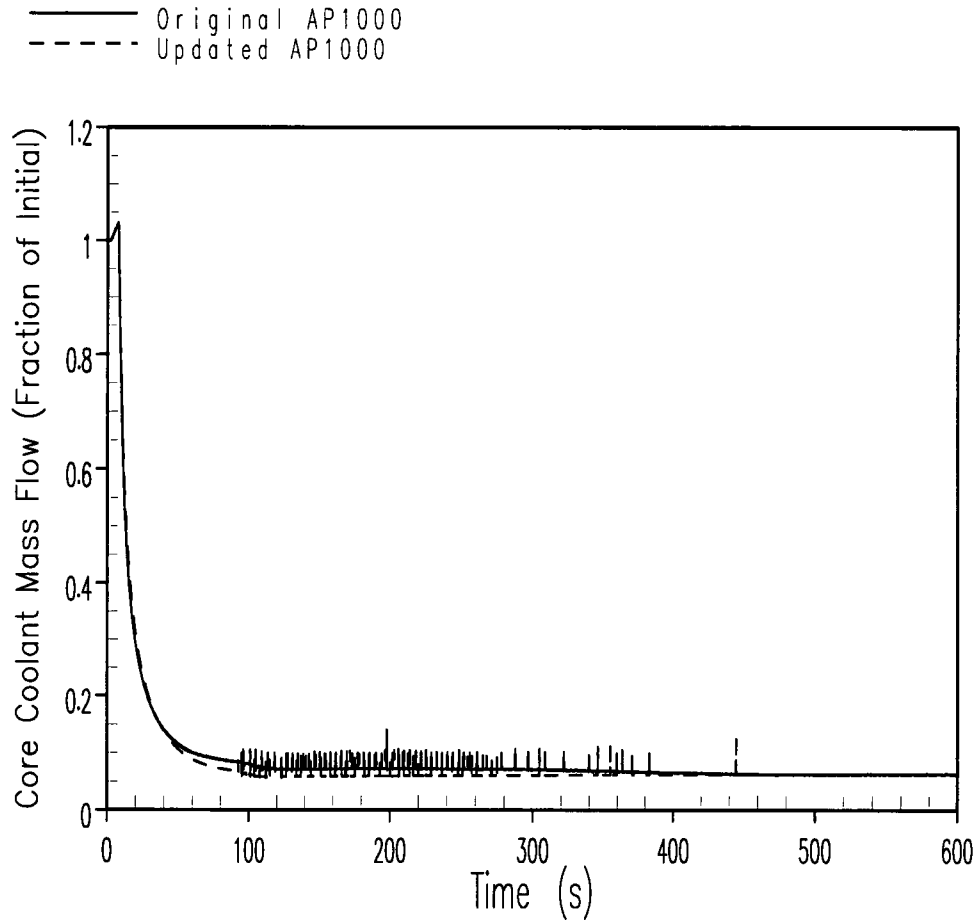


Figure 1-10  
Steam Line Break

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

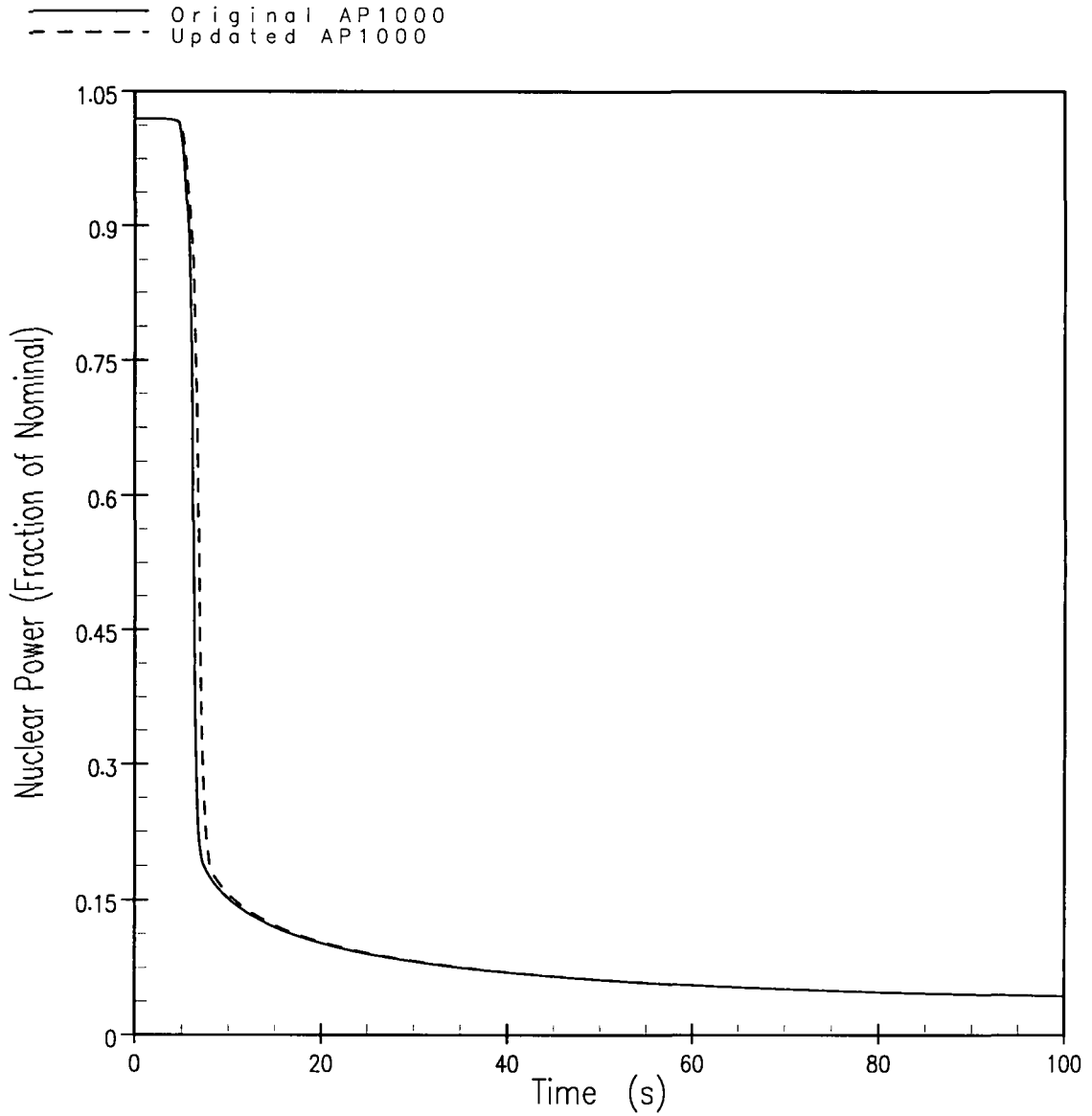


Figure 2-1  
Turbine Trip  
(Peak Pressure Case)

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

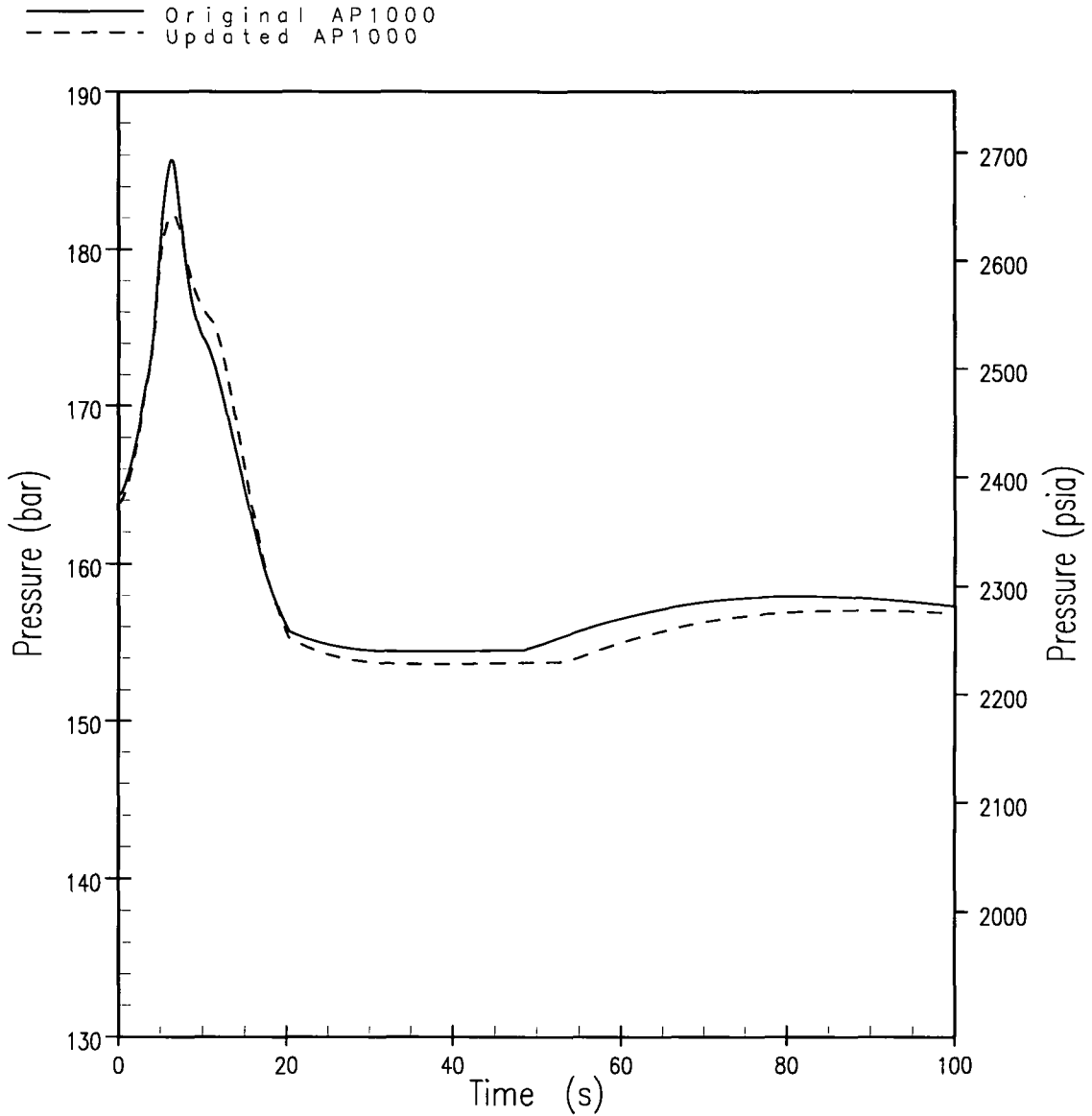


Figure 2-2 RCP Outlet Pressure  
Turbine Trip  
(Peak Pressure Case).

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

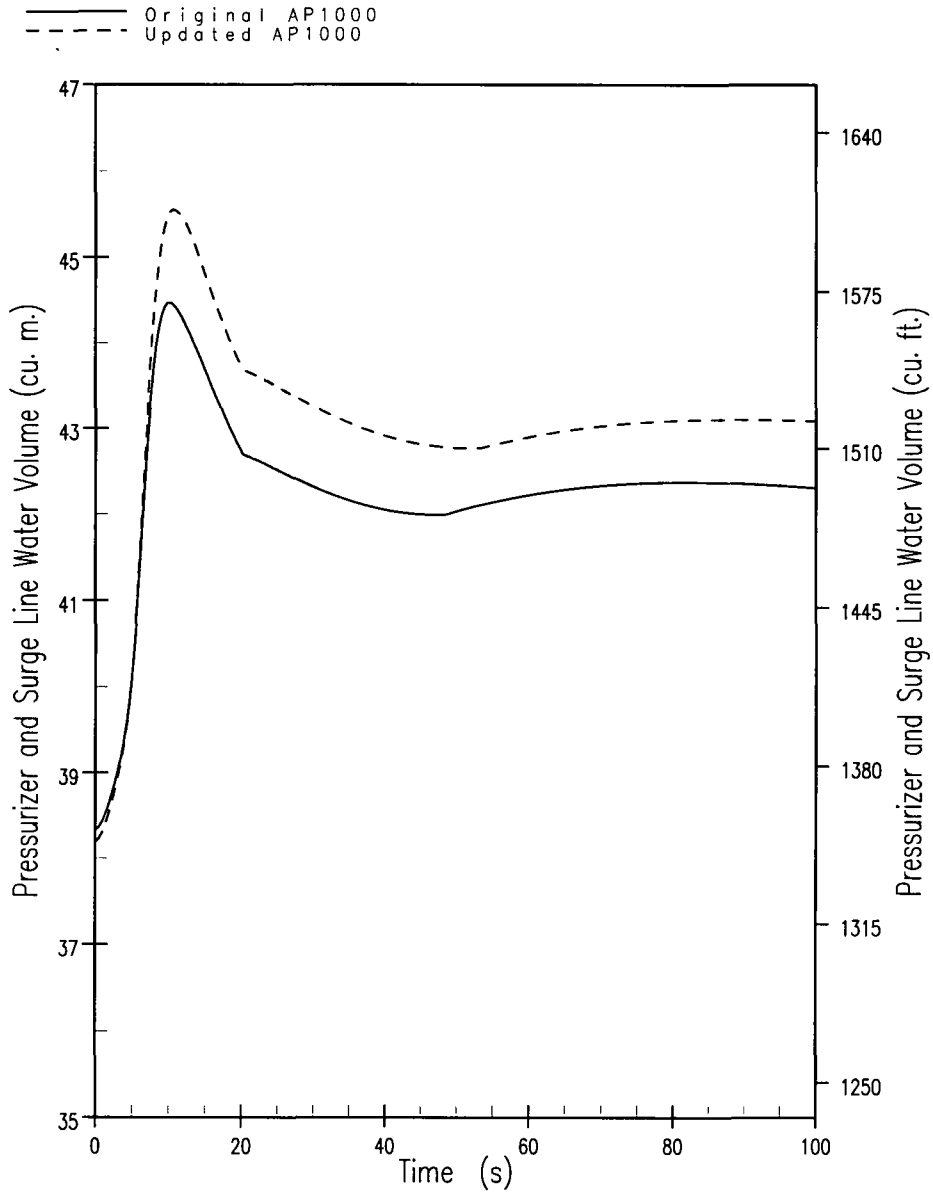


Figure 2-3  
Turbine Trip  
(Peak Pressure Case)

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

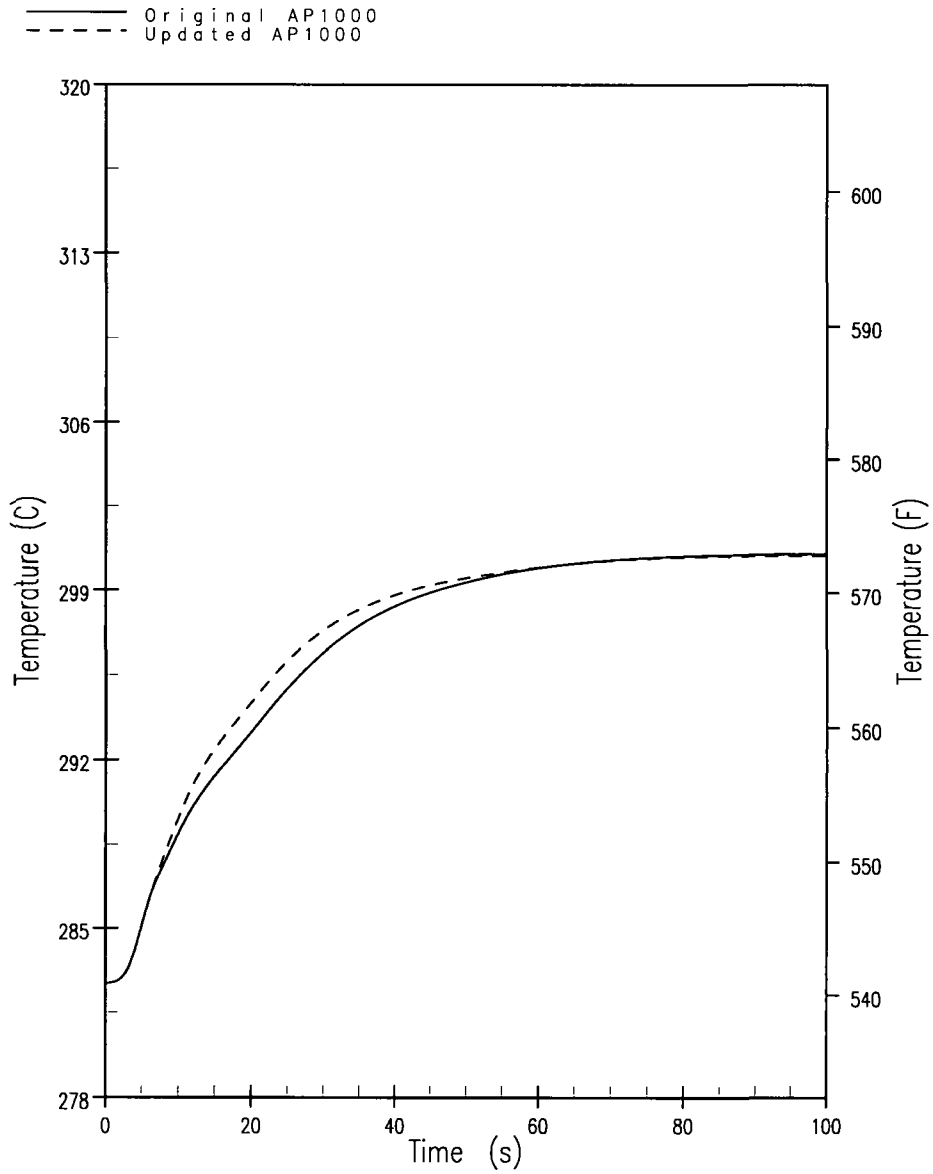


Figure 2-4 Vessel Inlet Temperature  
Turbine Trip  
(Peak Pressure Case)

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

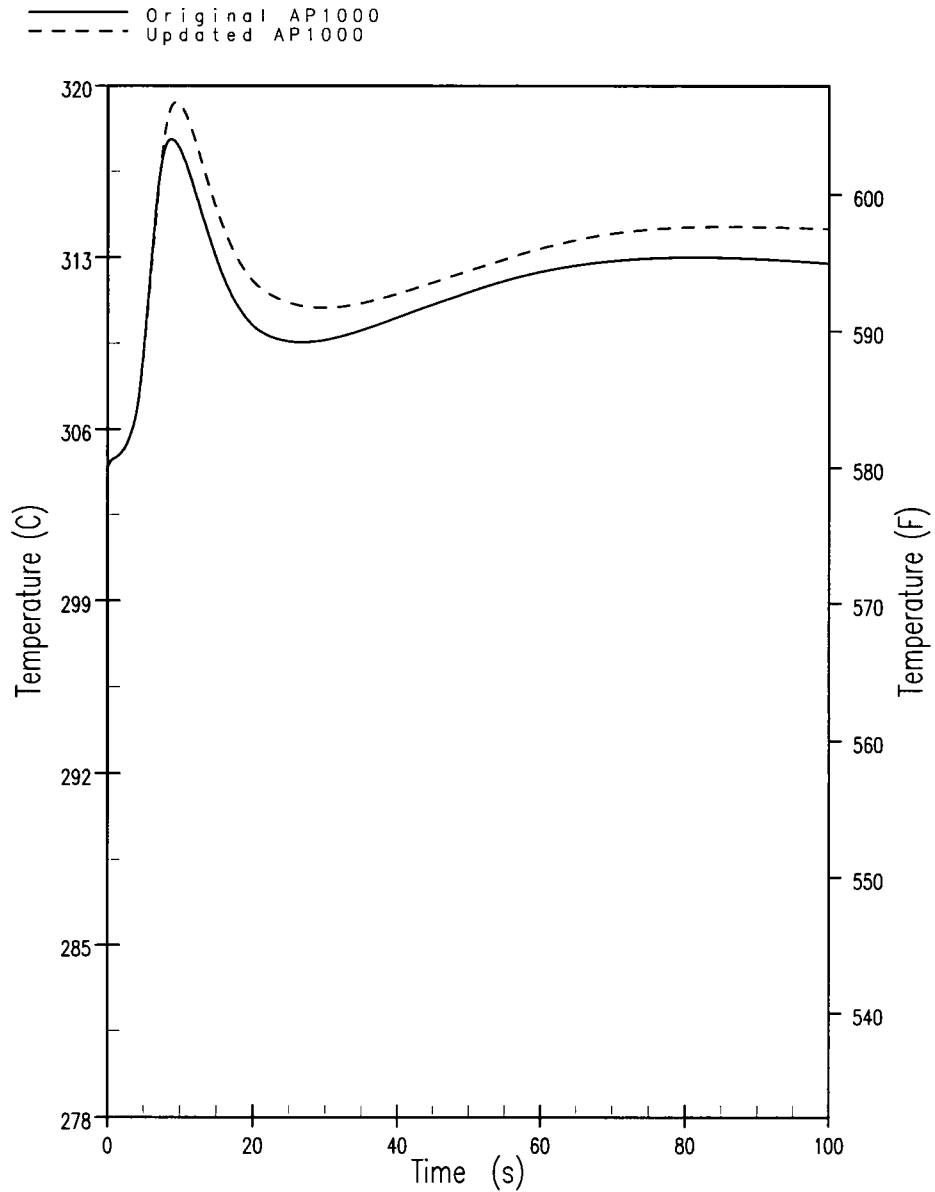


Figure 2-5 Vessel Average Temperature  
Turbine Trip  
(Peak Pressure Case)

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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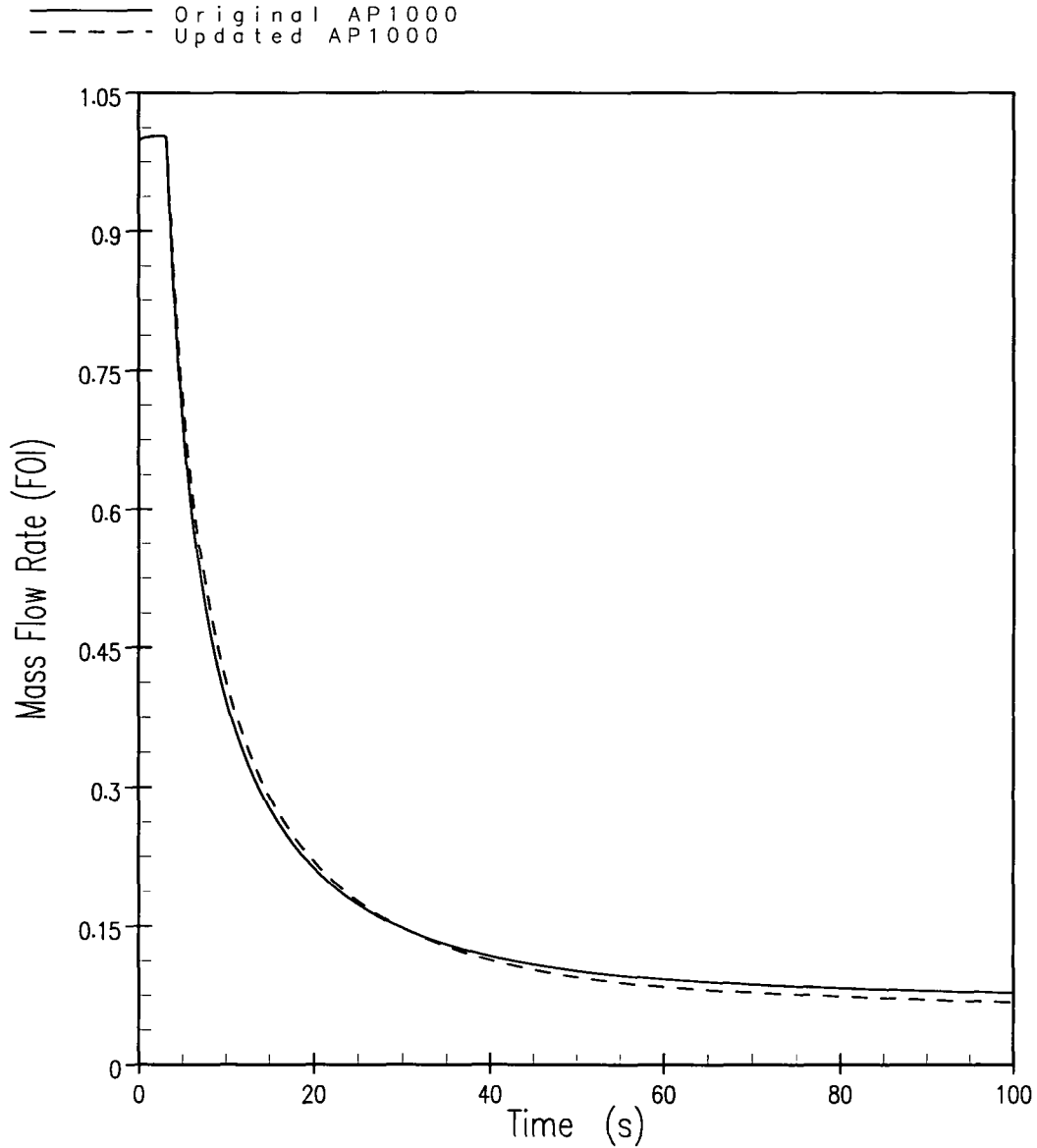


Figure 2-6  
Turbine Trip  
(Peak Pressure Case)



# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

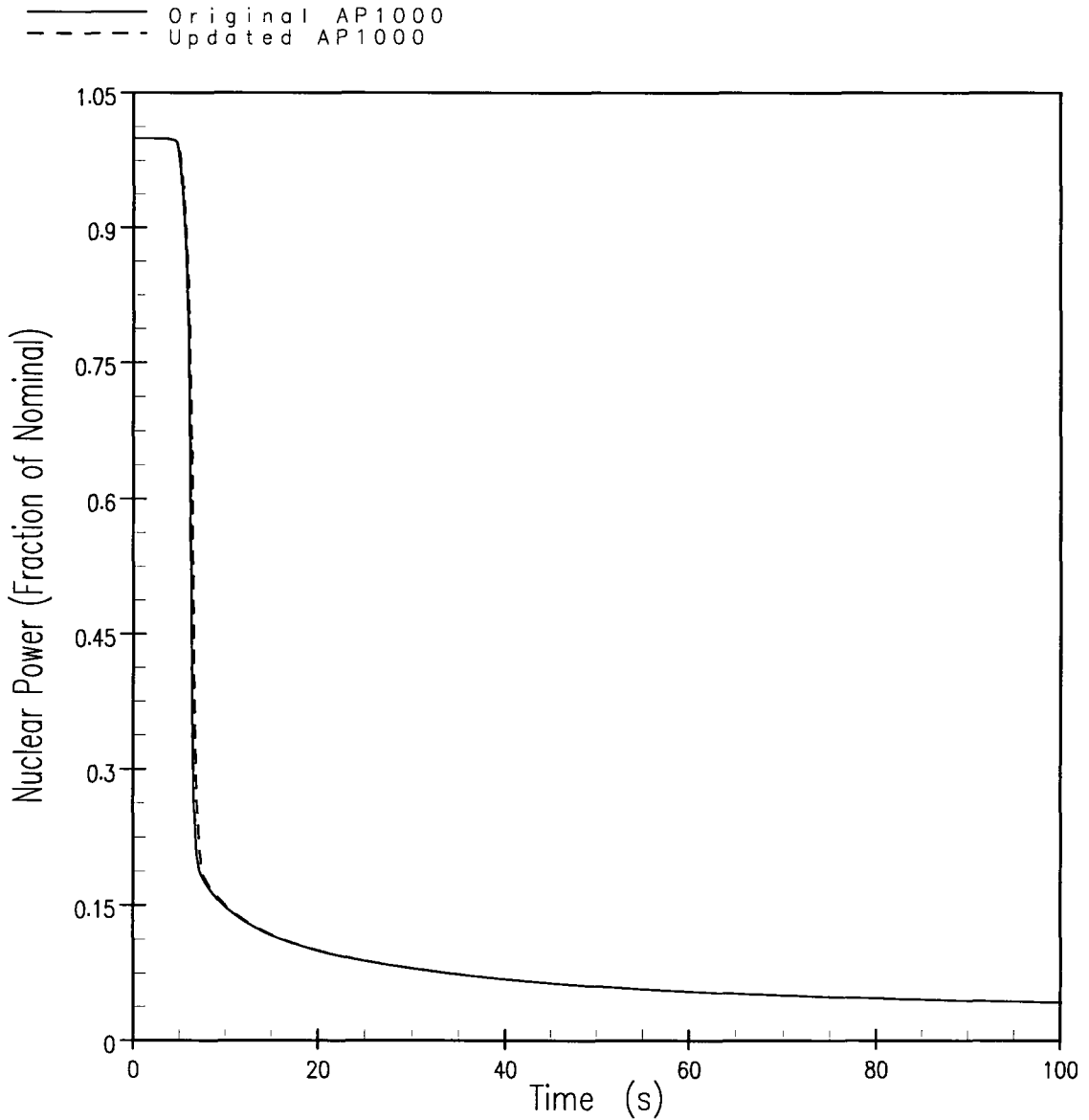


Figure 2-7  
Turbine Trip  
(Minimum DNBR Case)

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

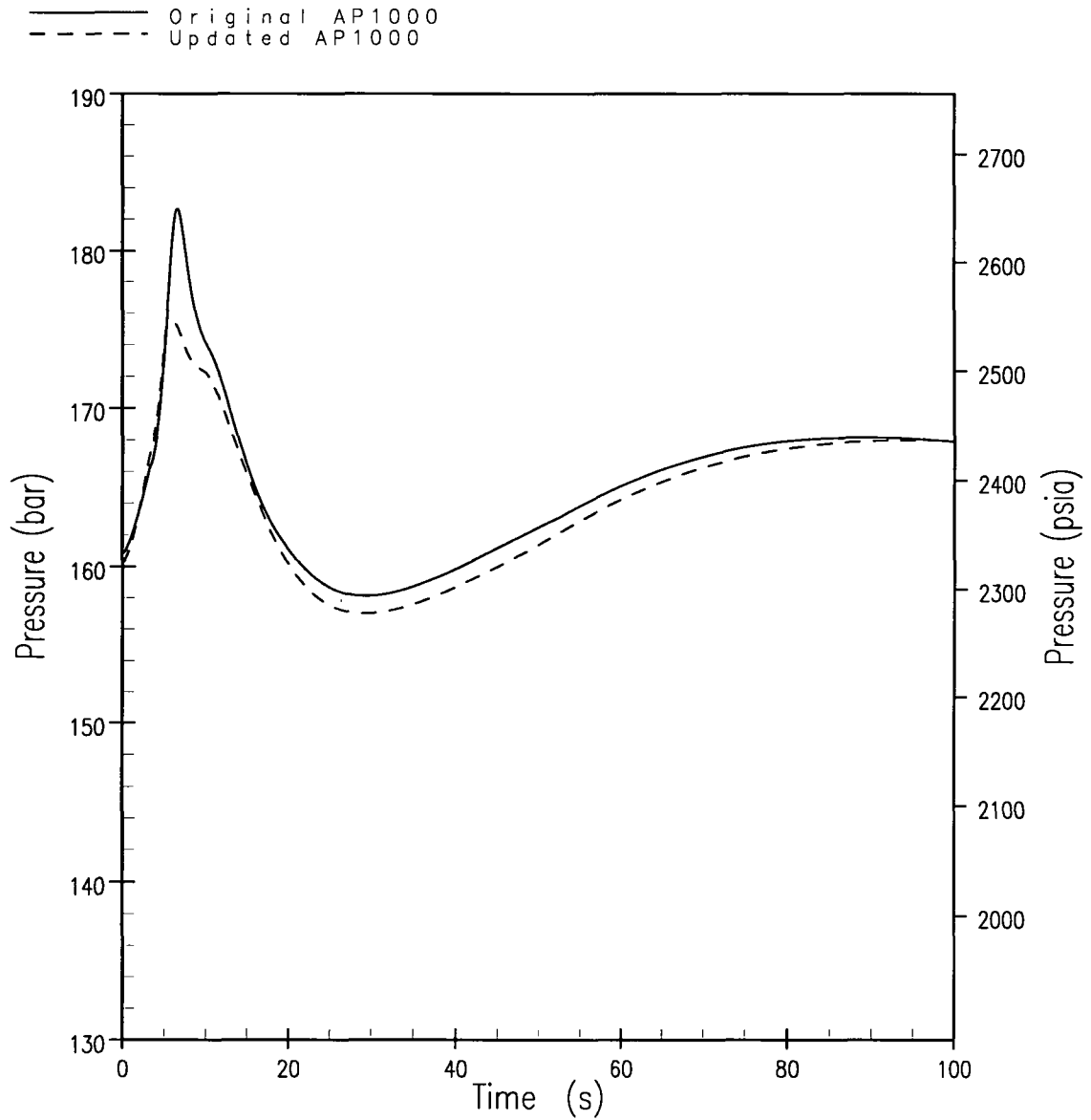


Figure 2-8 RCP Outlet Pressure  
Turbine Trip  
(Minimum DNBR Case)

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

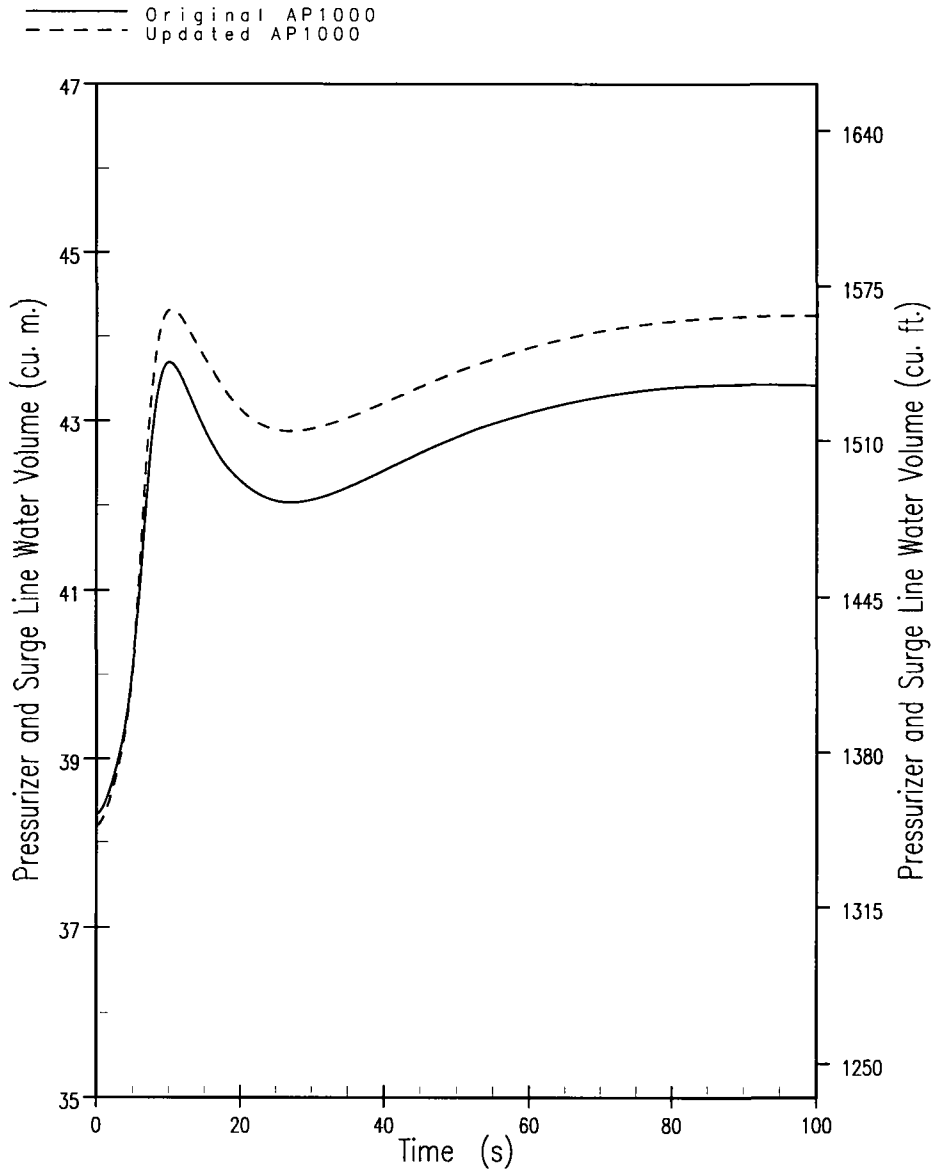


Figure 2-9  
Turbine Trip  
(Minimum DNBR Case)

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

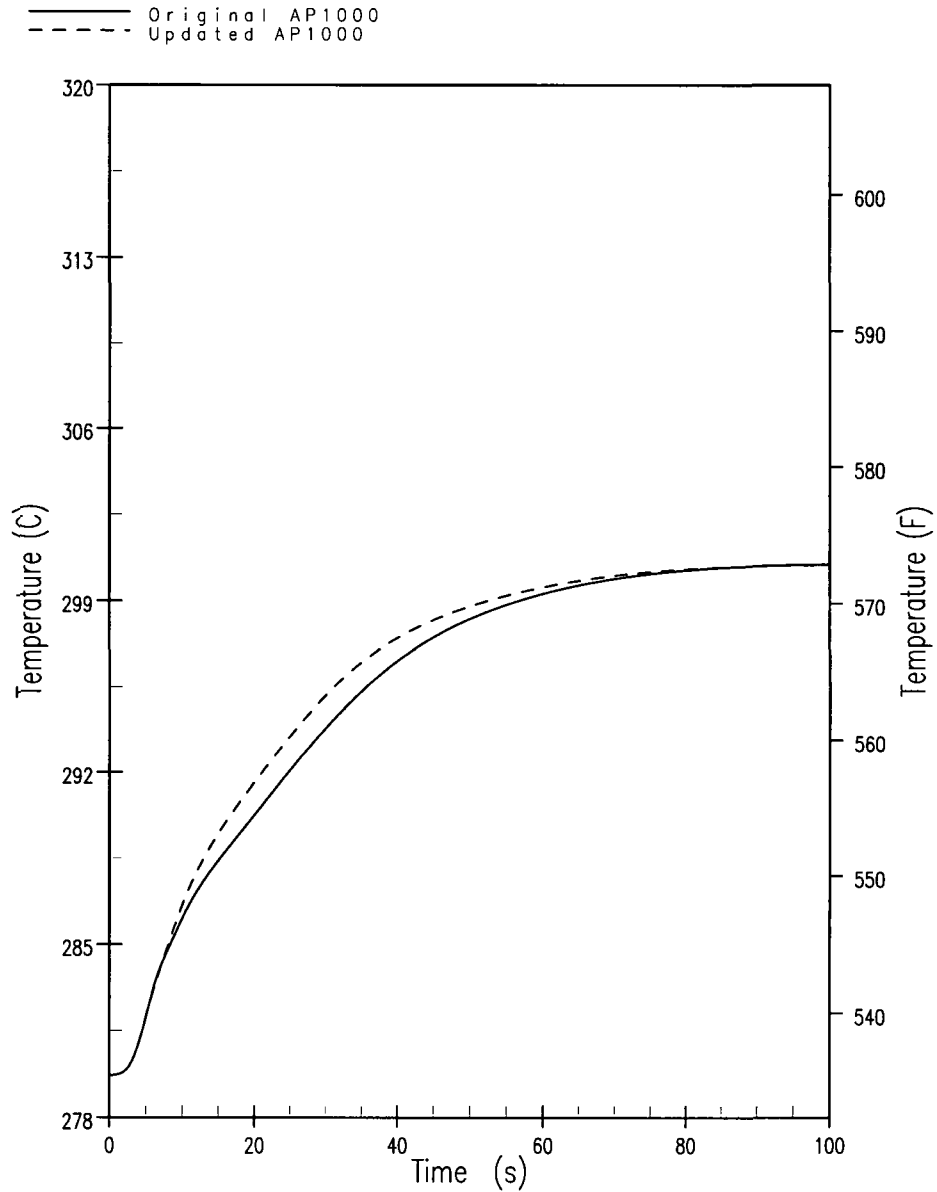


Figure 2-10 Vessel Inlet Temperature  
Turbine Trip  
(Minimum DNBR Case)

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

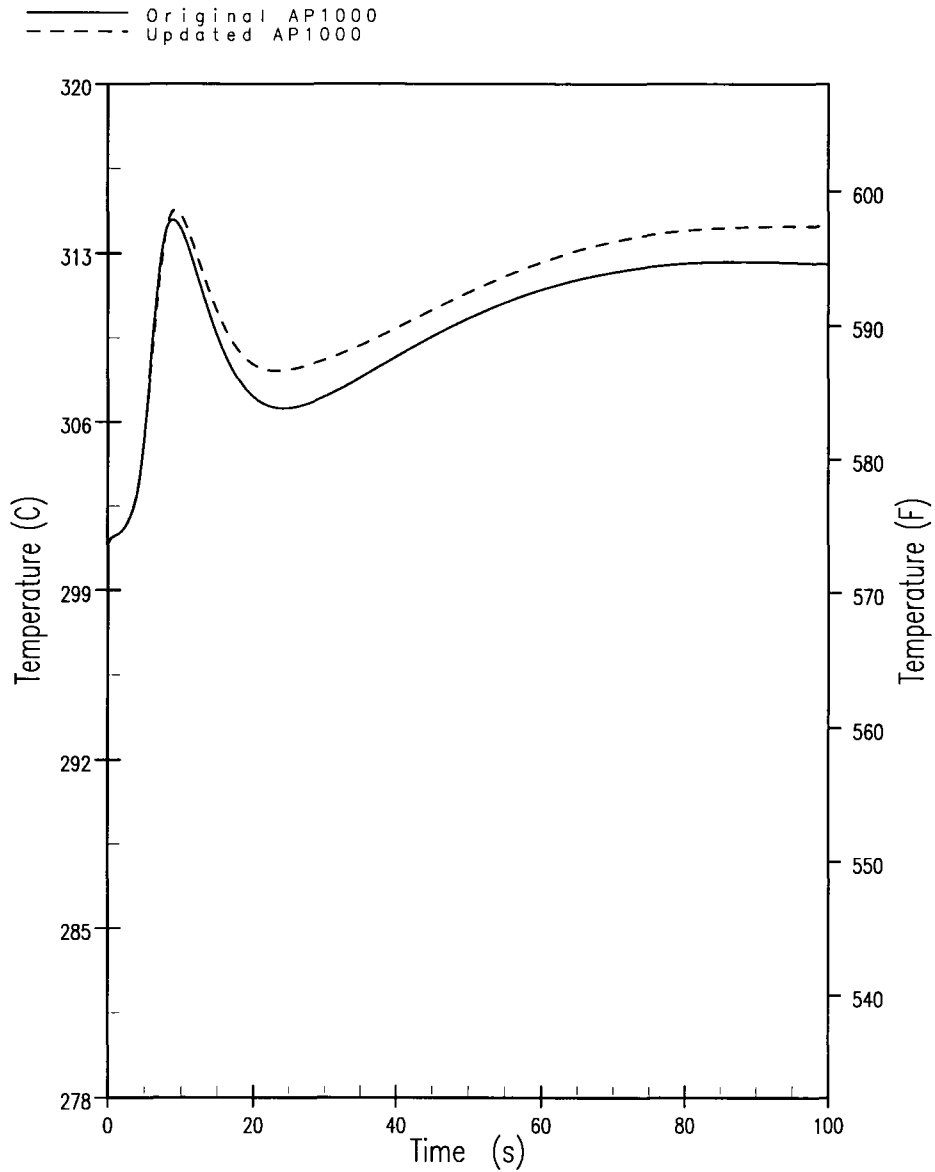


Figure 2-11 Vessel Average Temperature  
Turbine Trip  
(Minimum DNBR Case)

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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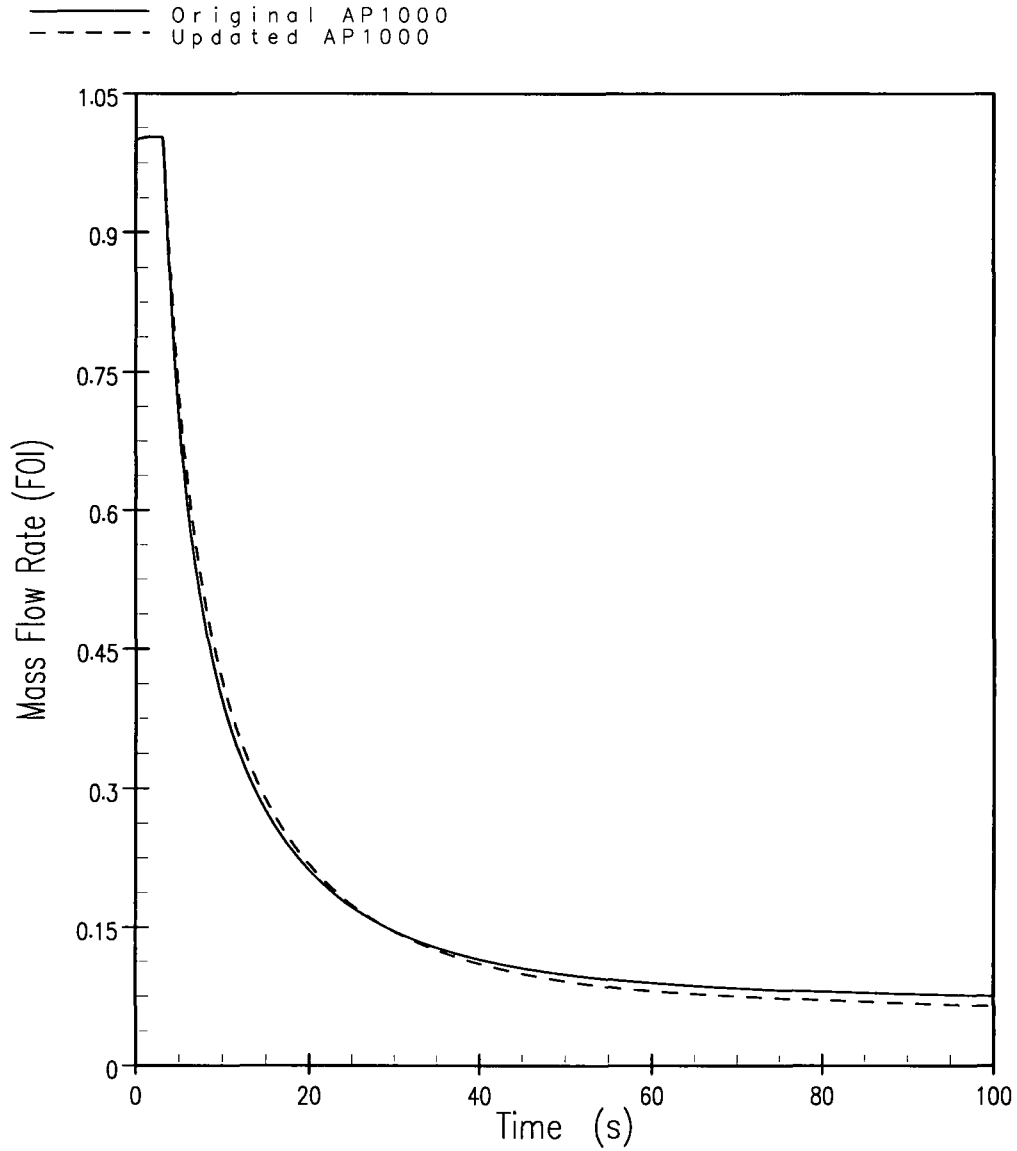


Figure 2-12  
Turbine Trip  
(Minimum DNBR Case)

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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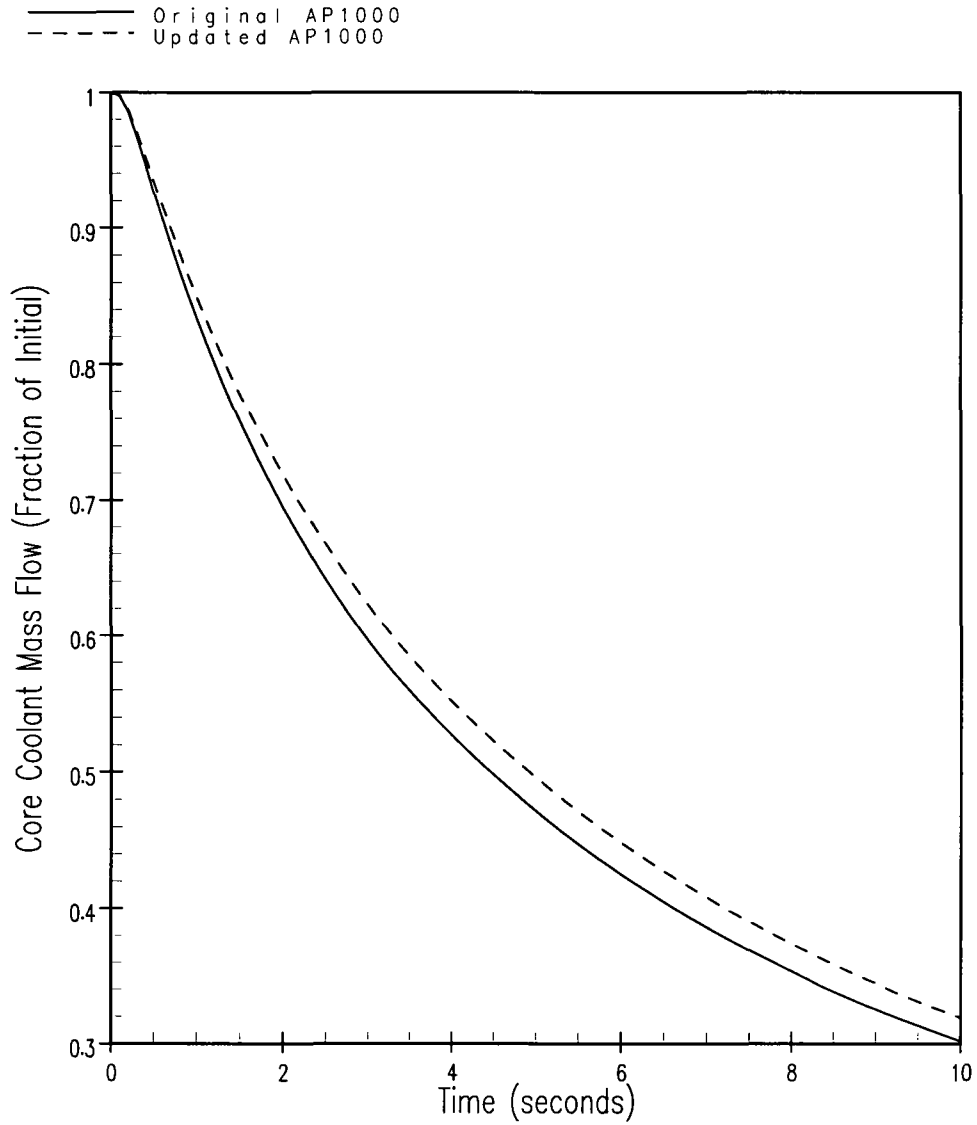


Figure 3-1  
Complete Loss of Forced Reactor Coolant Flow

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

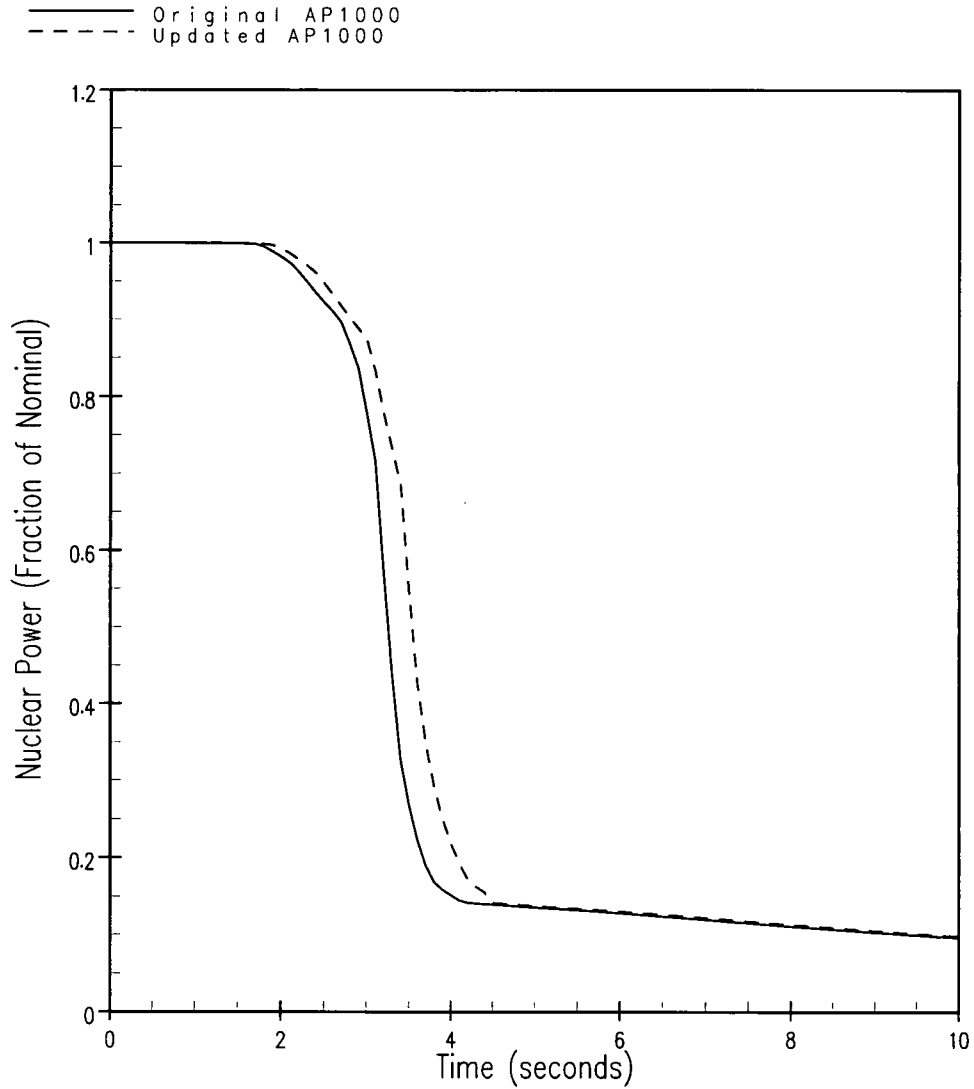


Figure 3-2  
Complete Loss of Forced Reactor Coolant Flow



# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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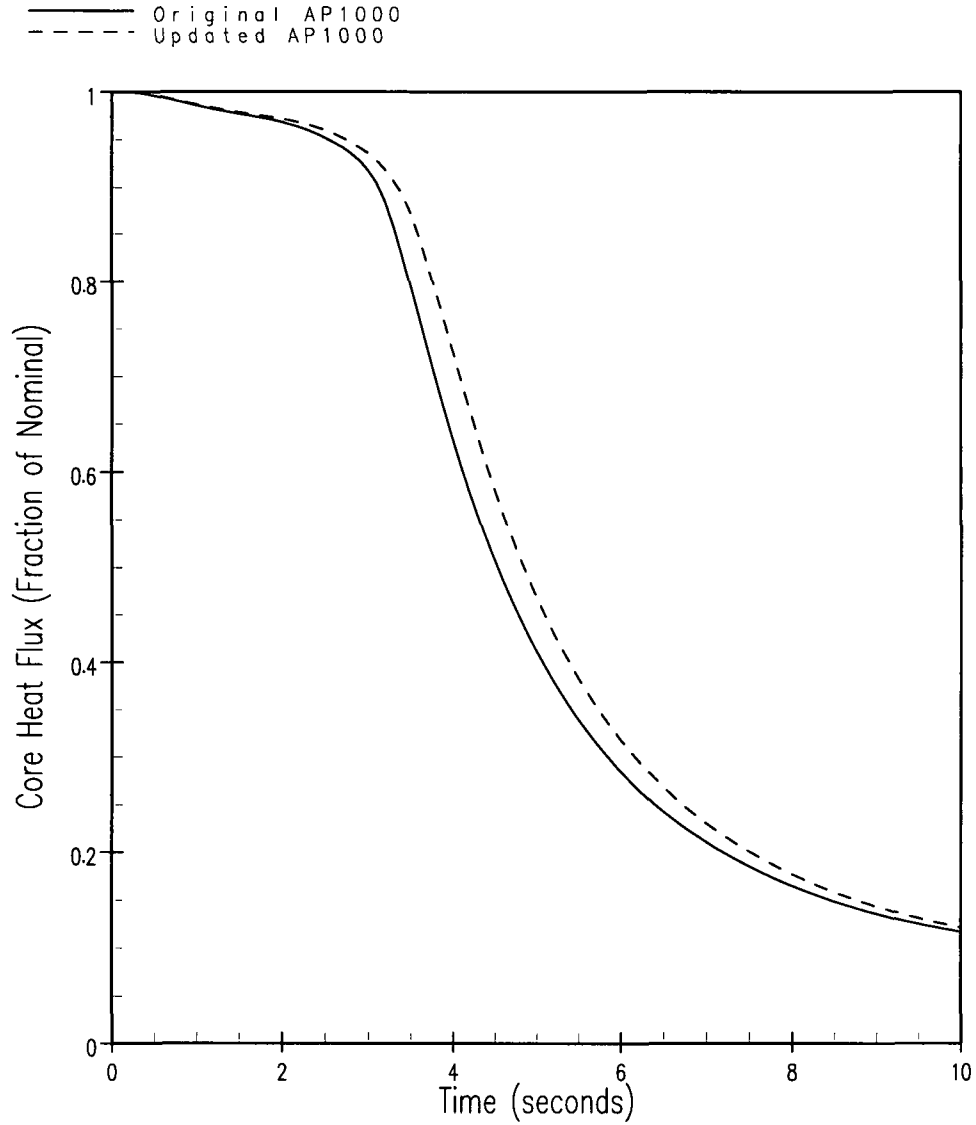


Figure 3-3  
Complete Loss of Forced Reactor Coolant Flow

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

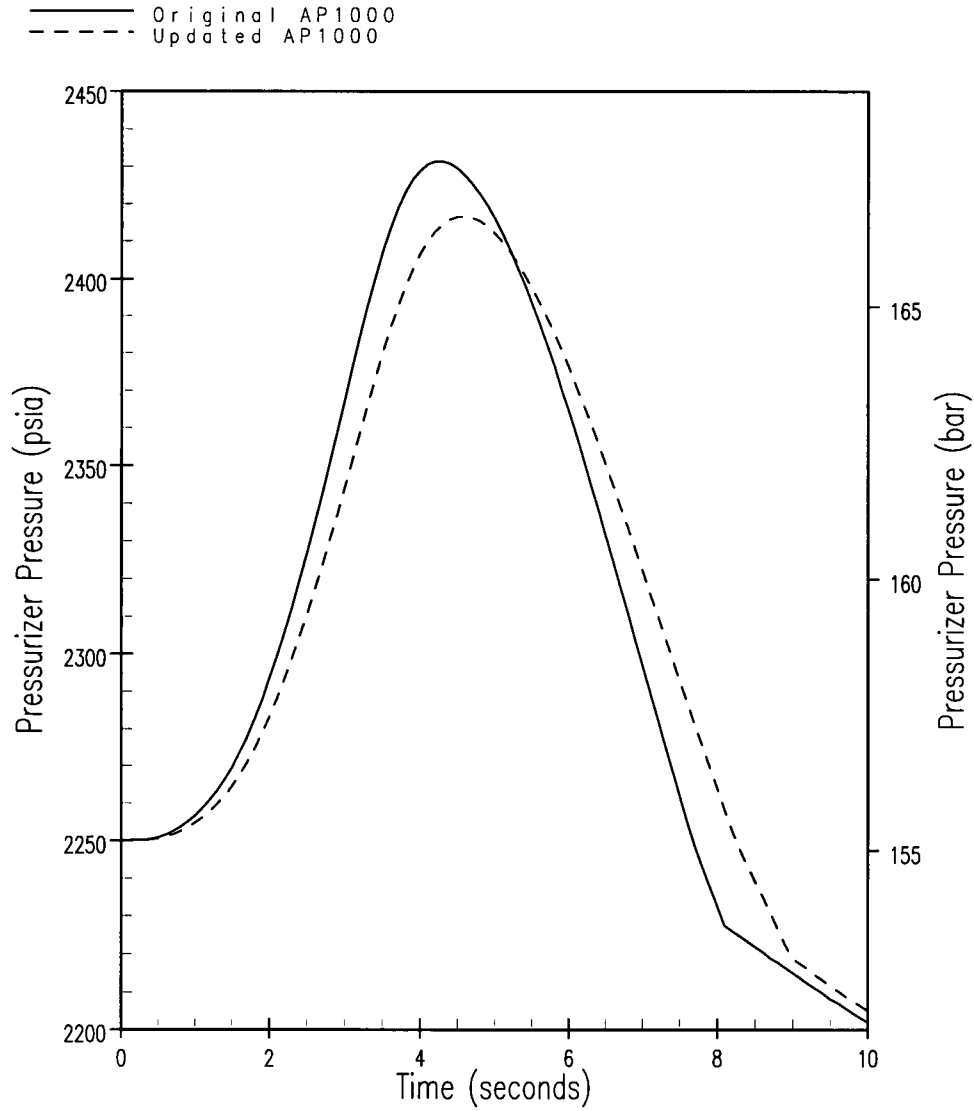


Figure 3-4  
Complete Loss of Forced Reactor Coolant Flow

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

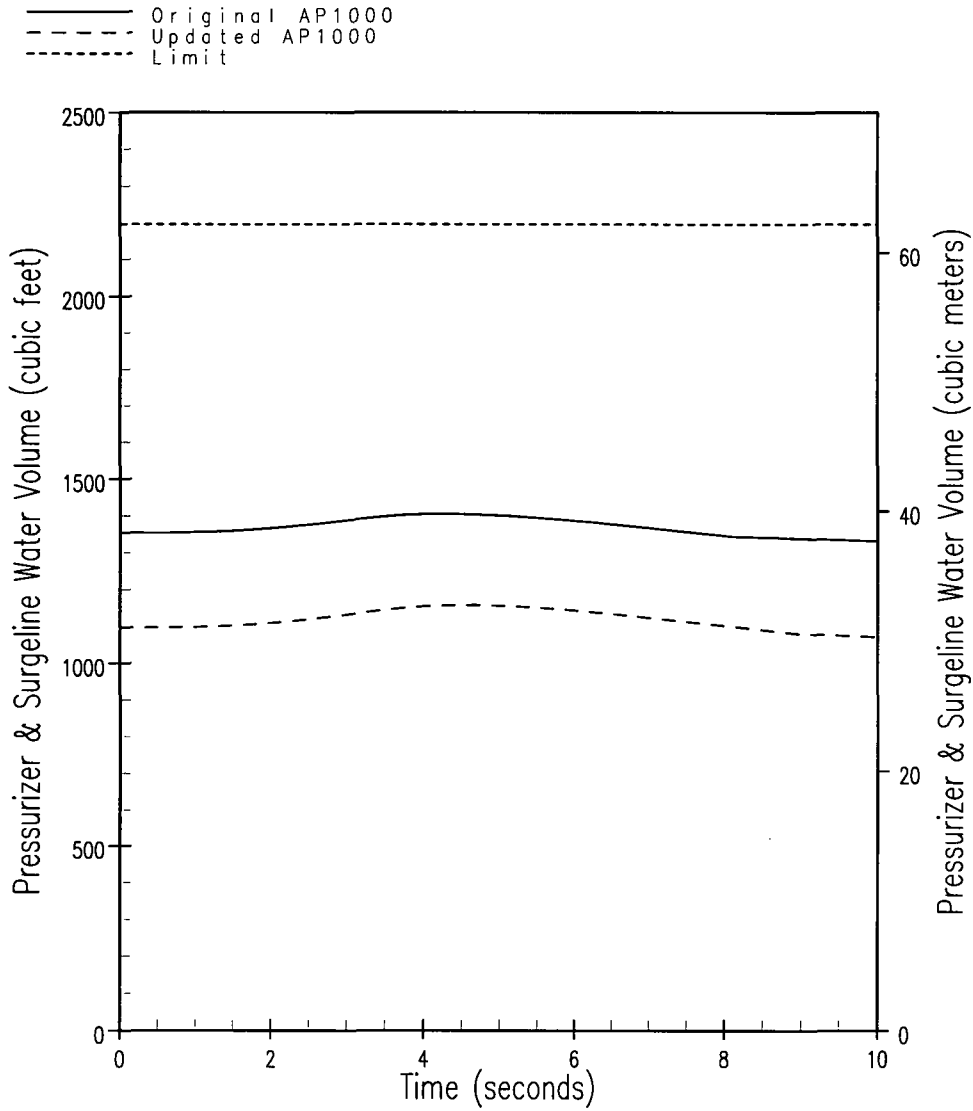


Figure 3-5  
Complete Loss of Forced Reactor Coolant Flow

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

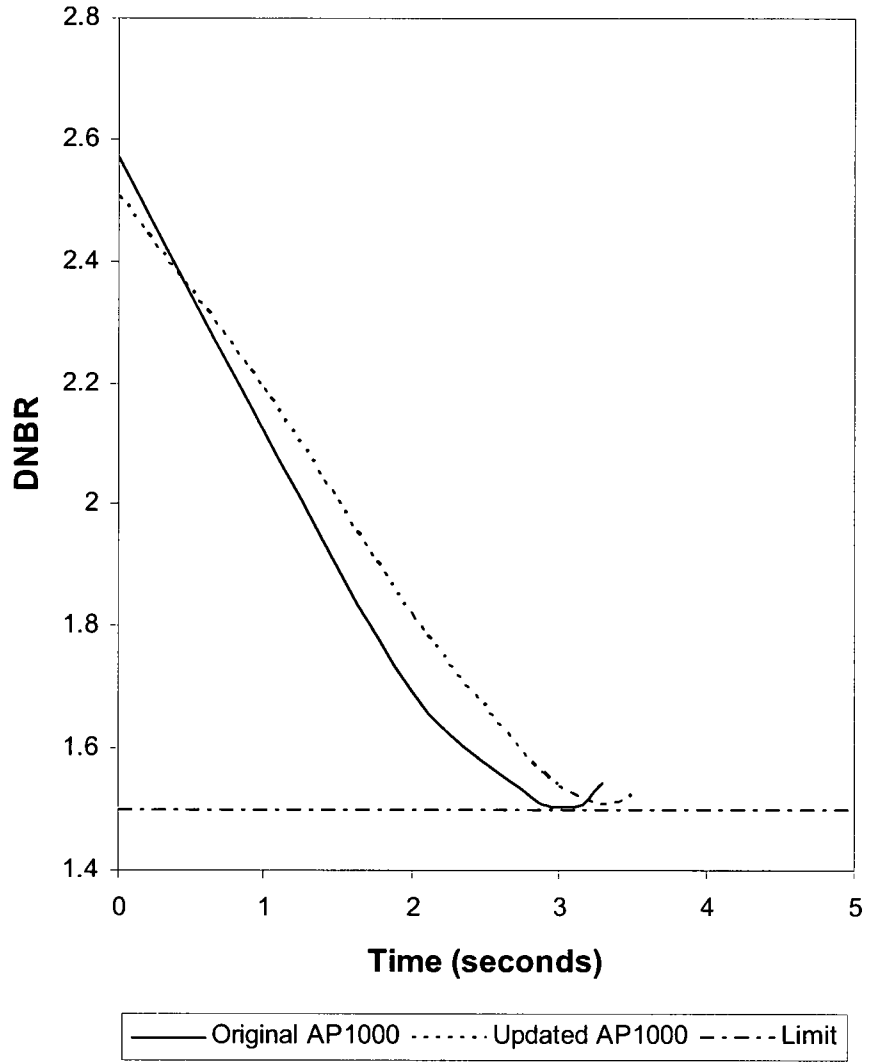


Figure 3-6  
Complete Loss of Forced Reactor Coolant Flow

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

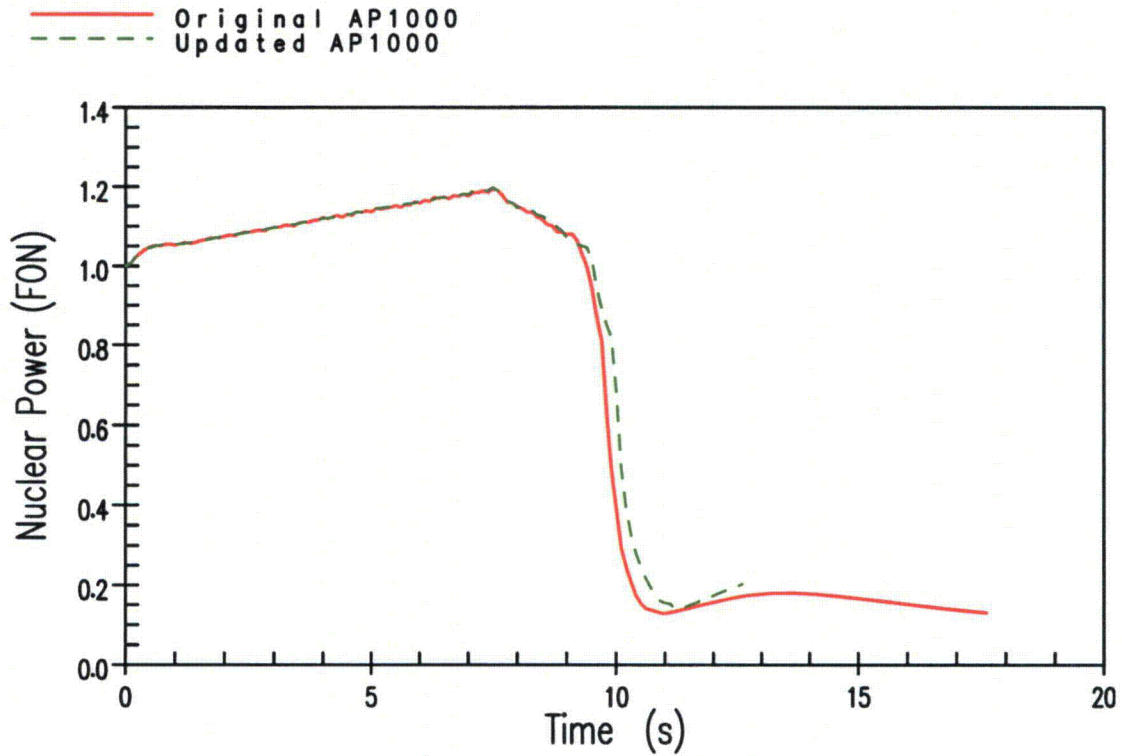


Figure 4-1

Uncontrolled RCCA Bank Withdrawal at Power  
Full Power, Maximum Reactivity Feedback, 75 pcm/s

Nuclear Power vs. Time

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

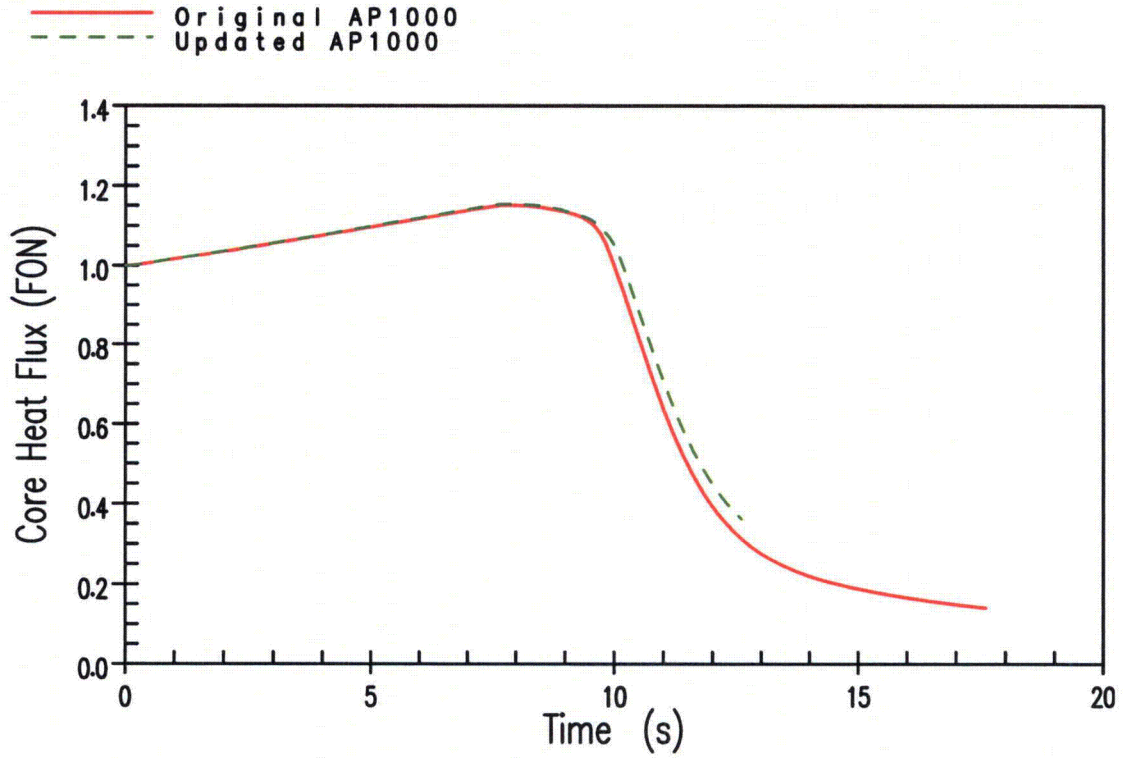


Figure 4-2

Uncontrolled RCCA Bank Withdrawal at Power  
Full Power, Maximum Reactivity Feedback, 75 pcm/s

Core Heat Flux vs. Time

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

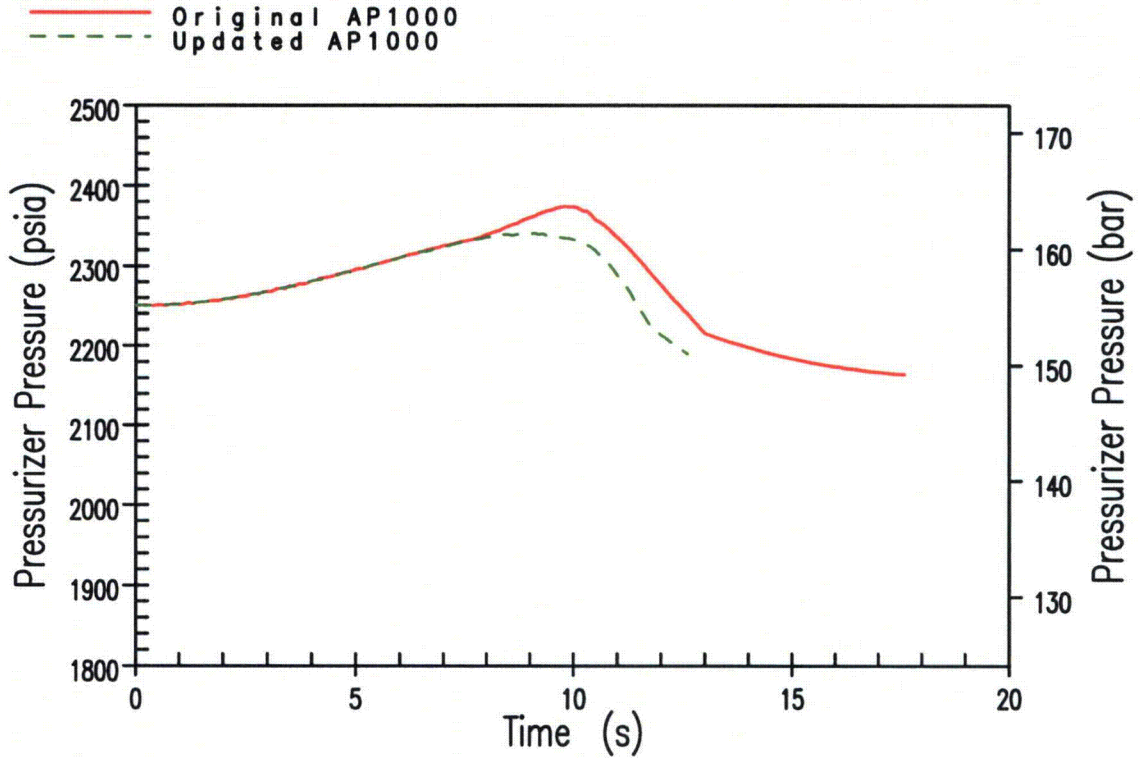


Figure 4-3

Uncontrolled RCCA Bank Withdrawal at Power  
Full Power, Maximum Reactivity Feedback, 75 pcm/s

Pressurizer Pressure vs. Time

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

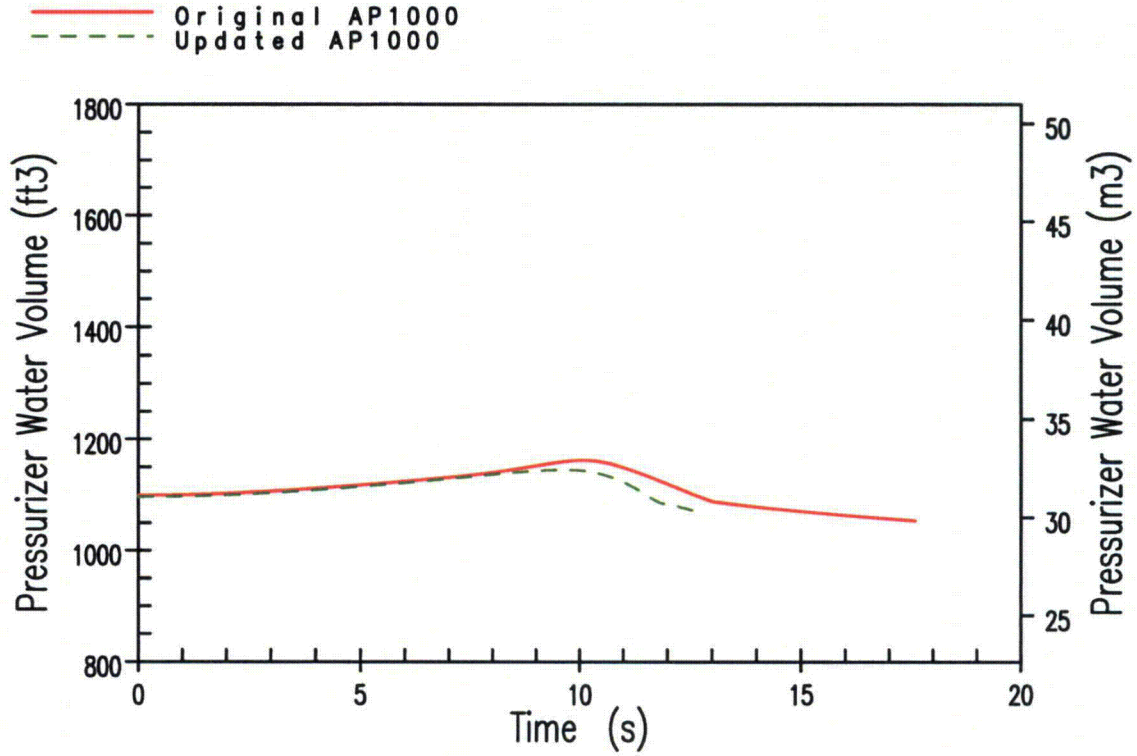


Figure 4-4

Uncontrolled RCCA Bank Withdrawal at Power  
Full Power, Maximum Reactivity Feedback, 75 pcm/s

Pressurizer Water Volume vs. Time



# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

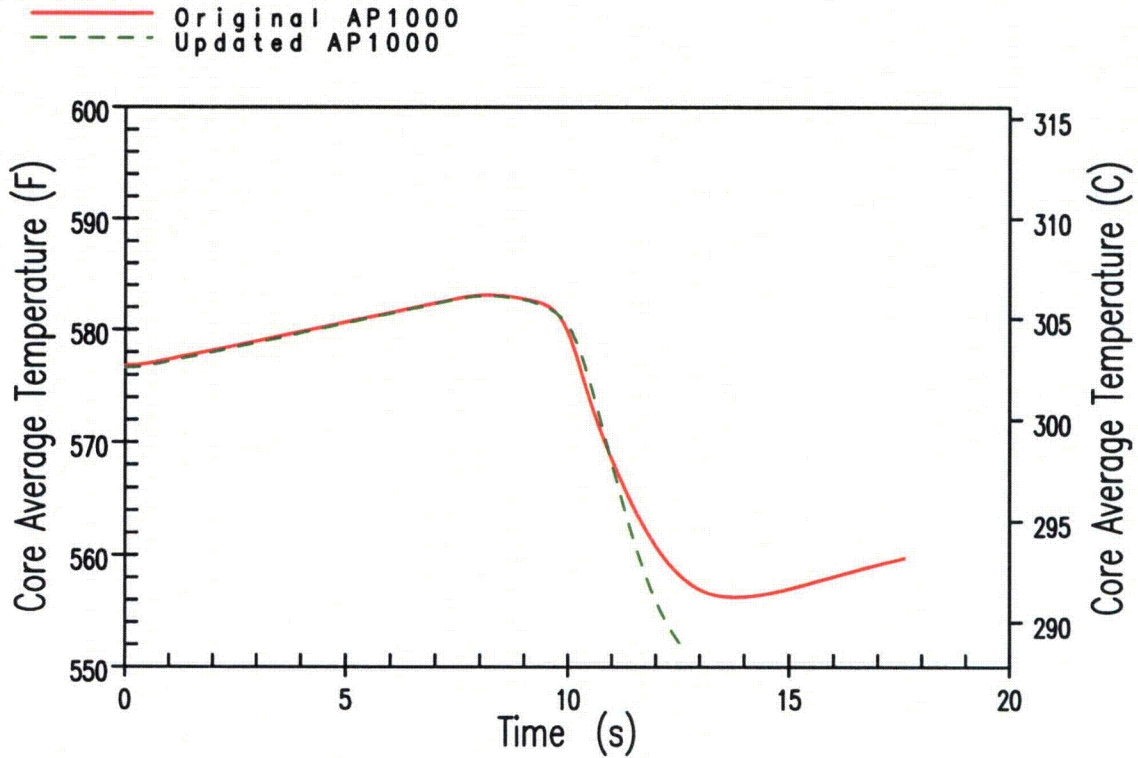


Figure 4-5

Uncontrolled RCCA Bank Withdrawal at Power  
Full Power, Maximum Reactivity Feedback, 75 pcm/s

Core Average Temperature vs. Time

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

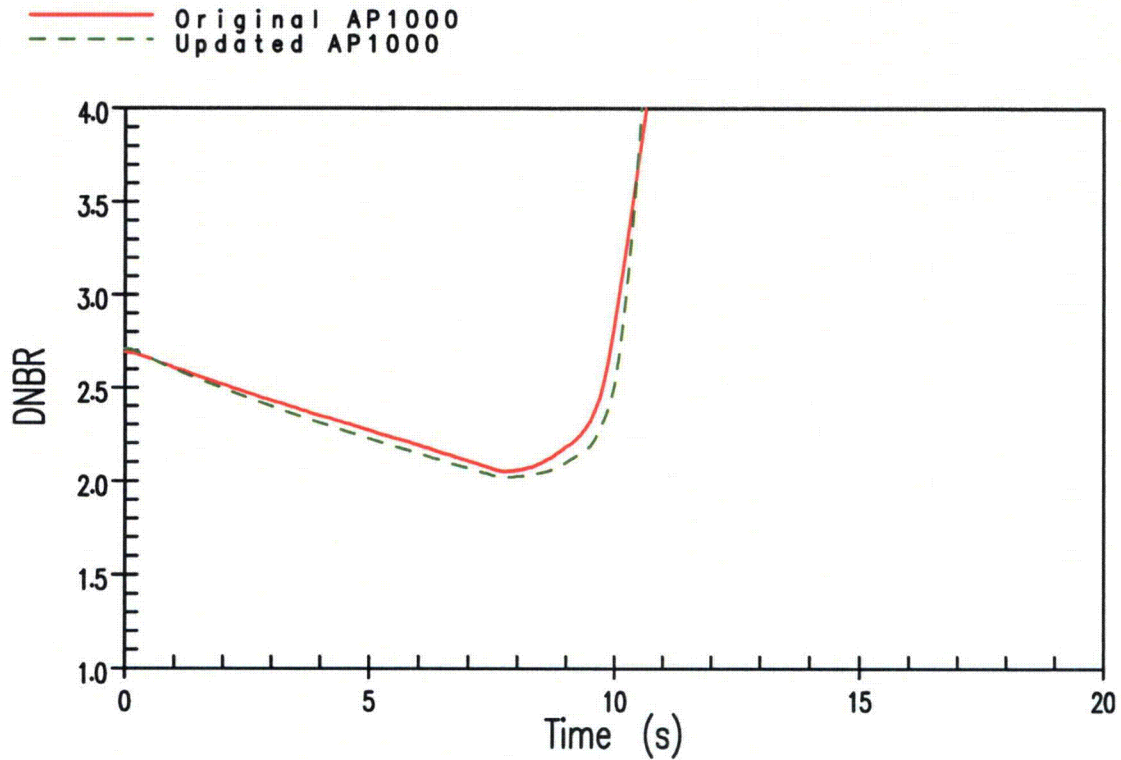


Figure 4-6

Uncontrolled RCCA Bank Withdrawal at Power  
Full Power, Maximum Reactivity Feedback, 75 pcm/s

DNB Ratio vs. Time

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

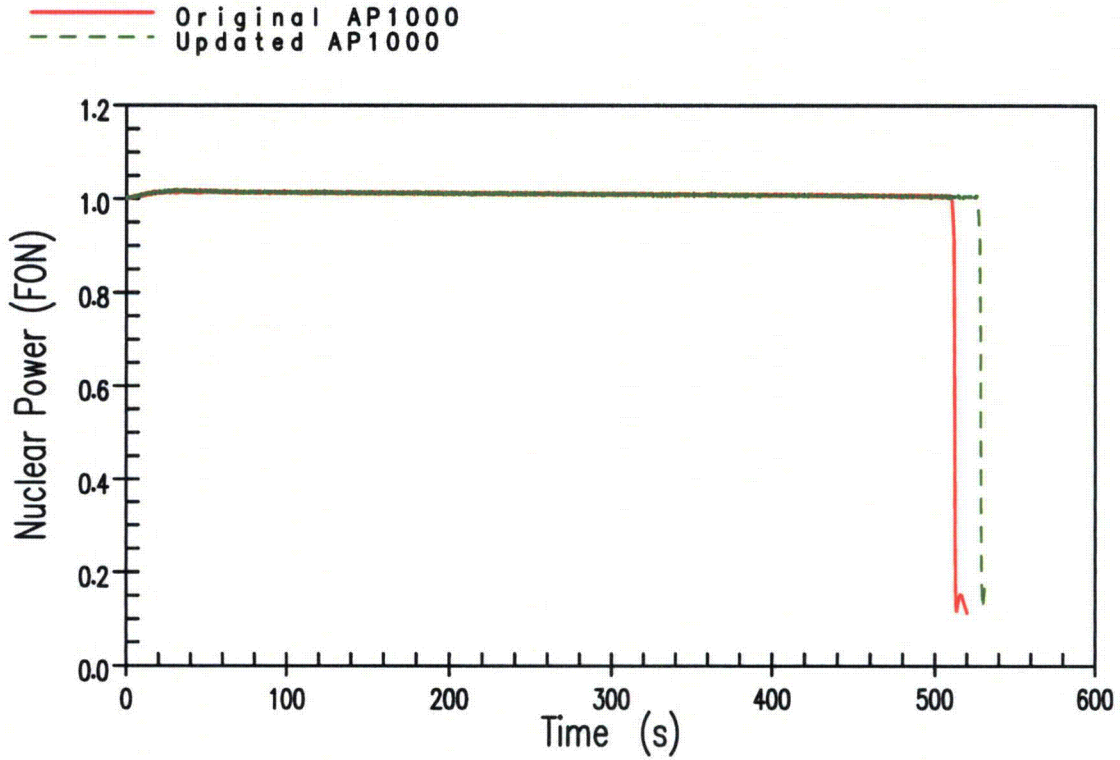


Figure 4-7

Uncontrolled RCCA Bank Withdrawal at Power  
Full Power, Maximum Reactivity Feedback, 3 pcm/s

Nuclear Power vs. Time

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

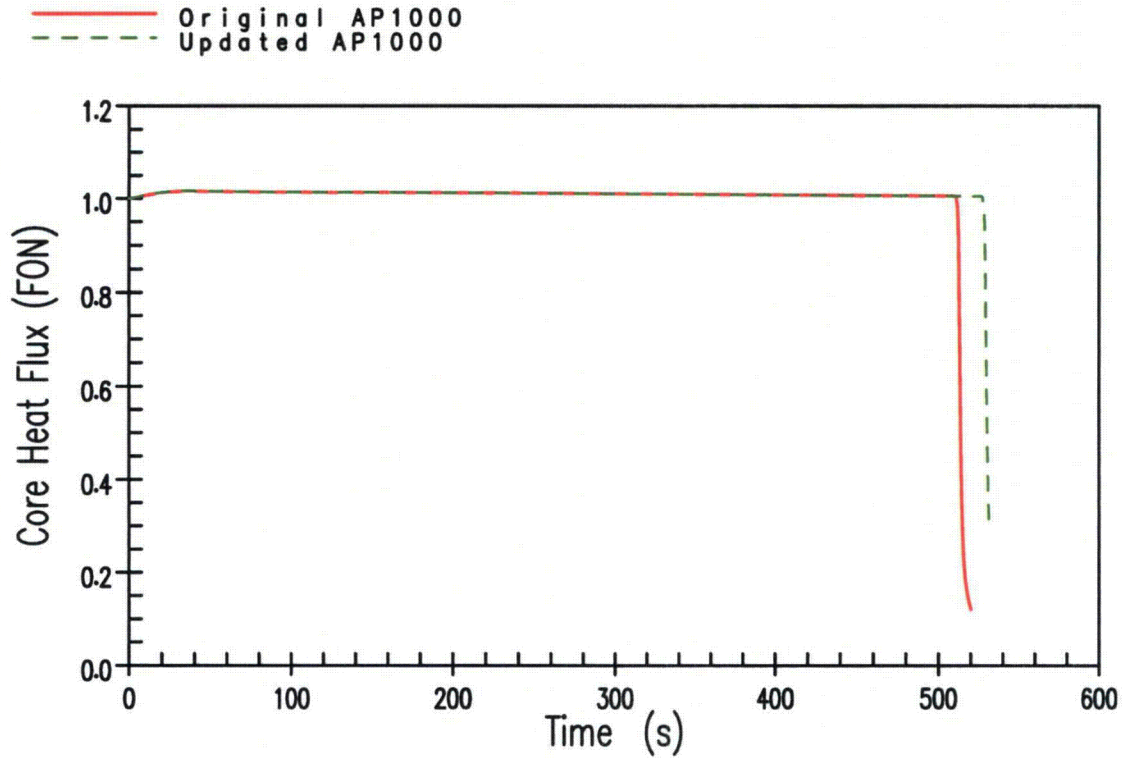


Figure 4-8

Uncontrolled RCCA Bank Withdrawal at Power  
Full Power, Maximum Reactivity Feedback, 3 pcm/s

Core Heat Flux vs. Time

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

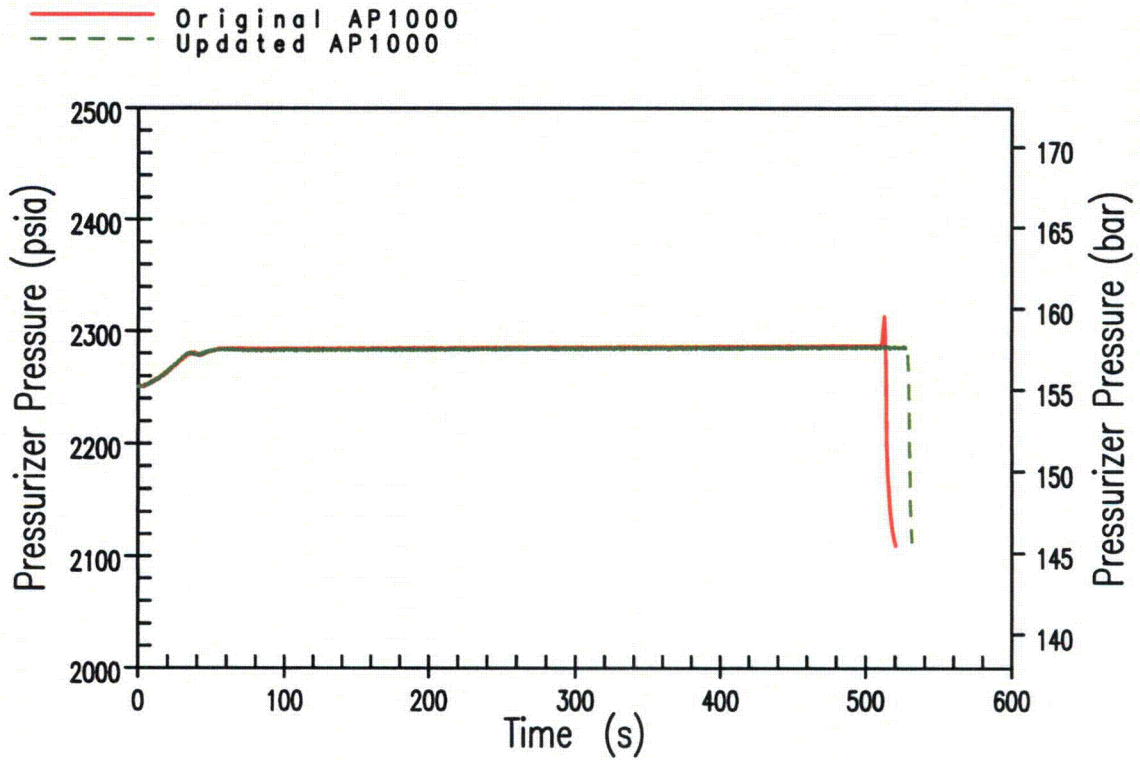


Figure 4-9

Uncontrolled RCCA Bank Withdrawal at Power  
Full Power, Maximum Reactivity Feedback, 3 pcm/s

Pressurizer Pressure vs. Time

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

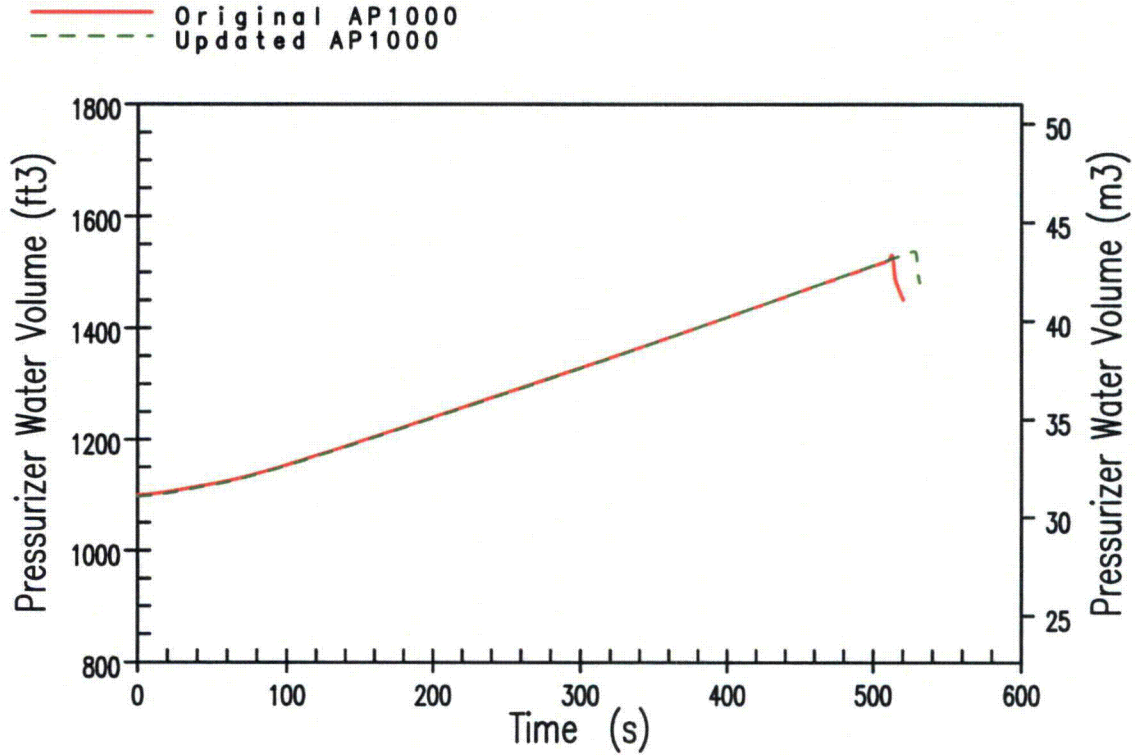


Figure 4-10

Uncontrolled RCCA Bank Withdrawal at Power  
Full Power, Maximum Reactivity Feedback, 3 pcm/s

Pressurizer Water Volume vs. Time

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

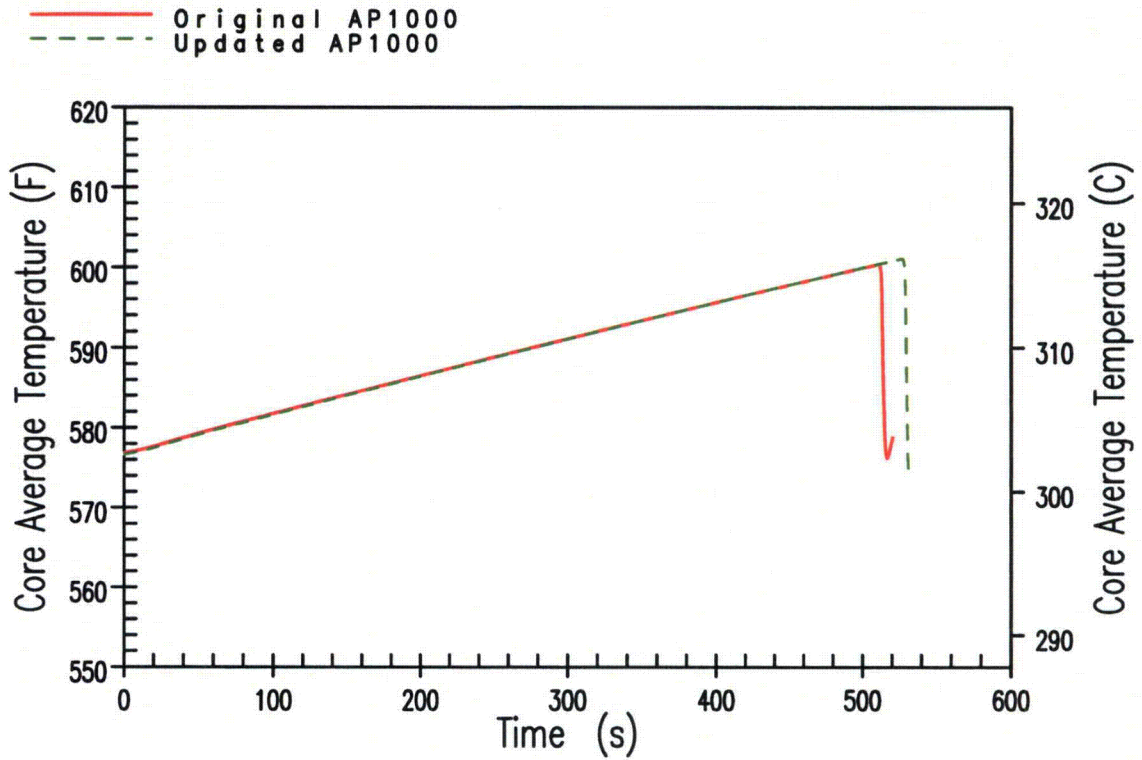


Figure 4-11

Uncontrolled RCCA Bank Withdrawal at Power  
Full Power, Maximum Reactivity Feedback, 3 pcm/s

Core Average Temperature vs. Time

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

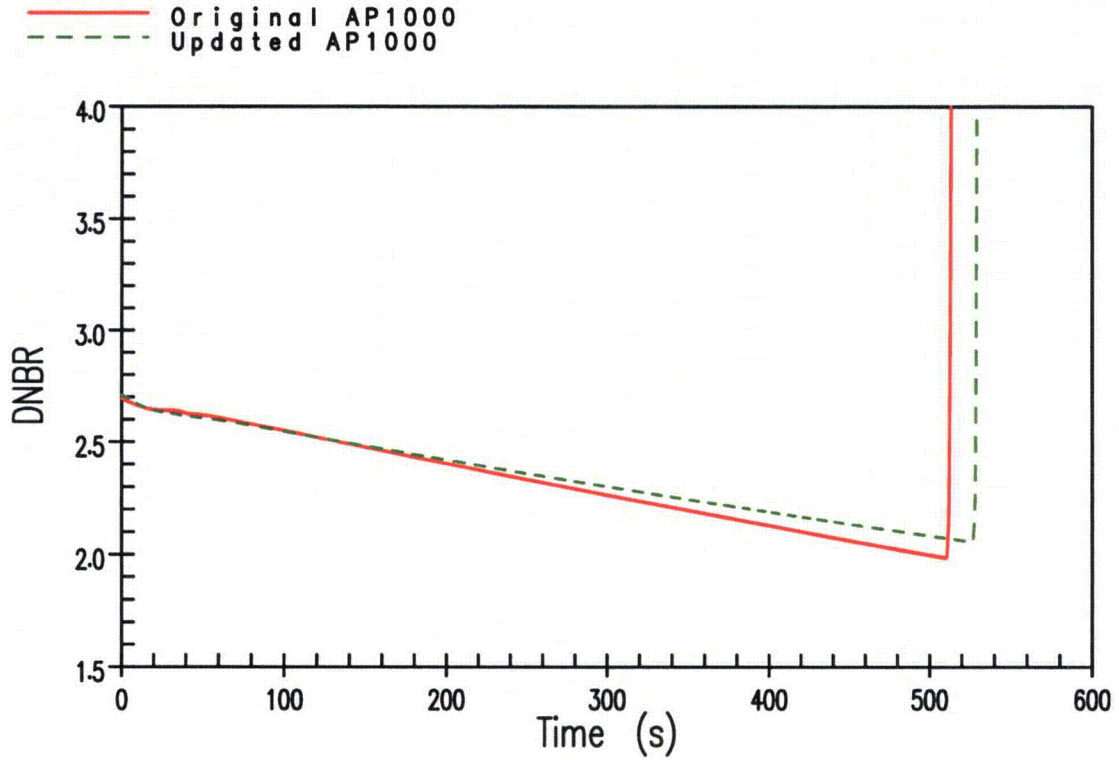


Figure 4-12

Uncontrolled RCCA Bank Withdrawal at Power  
Full Power, Maximum Reactivity Feedback, 3 pcm/s

DNB Ratio vs. Time



# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

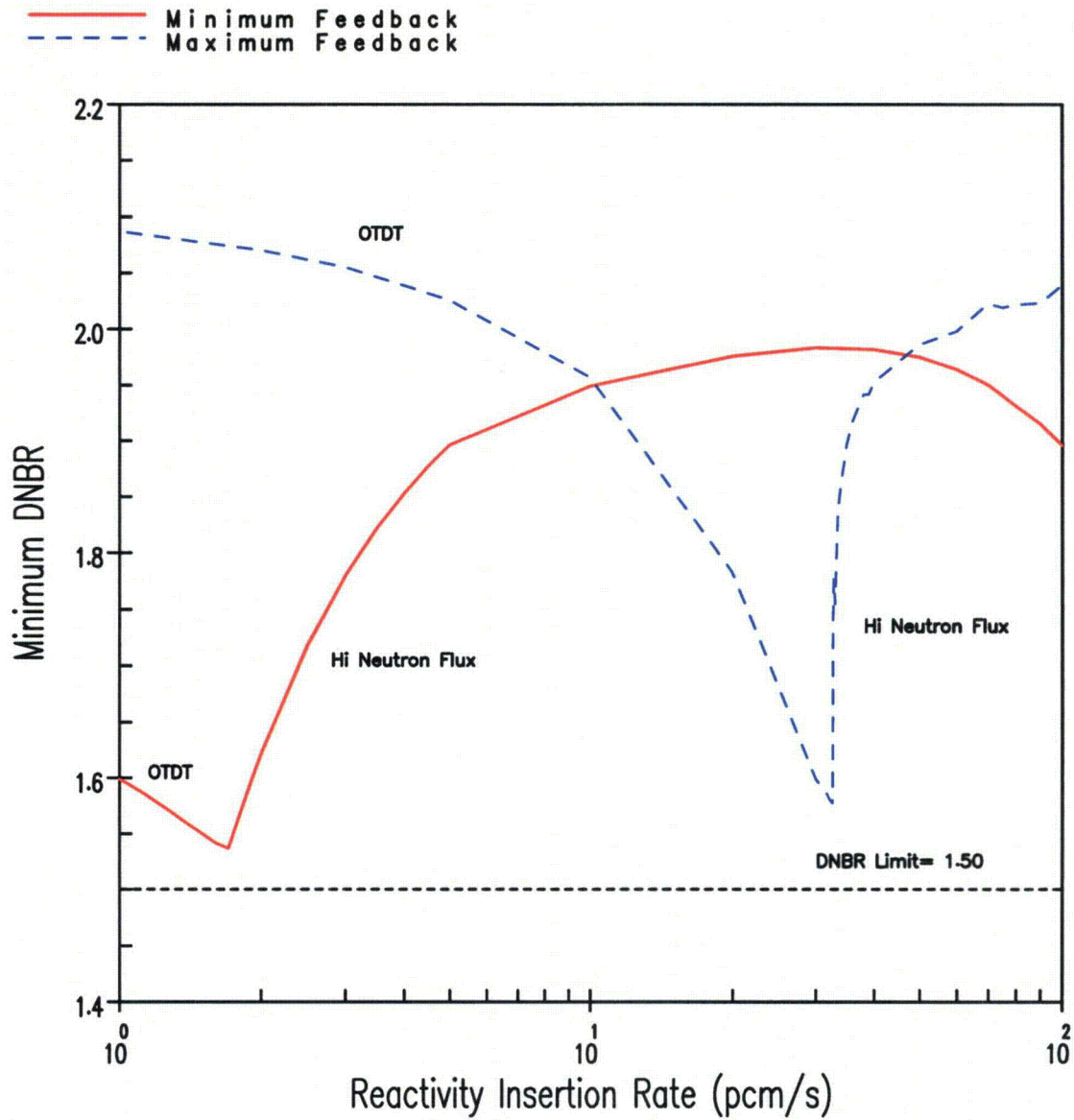


Figure 4-13

Uncontrolled RCCA Bank Withdrawal at Power  
100 Percent Power

Minimum DNBR Ratio vs. Reactivity Insertion Rate

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

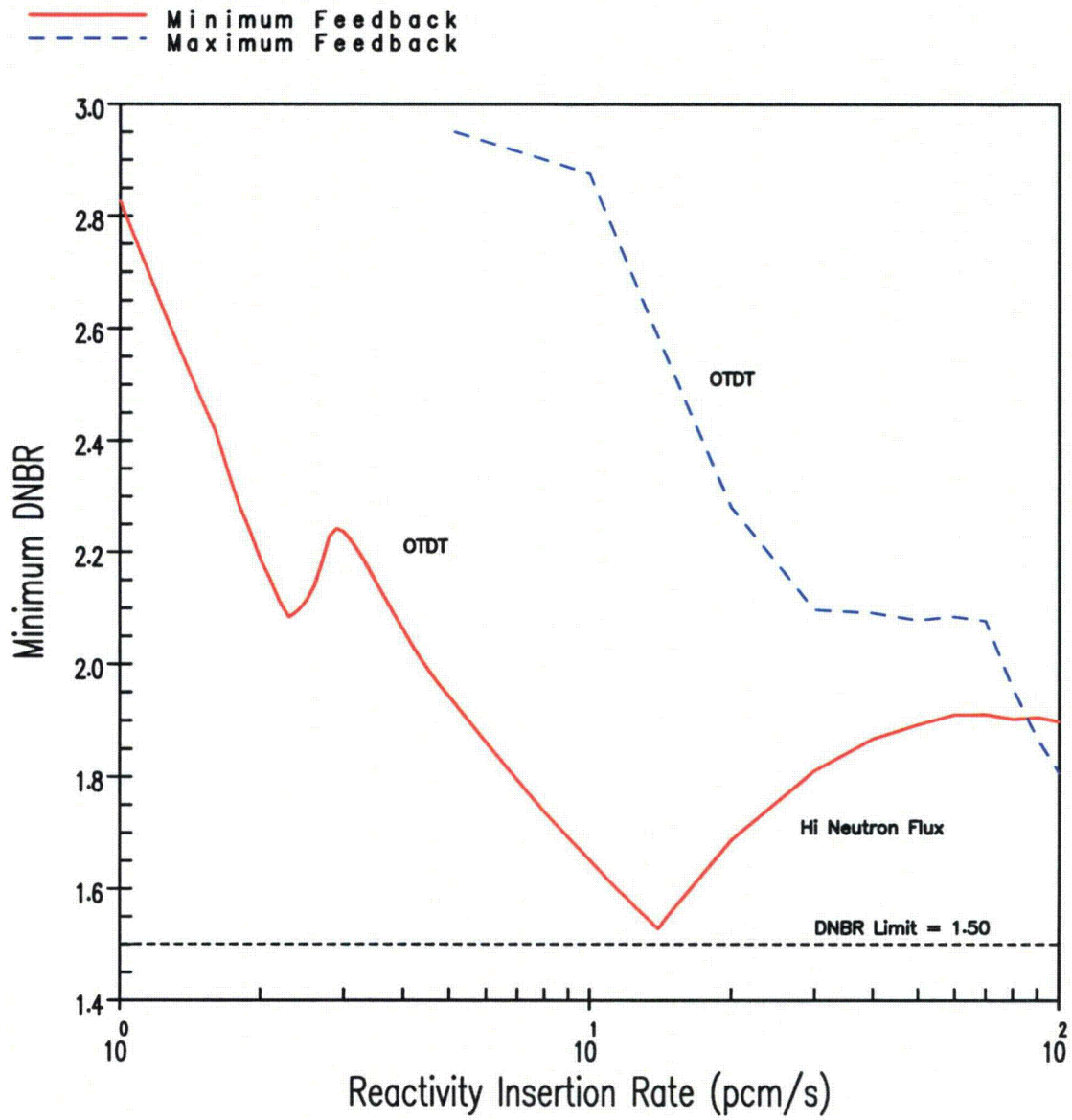


Figure 4-14

Uncontrolled RCCA Bank Withdrawal at Power  
60 Percent Power

Minimum DNBR Ratio vs. Reactivity Insertion Rate

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

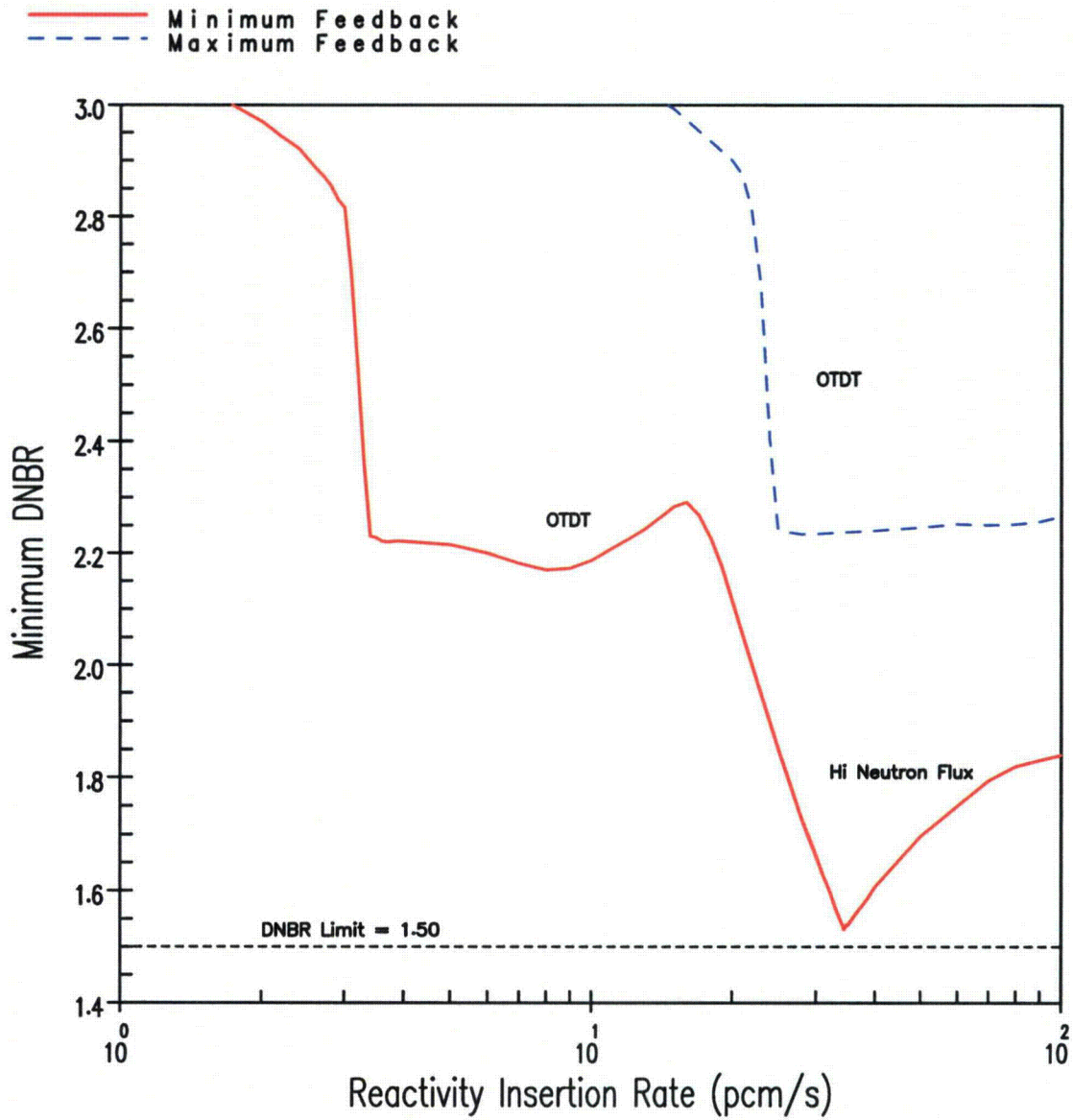


Figure 4-15

Uncontrolled RCCA Bank Withdrawal at Power  
10 Percent Power

Minimum DNB Ratio vs. Reactivity Insertion Rate

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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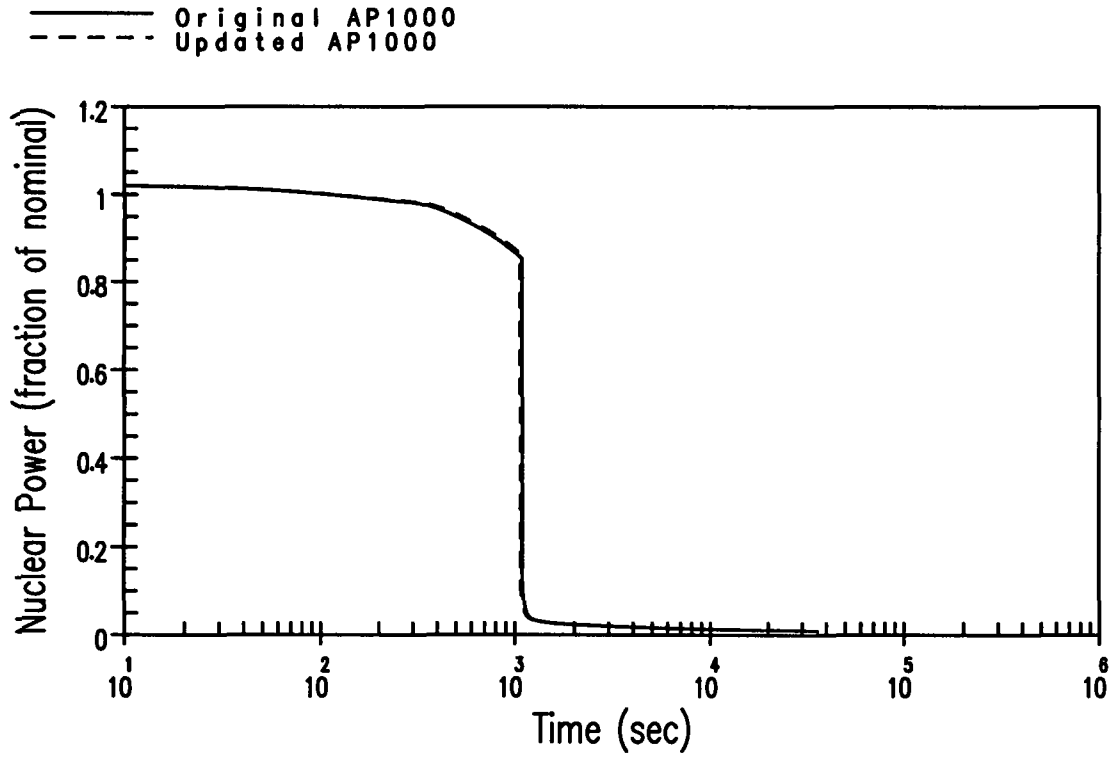


Figure 5-1  
Nuclear Power  
CVS Malfunction

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

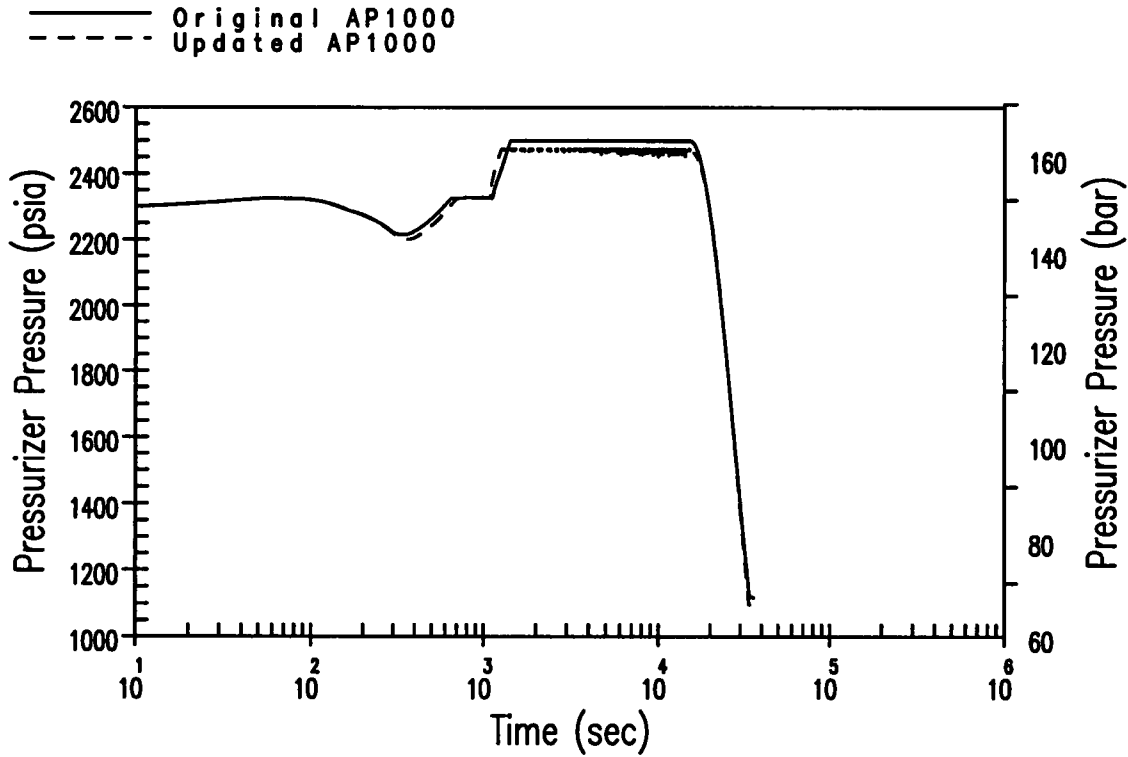


Figure 5-2  
Pressurizer Pressure  
CVS Malfunction

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

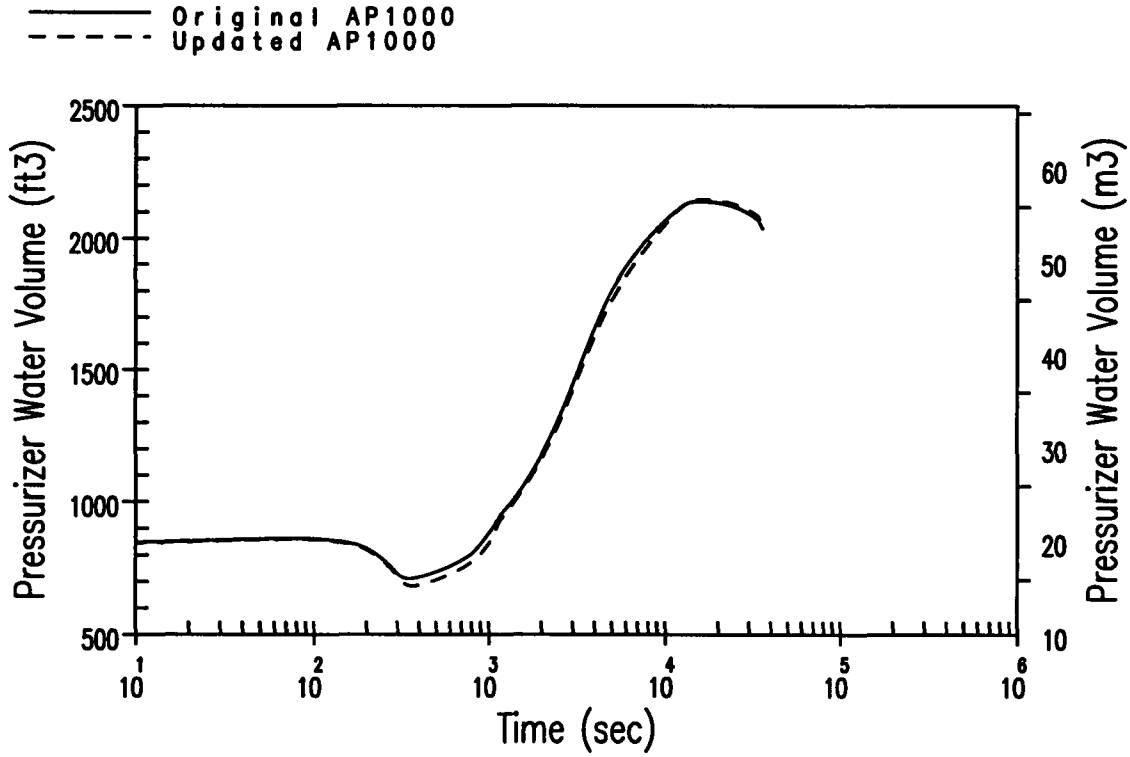


Figure 5-3  
Pressurizer Water Volume  
CVS Malfunction

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

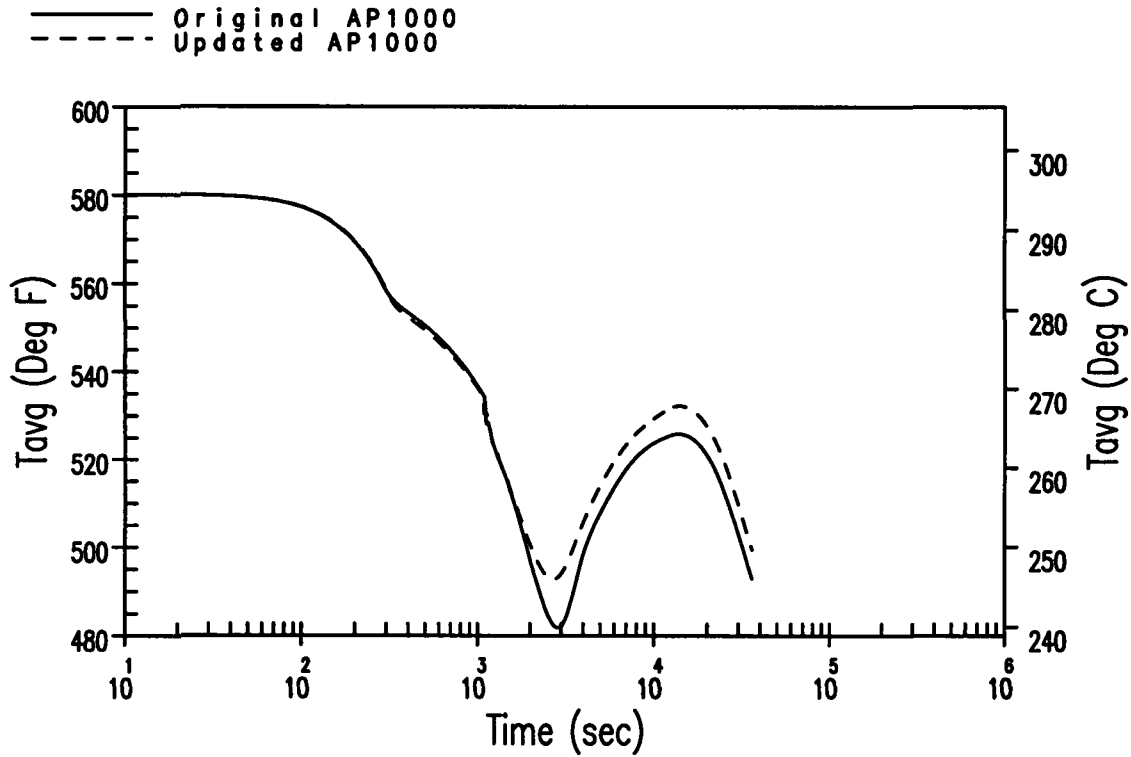


Figure 5-4  
RCS Average Temperature  
CVS Malfunction

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

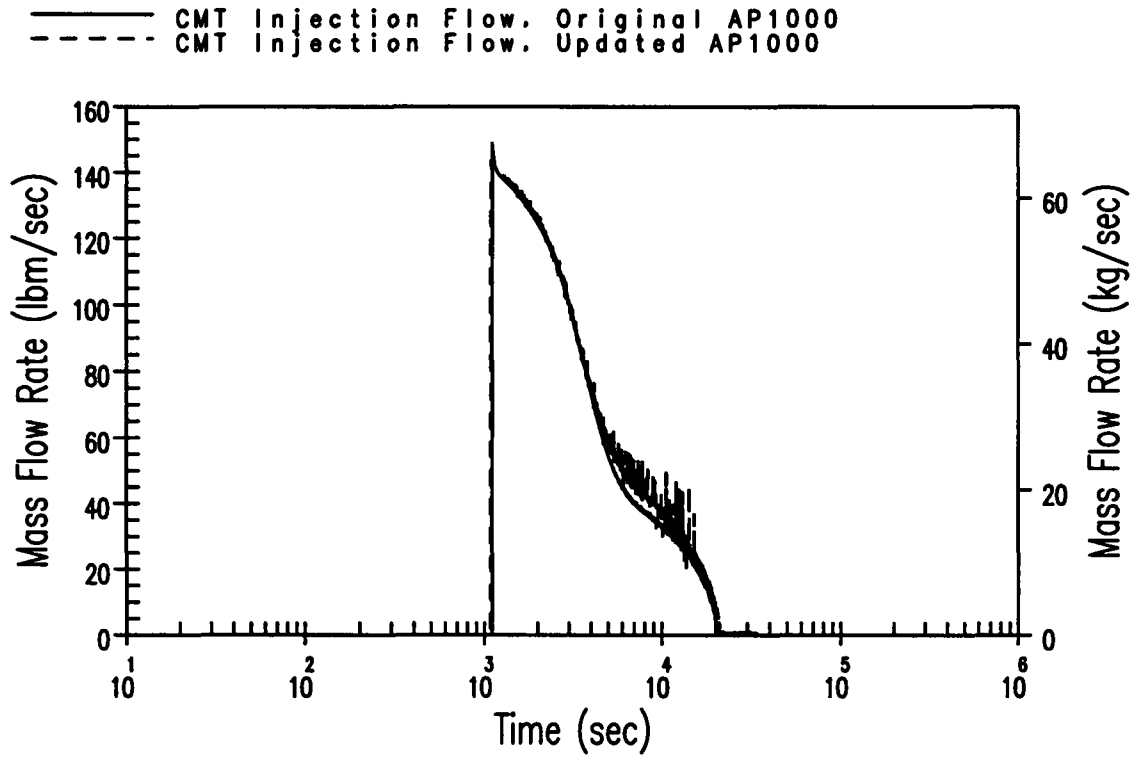


Figure 5-5  
CMT Injection Flow Rate  
CVS Malfunction



# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

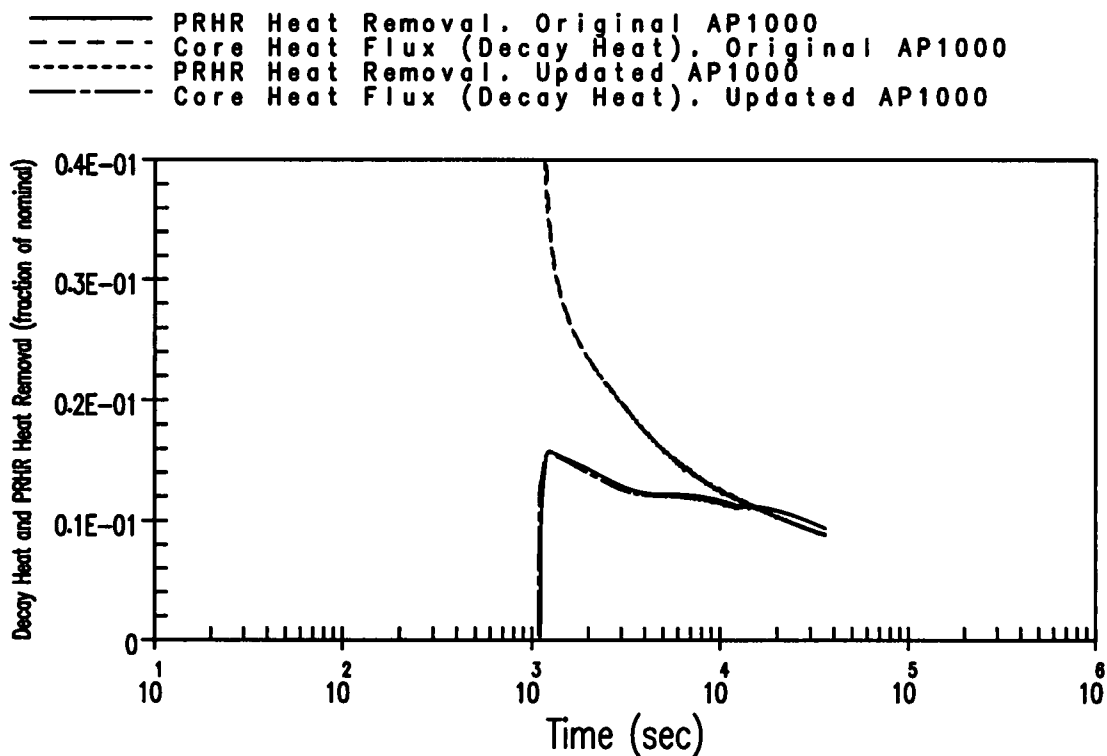


Figure 5-6  
Decay Heat and PRHR Heat Removal  
CVS Malfunction

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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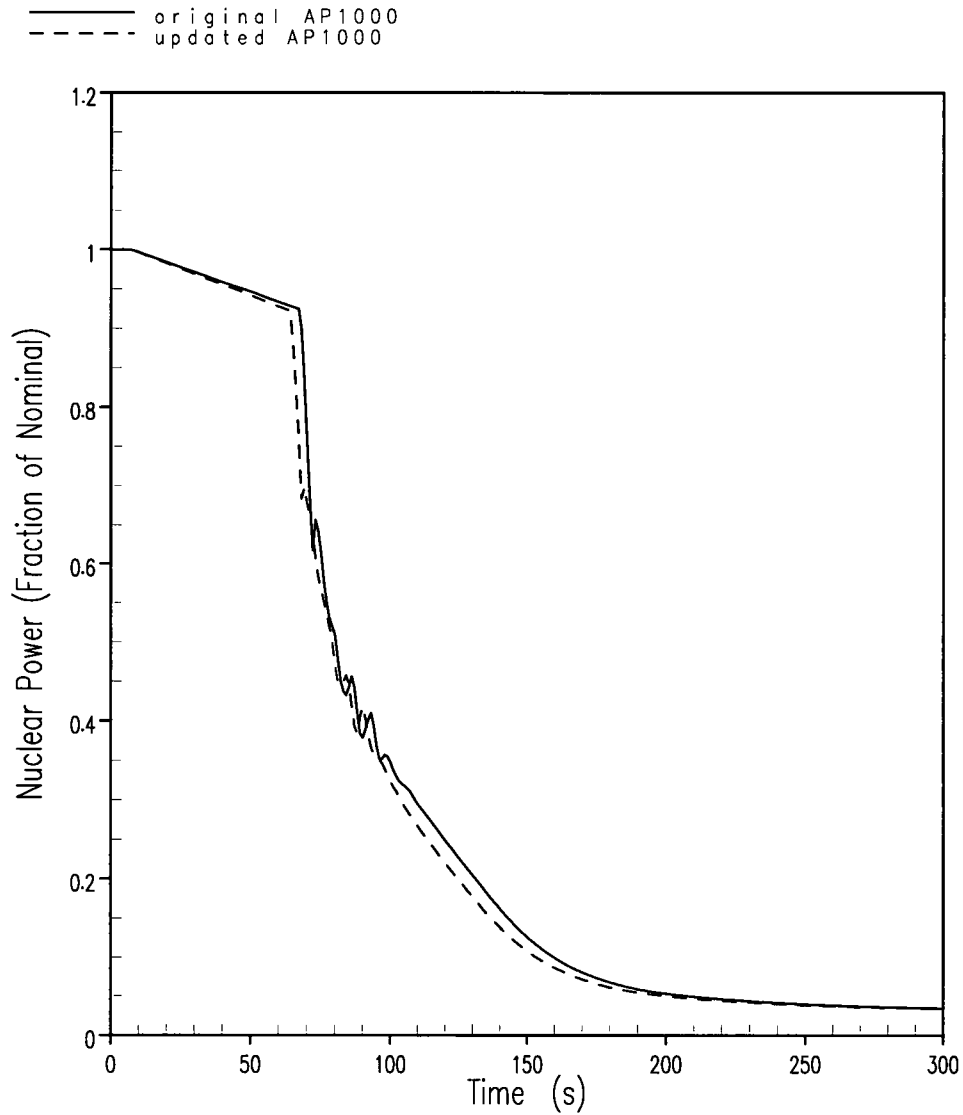


Figure 7-1  
ATWS

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

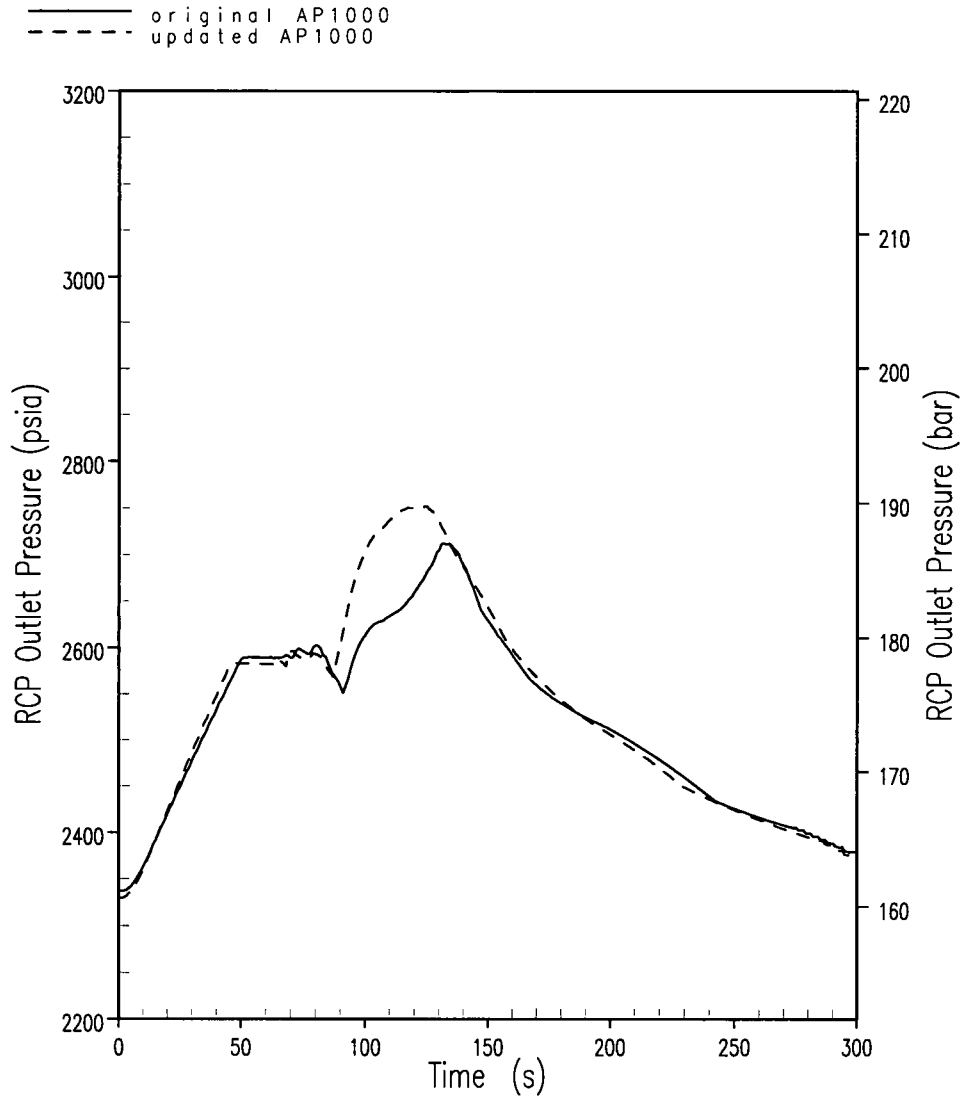


Figure 7-2  
ATWS

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

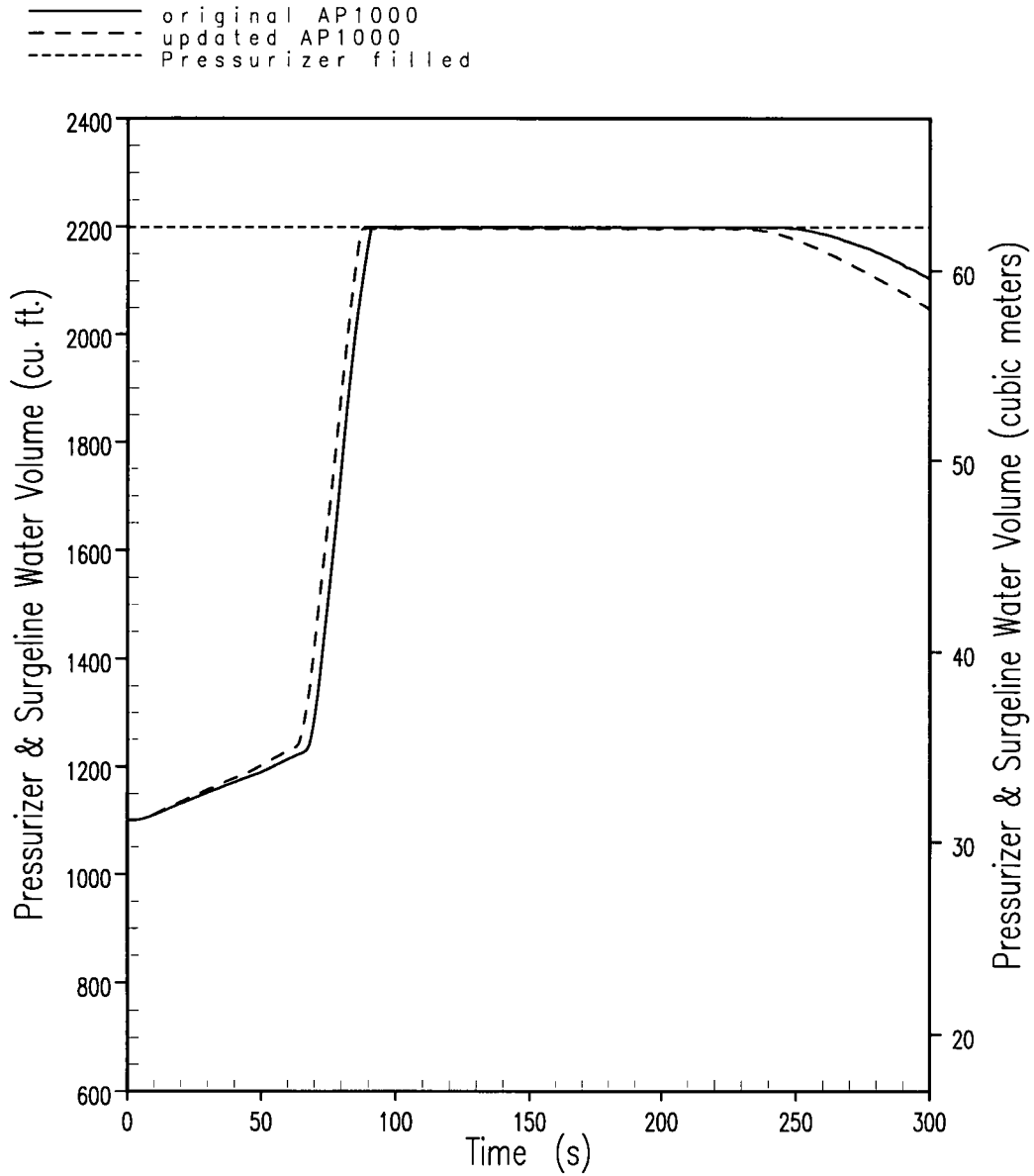


Figure 7-3  
ATWS

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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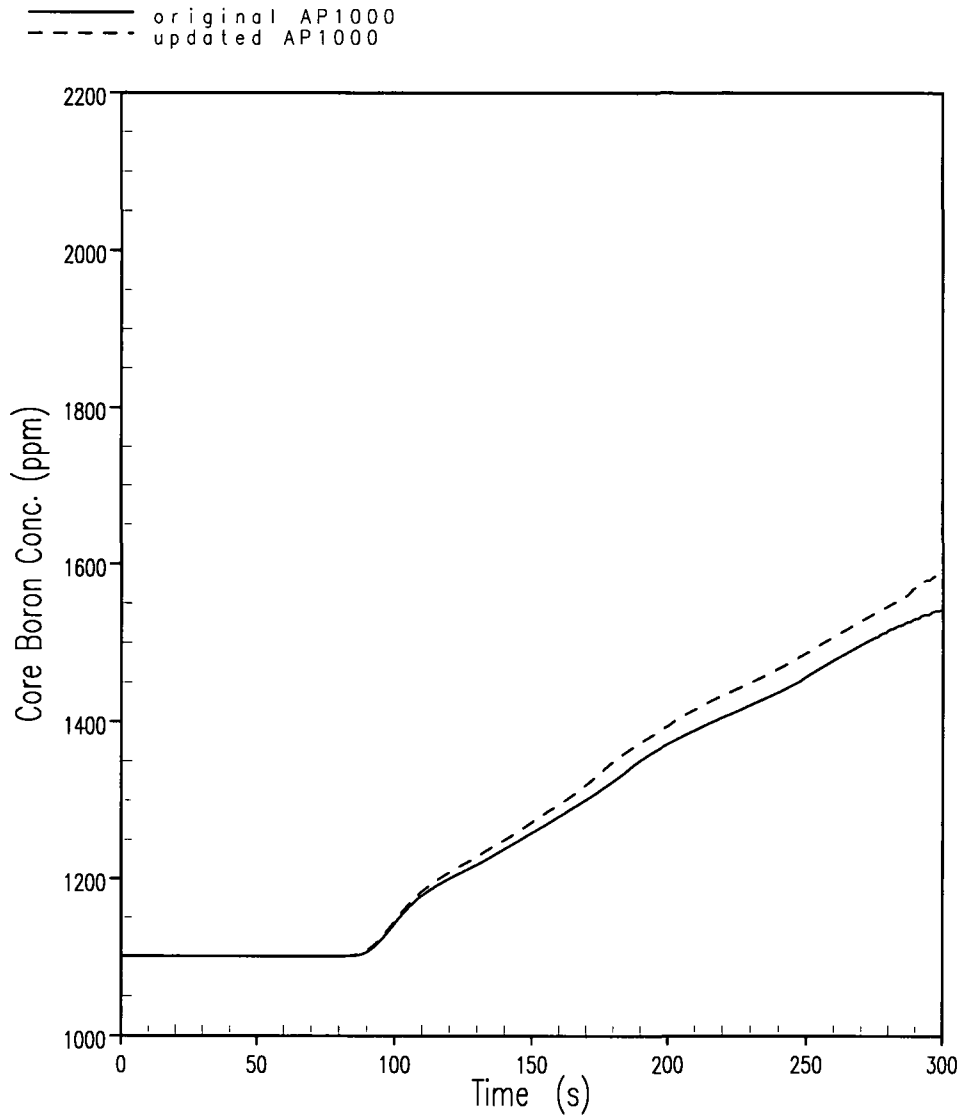


Figure 7-4  
ATWS

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

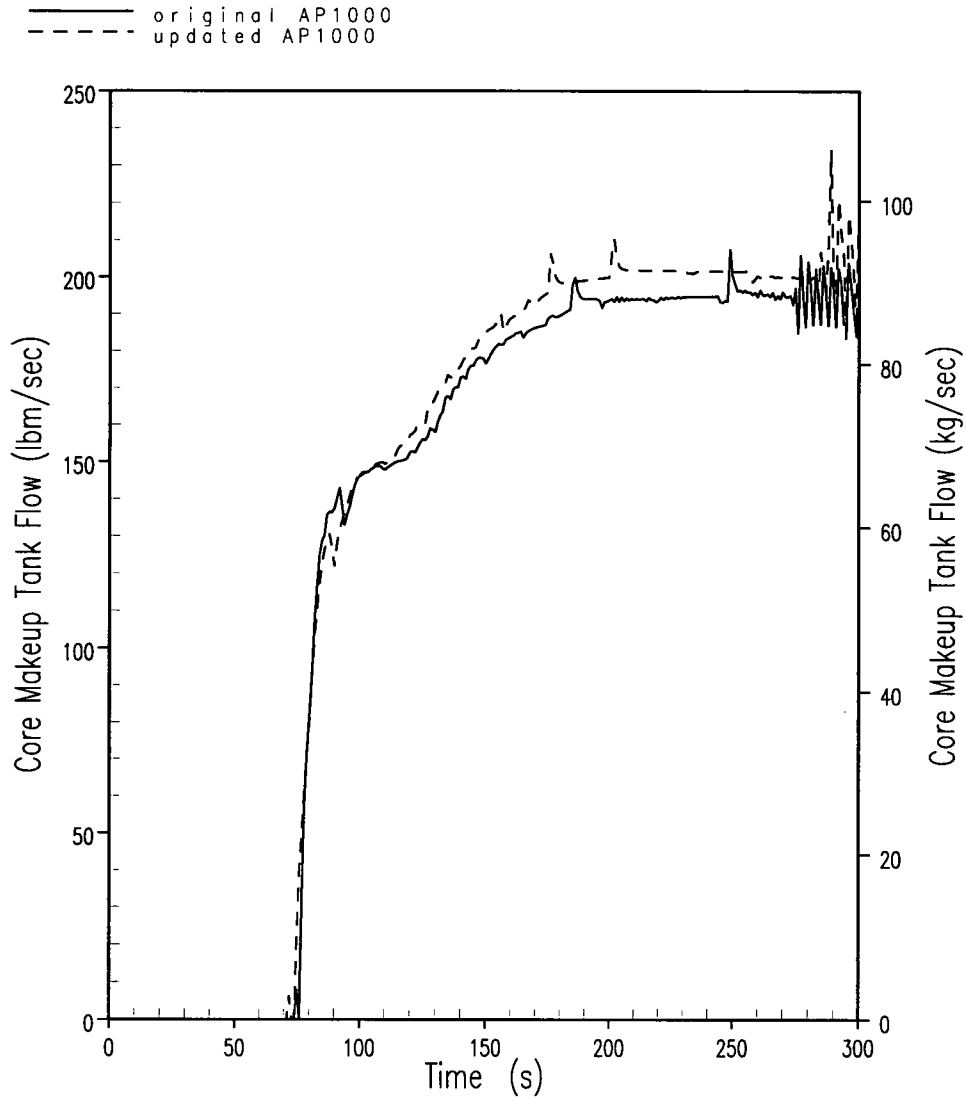
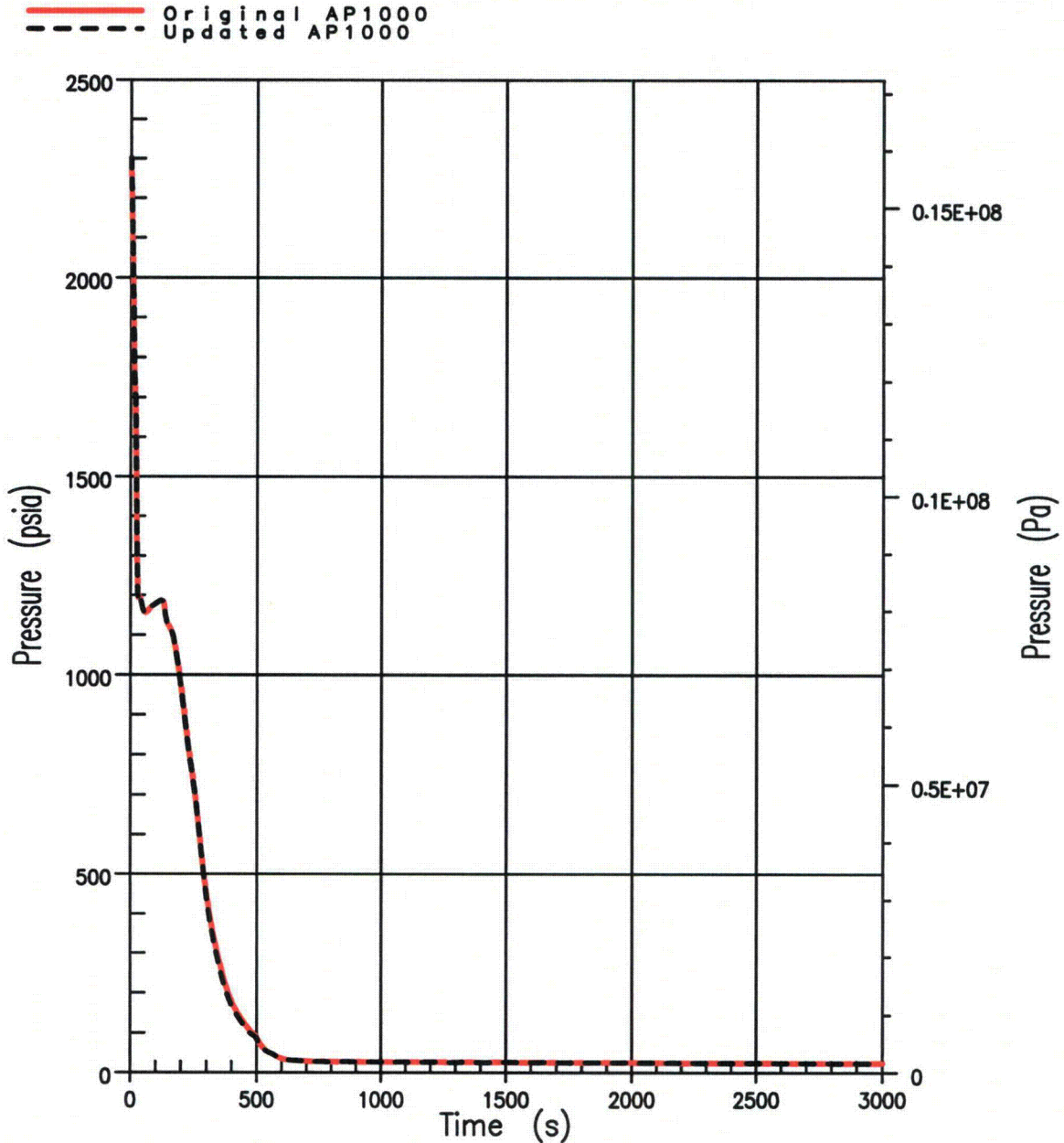


Figure 7-5  
ATWS

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

### AP1000 DEDVI Break, 20 psi, ADS Non-Critical Pressurizer Pressure



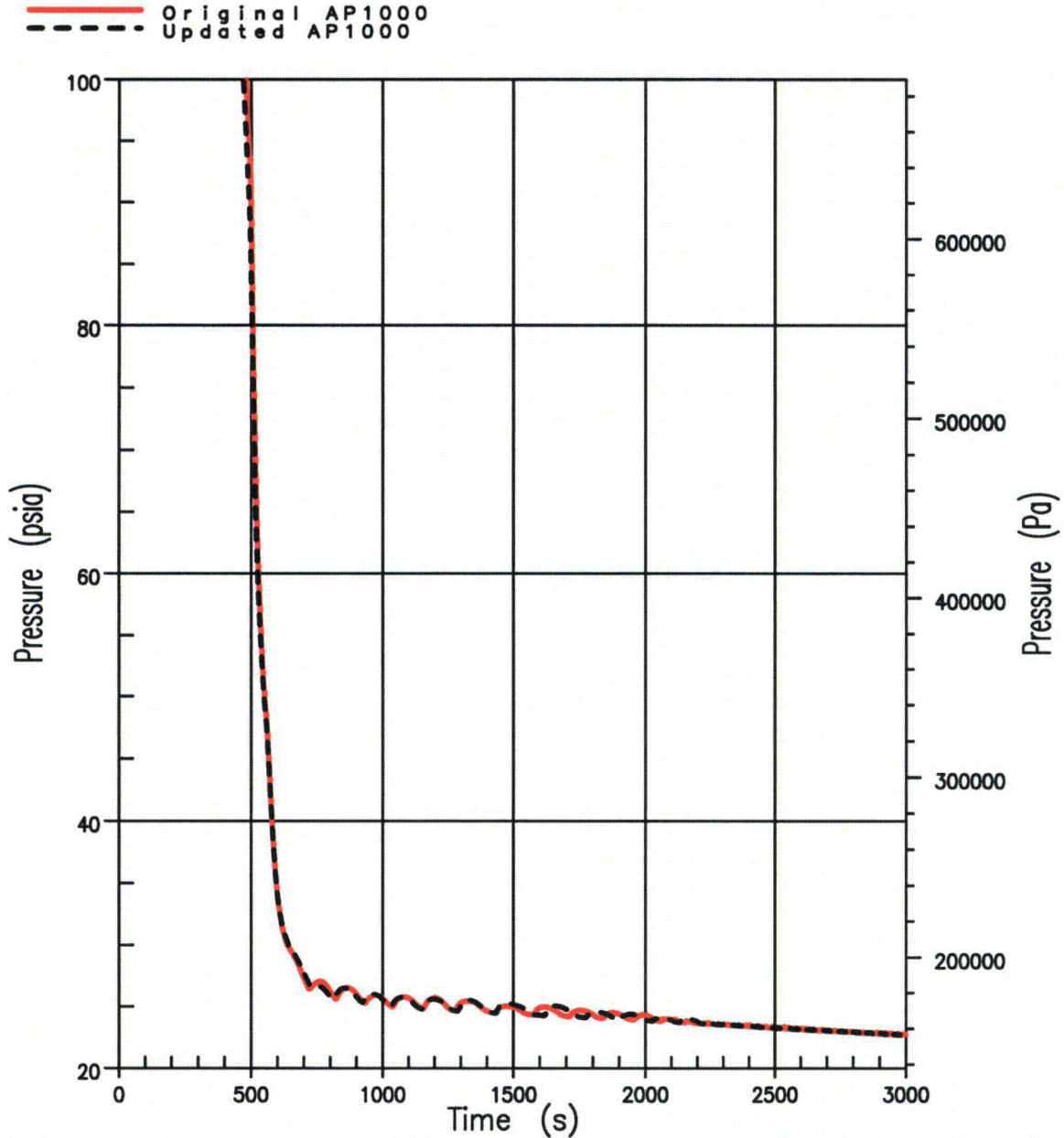
Created on leopard on X2007/08/20 by gagnona

Figure 6.3-1 DEDVI Break, RCS Pressure

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

### AP1000 DEDVI Break, 20 psi, ADS Non-Critical Pressurizer Pressure



Created on leopard on X2007/09/20 by gognons

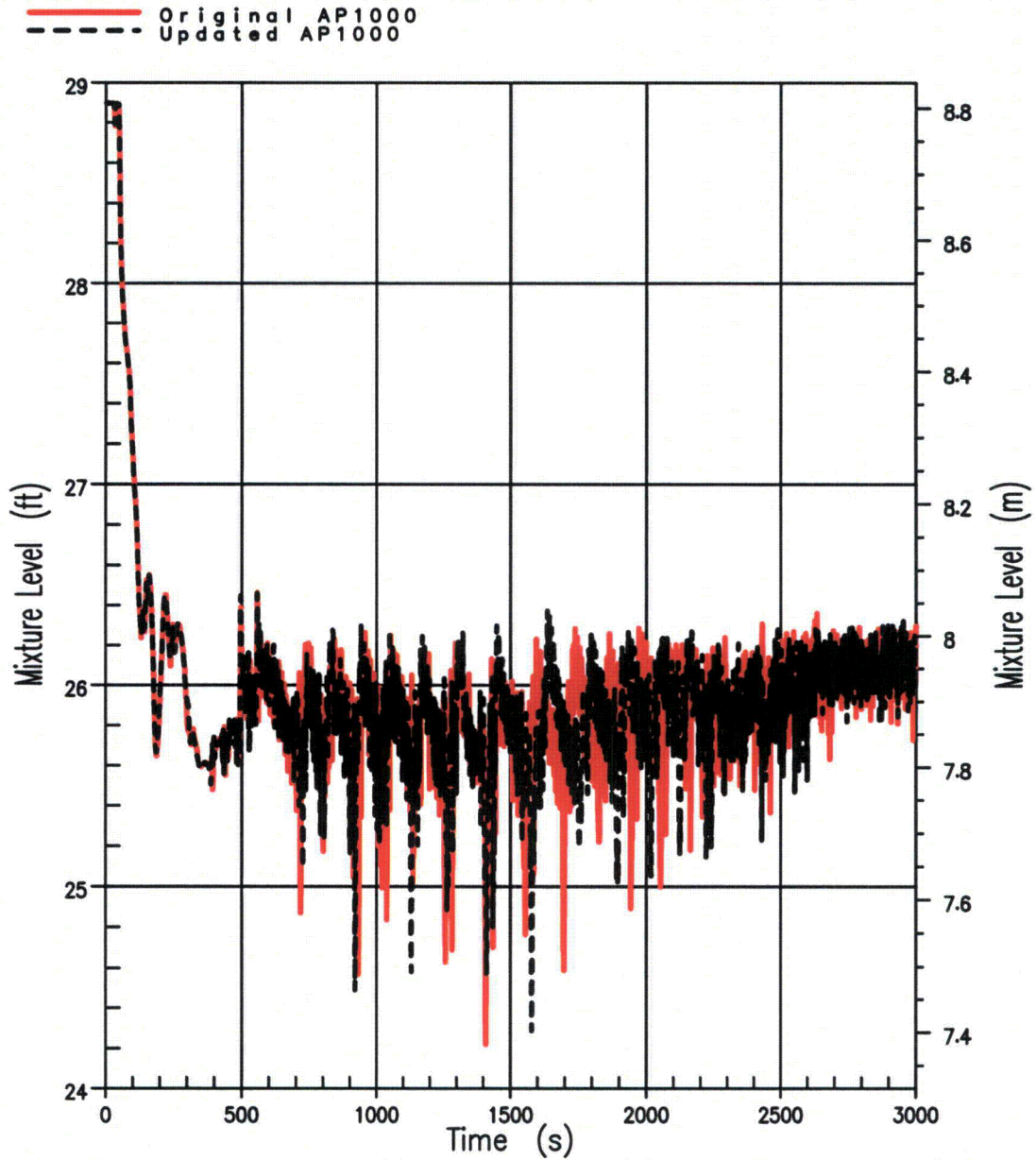
Figure 6.3-2 DEDVI, RCS Pressure, Low Pressure Region



# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

### AP1000 DEDVI Break, 20 psi, ADS Non-Critical Core Mixture Level



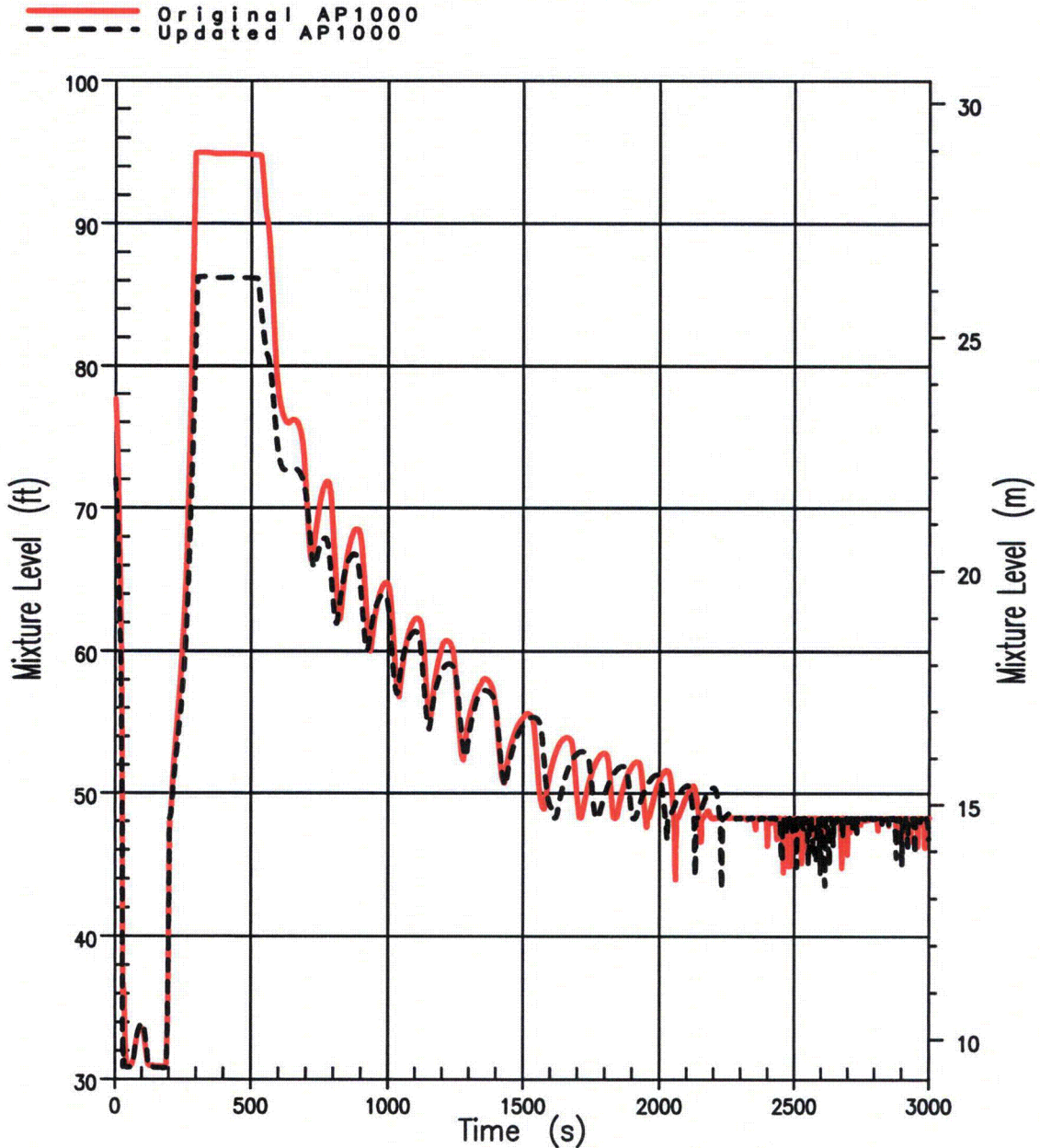
Created on leopard on X2007/08/20 by gagnona

Figure 6.3-3 DEDVI, Core/Upper Plenum Mixture Level

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

### AP1000 DEDVI Break, 20 psi, ADS Non-Critical Pressurizer Level



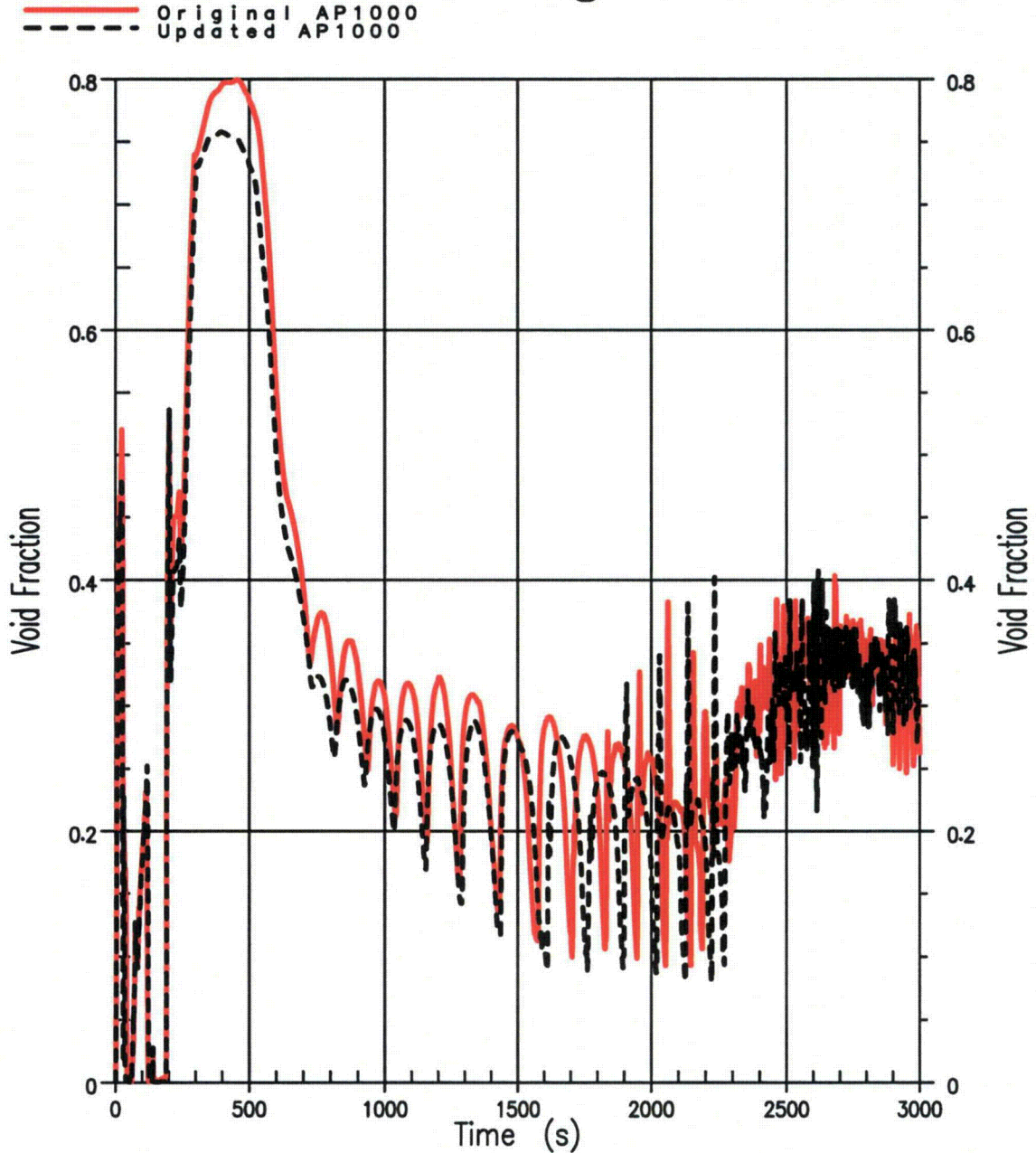
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Figure 6.3-4 DEDVI, Pressurizer Mixture Level

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

### AP1000 DEDVI Break, 20 psi, ADS Non-Critical Pressurizer Mixture Region Void Fraction



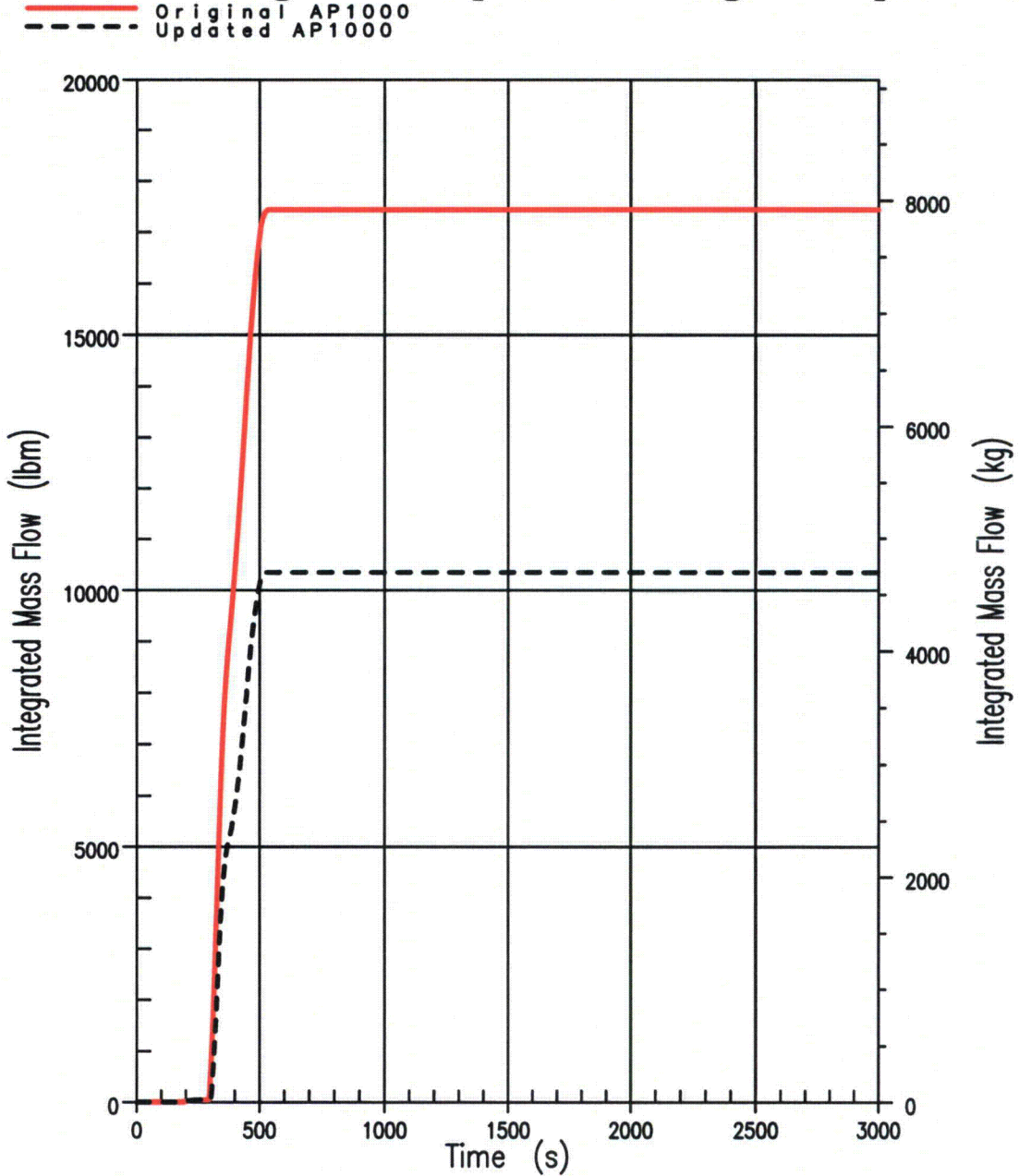
Created on leopard on X2007/09/20 by gognona

Figure 6.3-5 DEDVI, Pressurizer Mixture Region Void Fraction

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

### AP1000 DEDVI Break, 20 psi, ADS Non-Critical ADS 1-3 Integrated Liquid Discharge Comparison



Created on leopard on X2007/09/20 by gagnona

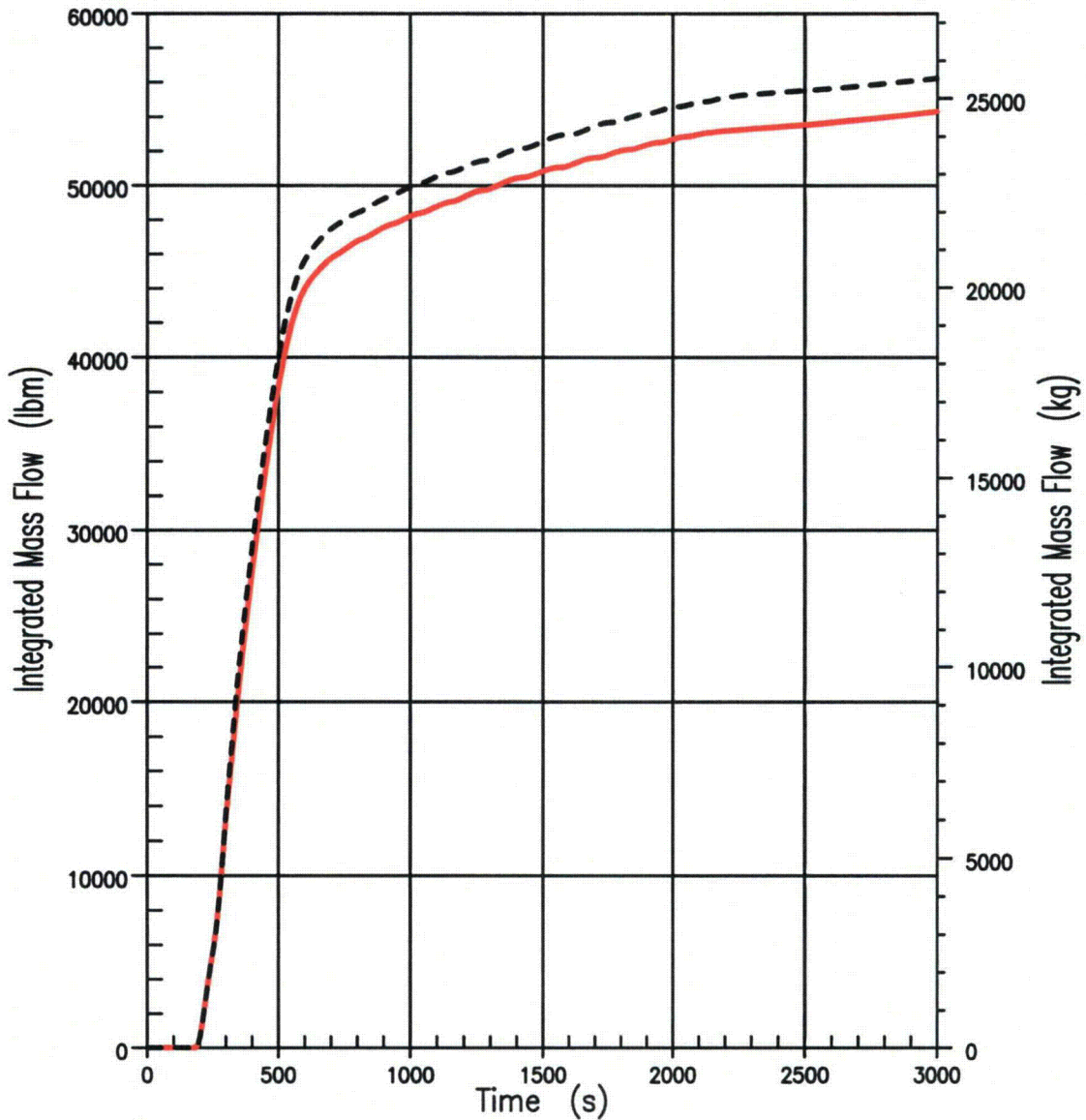
Figure 6.3-6 DEDVI, ADS 1-3 Integrated Liquid Discharge

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

### AP1000 DEDVI Break, 20 psi, ADS Non-Critical ADS 1-3 Integrated Vapor Discharge Comparison

— Original AP1000  
- - - Updated AP1000



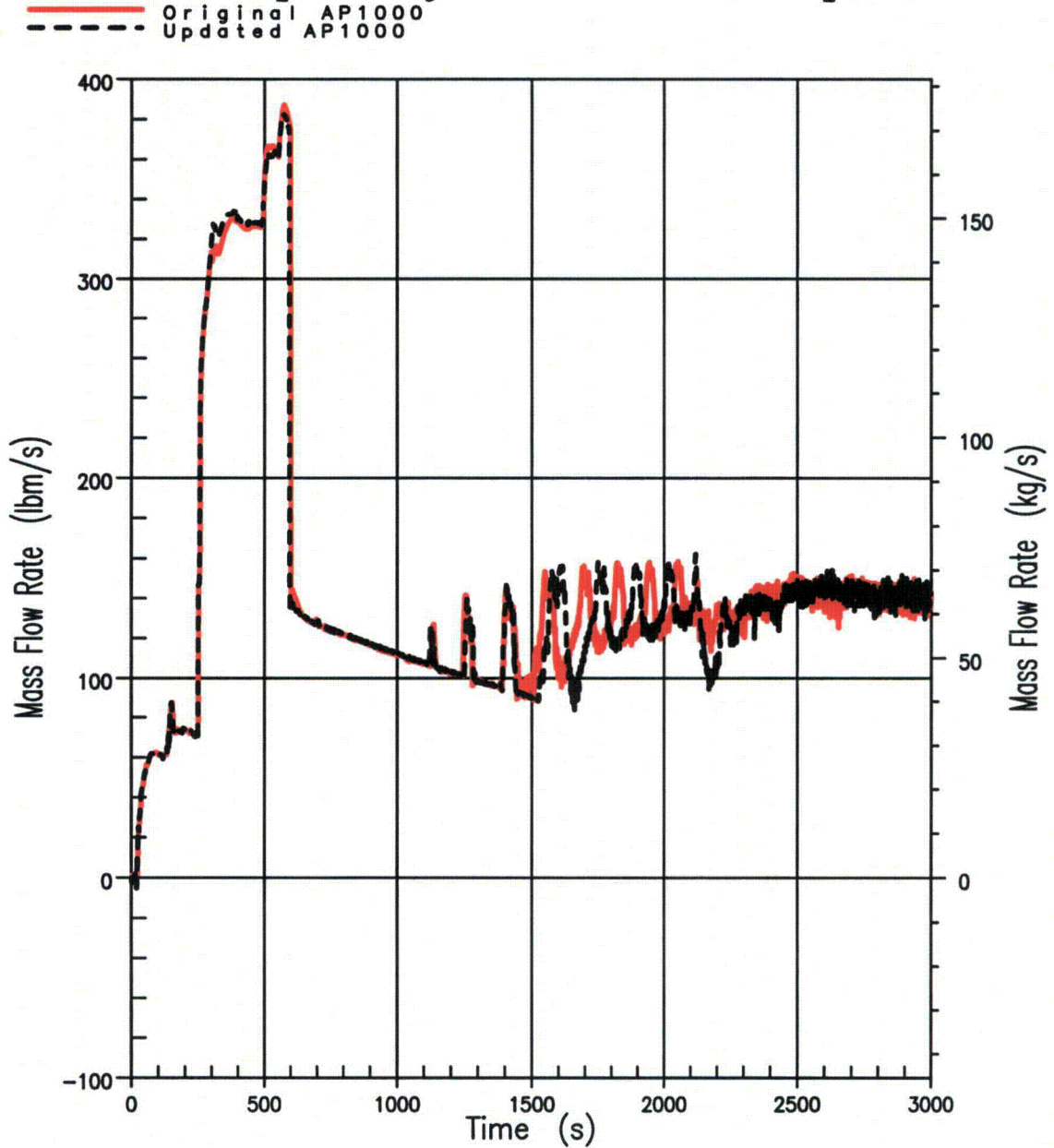
Created on leopard on X2007/09/20 by gognona

Figure 6.3-7 DEDVI, ADS 1-3 Integrated Vapor Discharge

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

### AP1000 DEDVI Break, 20 psi, ADS Non-Critical DVI-2 Liquid Injection Flow Comparison



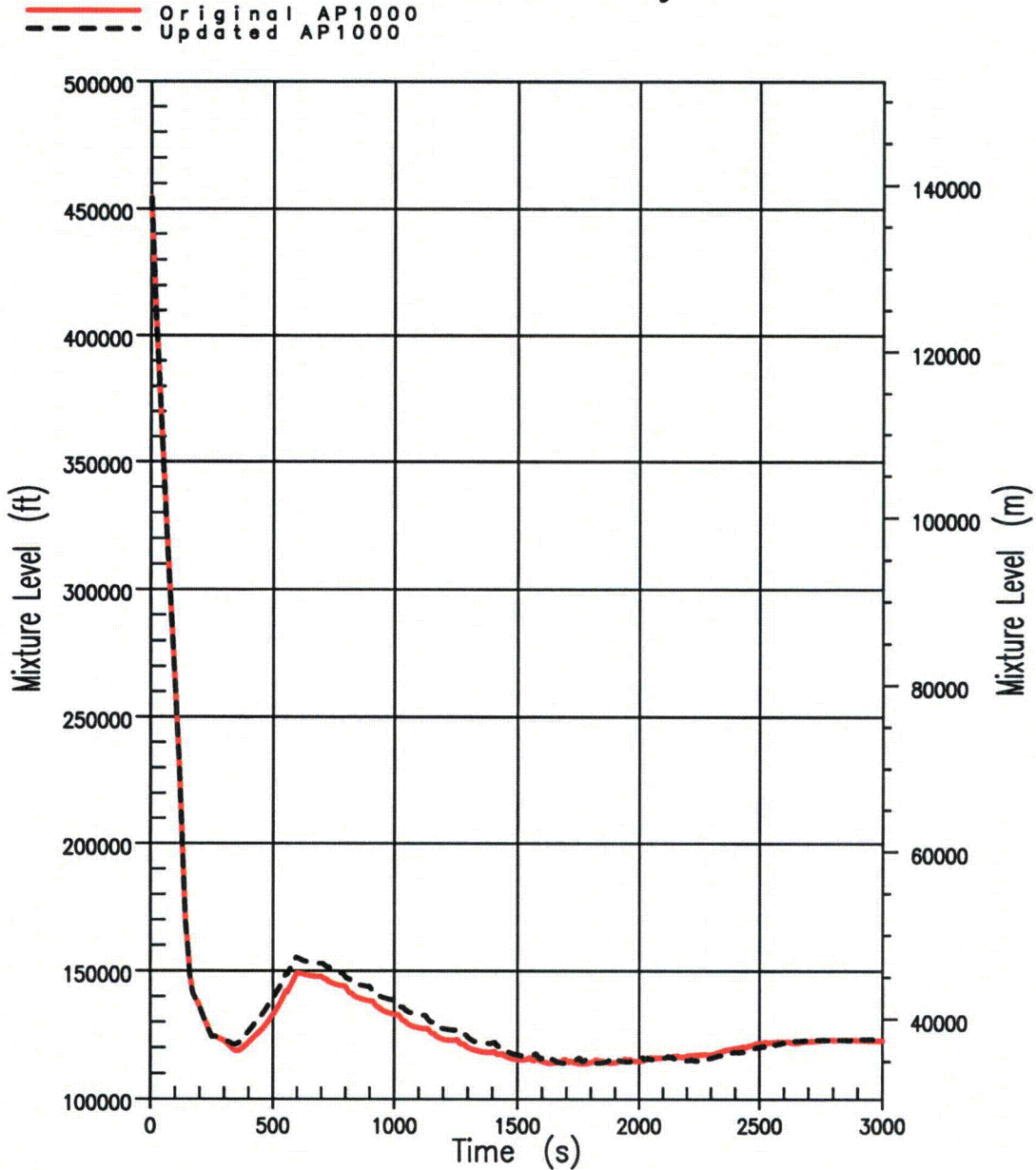
Created on leopard on X2007/09/20 by gagnona

Figure 6.3-8 DEDVI, Intact DVI Injection Flow

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

### AP1000 DEDVI Break, 20 psi, ADS Non-Critical RCS Inventory



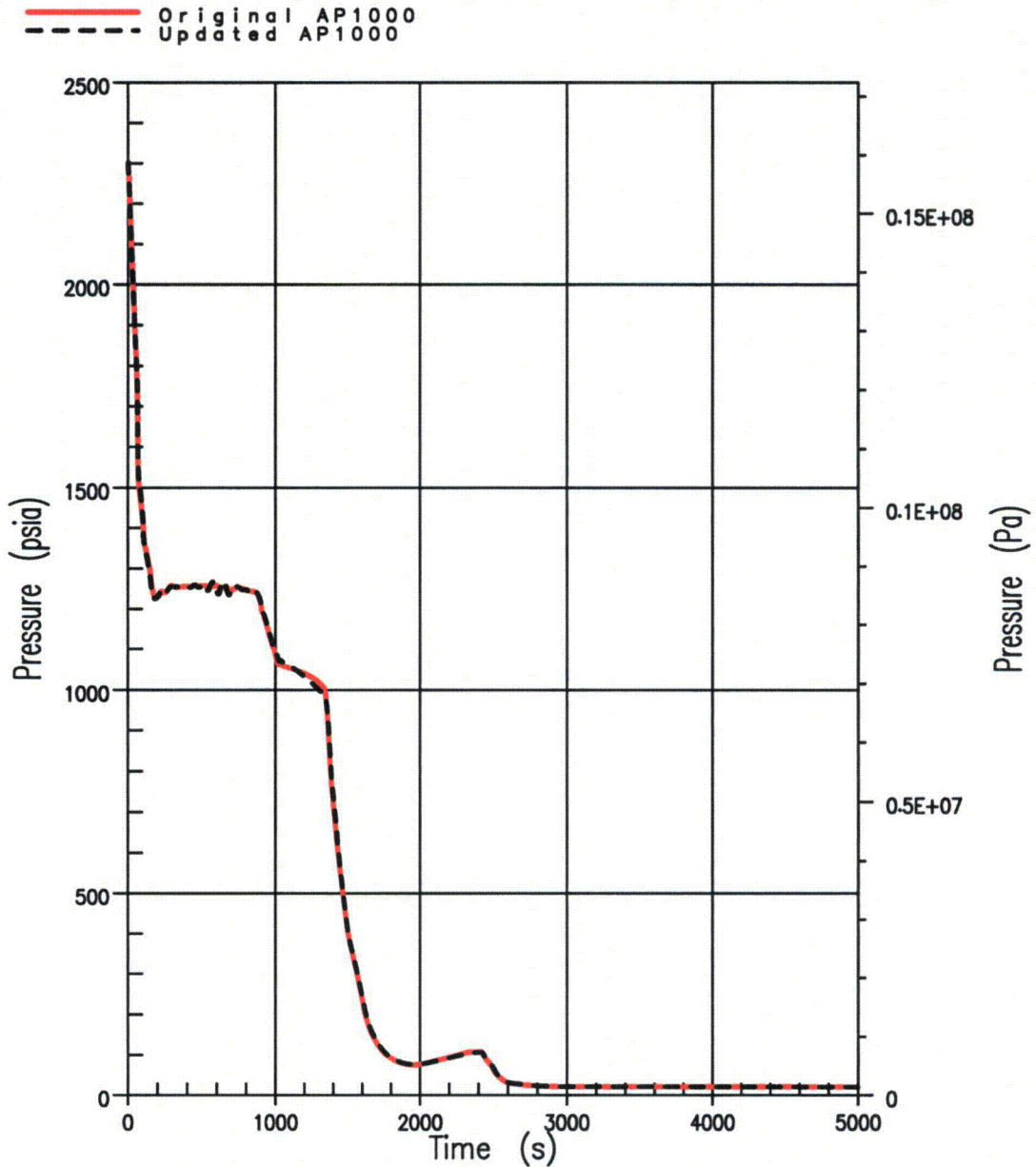
Created on leopard on X2007/08/20 by gognona

Figure 6.3-9 DEDVI, RCS Inventory

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

### AP1000 2inch Break, 14.7 psi, ADS Non-Critical Pressurizer Pressure



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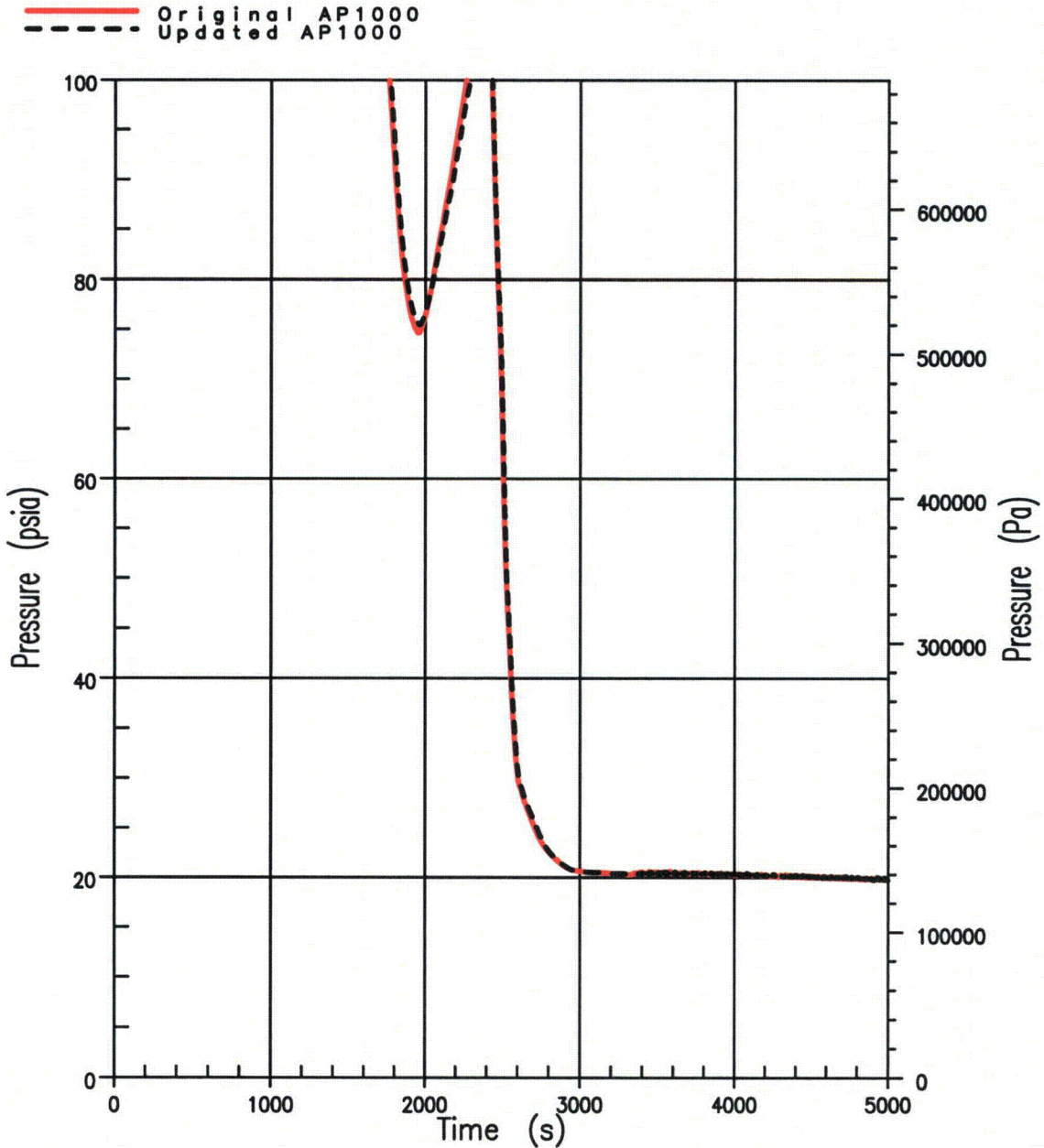
Figure 6.3-10 2-Inch Cold Leg Break, RCS Pressure



# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

### AP1000 2inch Break, 14.7 psi, ADS Non-Critical Pressurizer Pressure



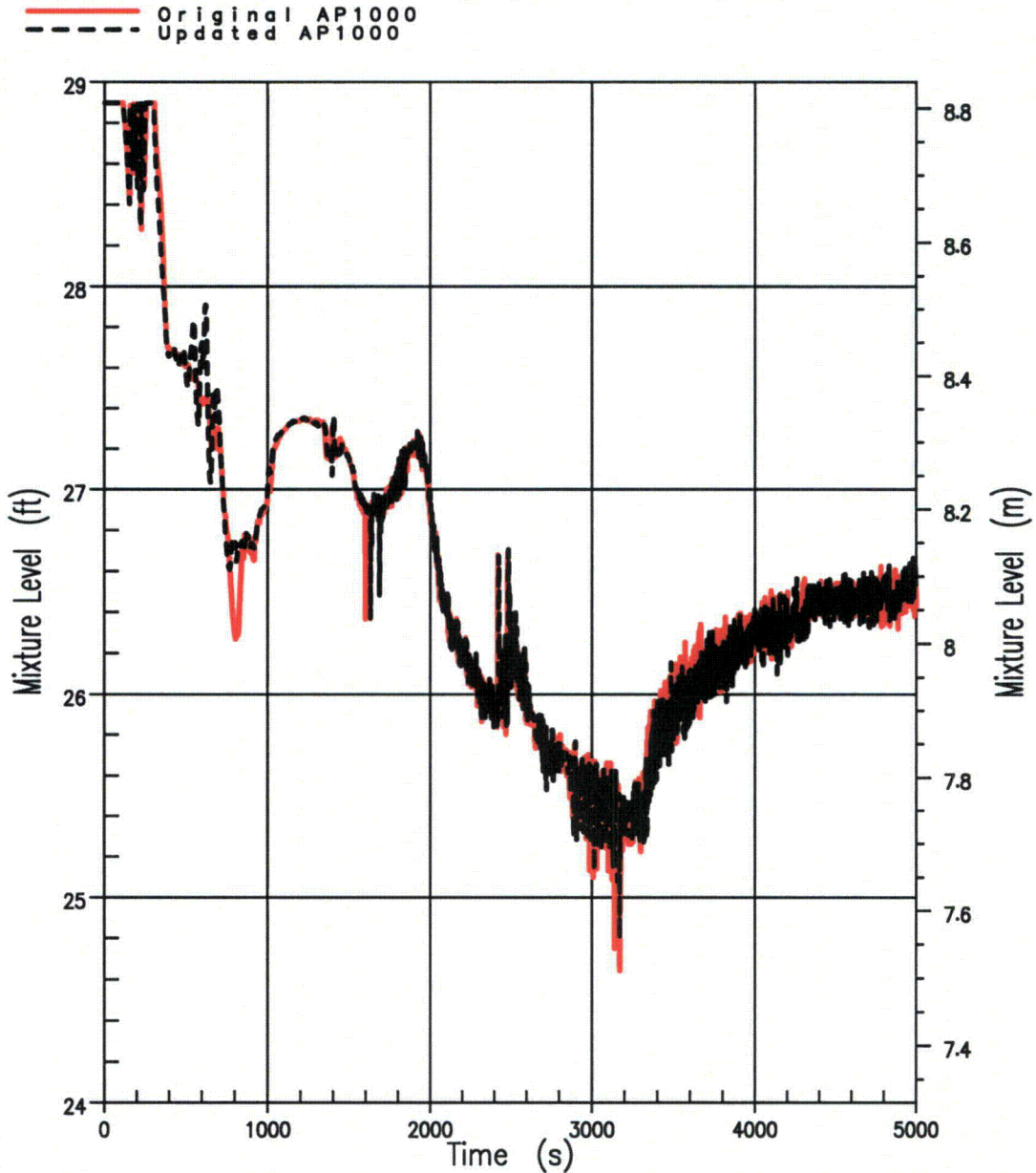
Created on leopard on X2007/08/20 by gagnona

Figure 6.3-11 2-Inch Cold Leg Break, RCS Pressure, Low Pressure Region

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

### AP1000 2inch Break, 14.7 psi, ADS Non-Critical Core Mixture Level



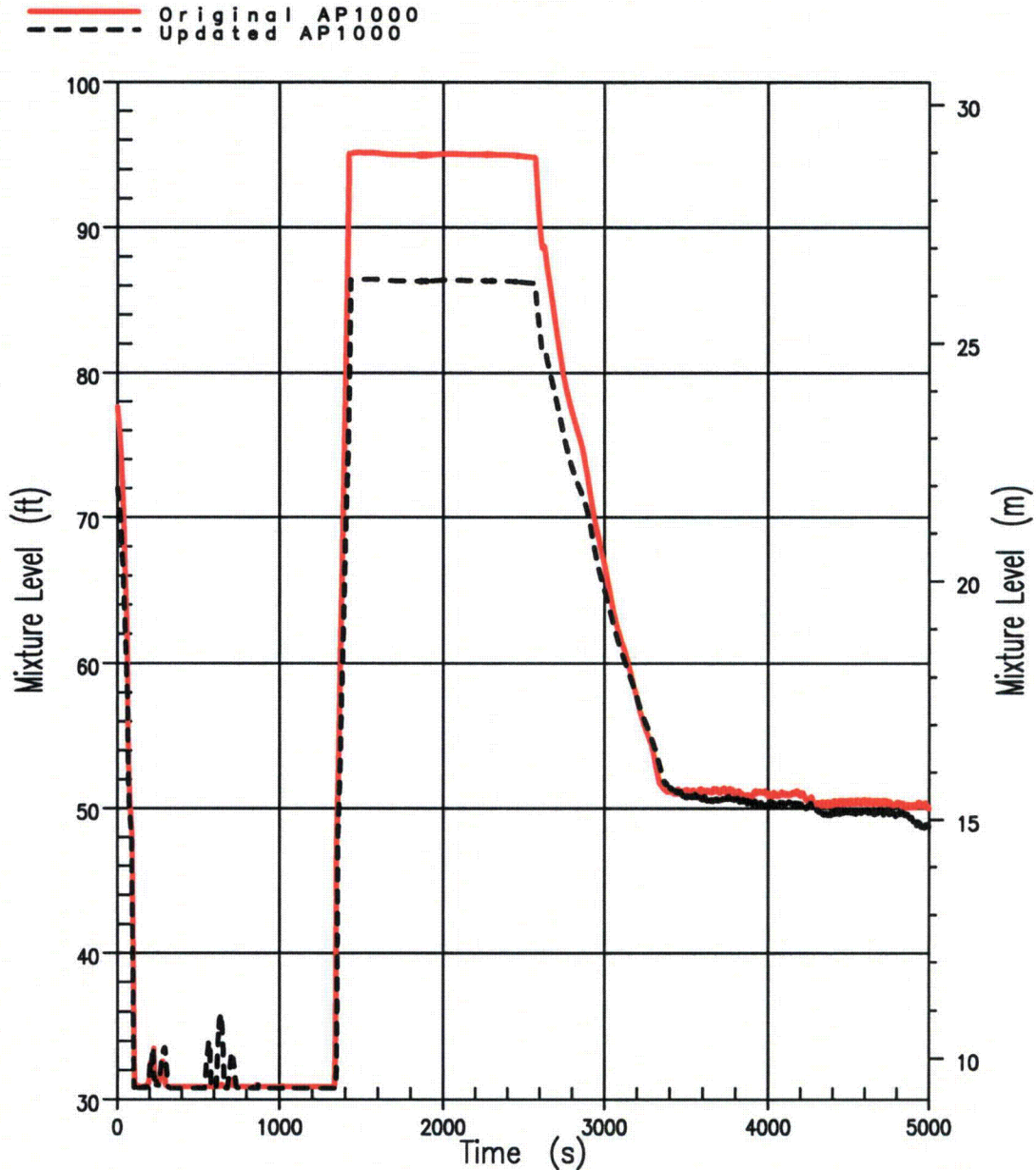
Created on leopard on X2007/08/20 by gagnona

Figure 6.3-12 2-Inch Cold Leg Break, Core/Upper Plenum Mixture Level

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

### AP1000 2inch Break, 14.7 psi, ADS Non-Critical Pressurizer Level



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Figure 6.3-13 2-Inch Cold Leg Break, Pressurizer Mixture Level

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

### AP1000 2inch Break, 14.7 psi, ADS Non-Critical Pressurizer Mixture Region Void Fraction

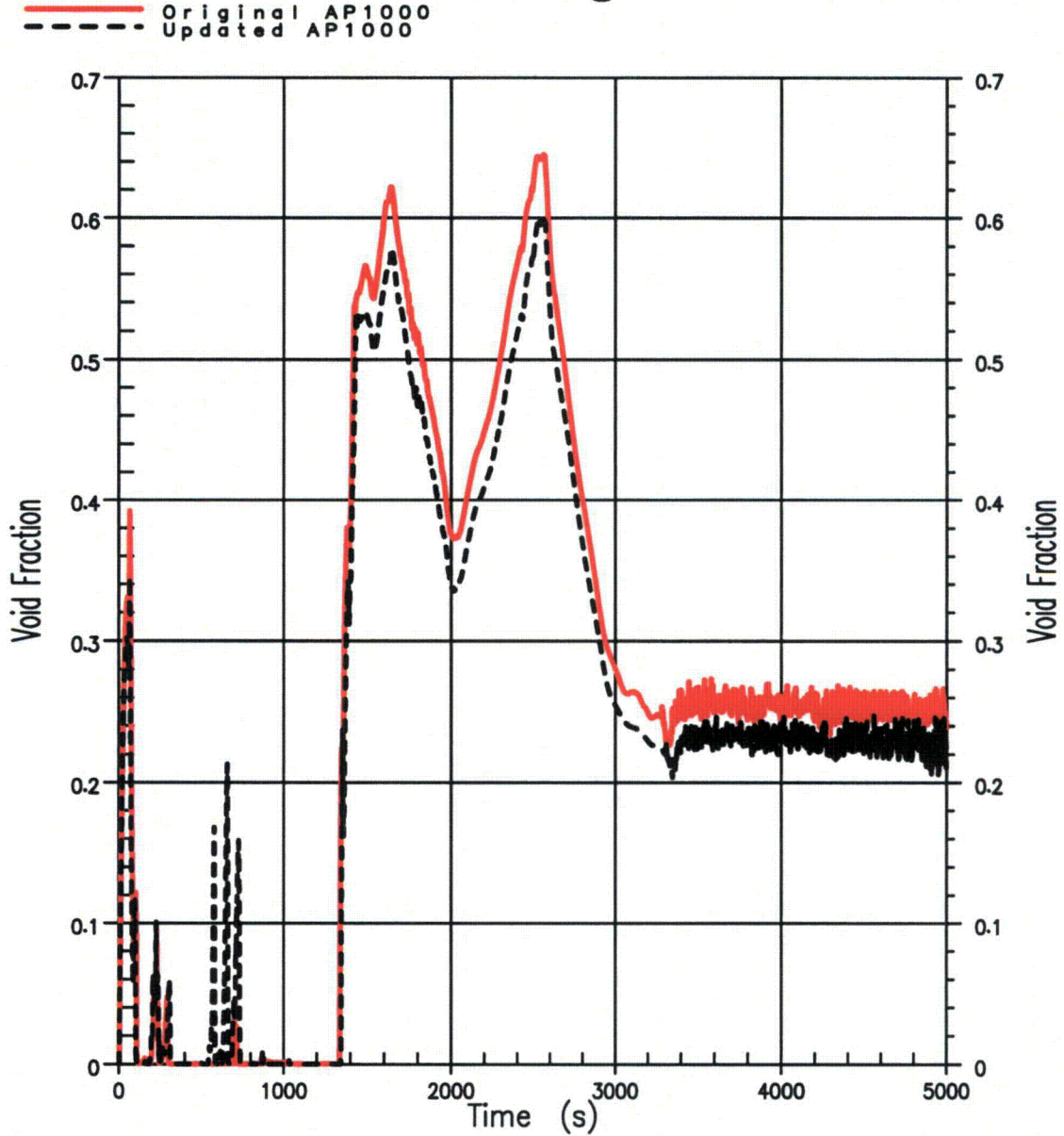


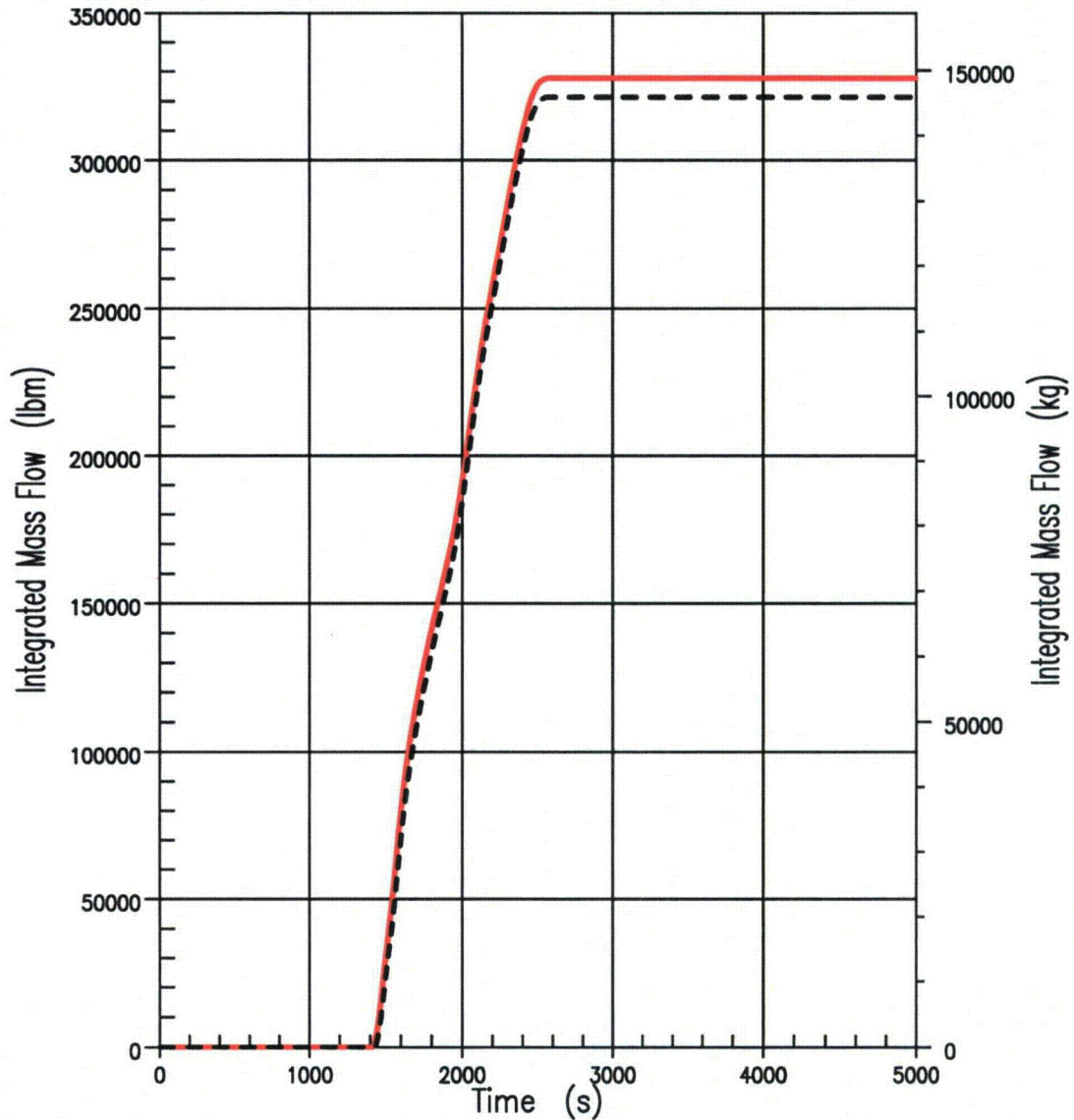
Figure 6.3-14 2-Inch Cold Leg Break, Pressurizer Mixture Region Void Fraction

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

### AP1000 2inch Break, 14.7 psi, ADS Non-Critical ADS 1-3 Integrated Liquid Discharge Comparison

— Original AP1000  
- - - Updated AP1000



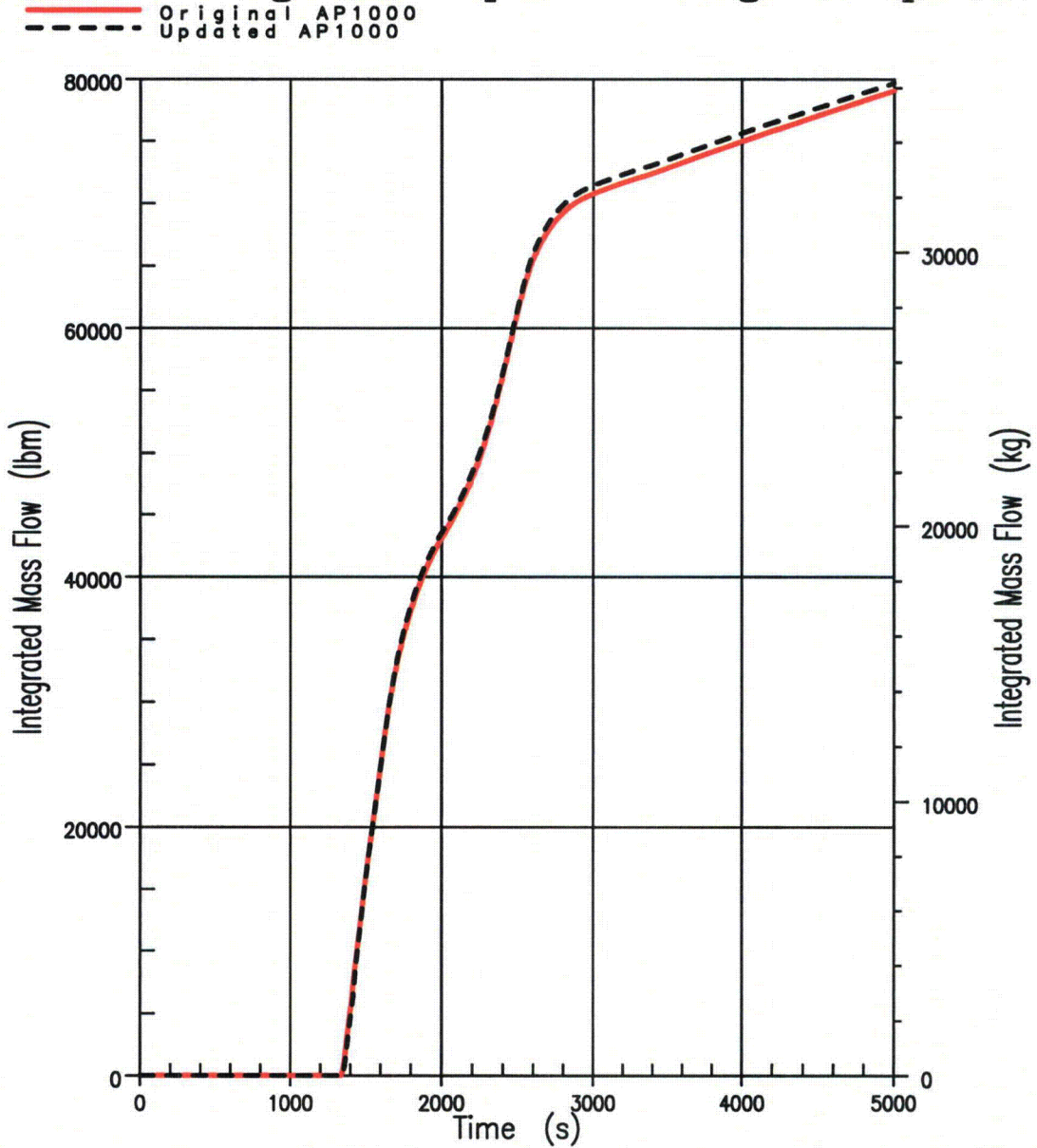
Created on leopard on X2007/09/20 by gagnone

Figure 6.3-15 2-Inch Cold Leg Break, ADS 1-3 Integrated Liquid Discharge

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

### AP1000 2inch Break, 14.7 psi, ADS Non-Critical ADS 1-3 Integrated Vapor Discharge Comparison



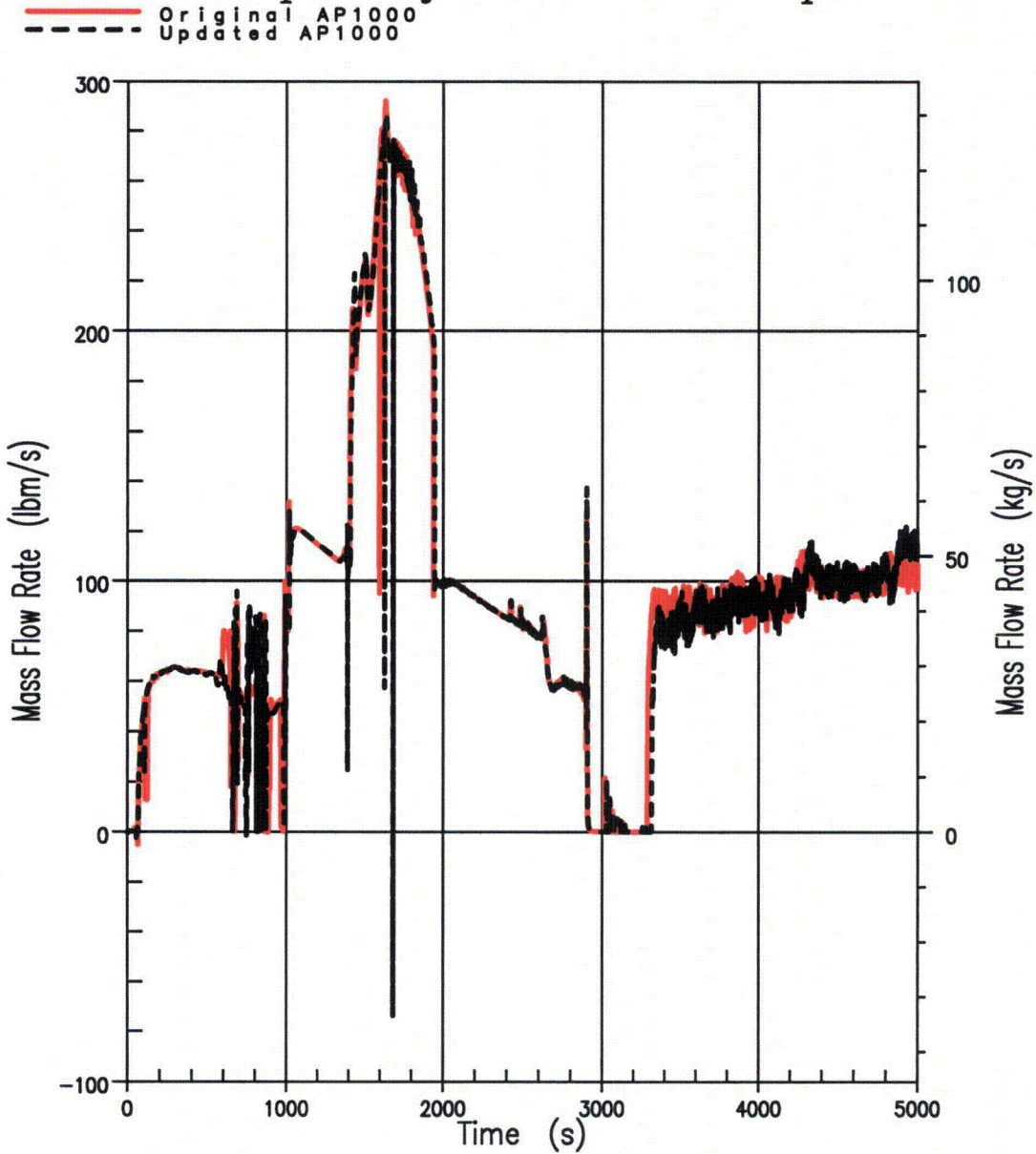
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Figure 6.3-16 2-Inch Cold Leg Break, ADS 1-3 Integrated Vapor Discharge

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

### AP1000 2inch Break, 14.7 psi, ADS Non-Critical DVI-1 Liquid Injection Flow Comparison



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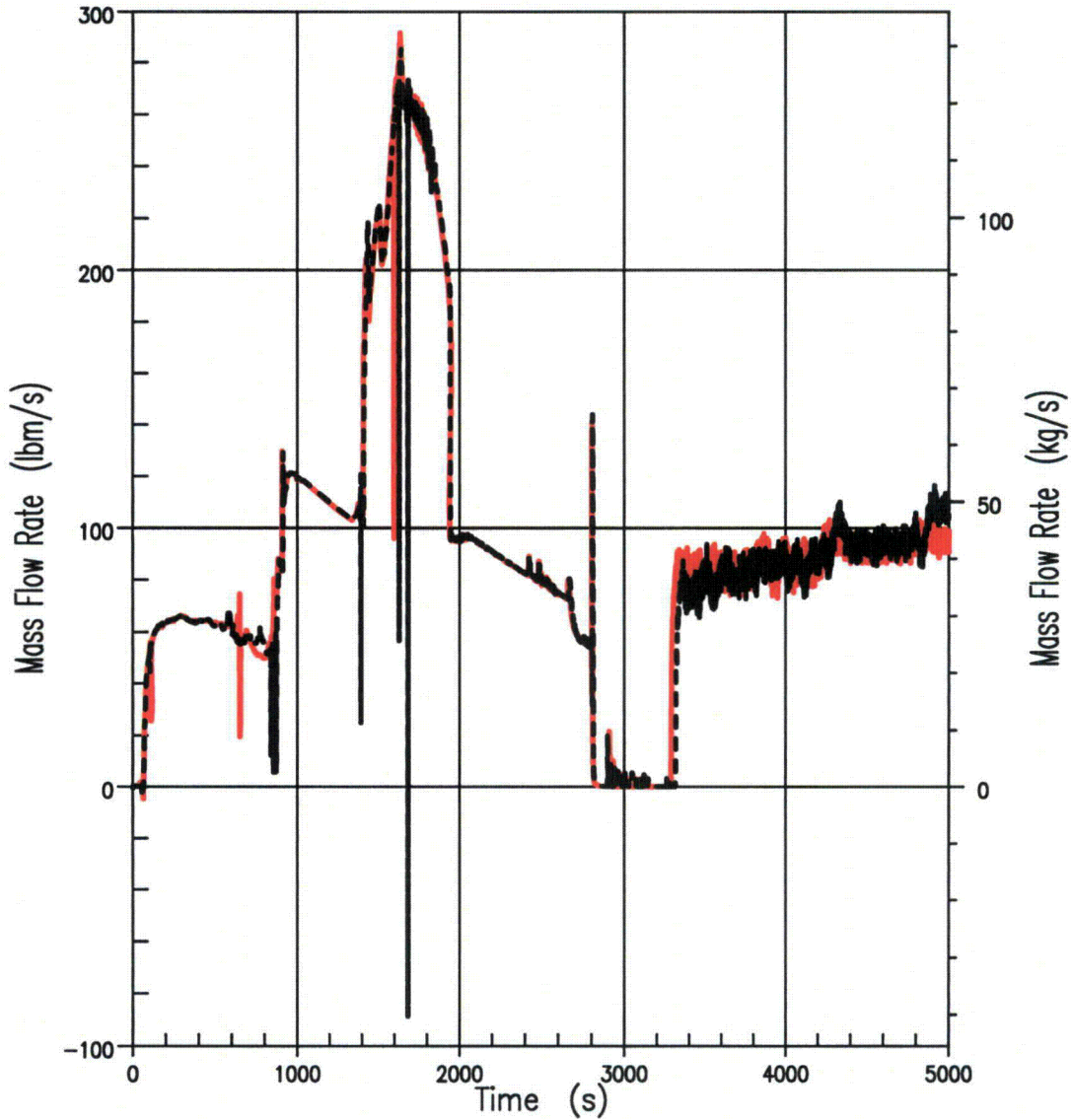
Figure 6.3-17 2-Inch Cold Leg Break, DVI-1 Injection Flow

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

### AP1000 2inch Break, 14.7 psi, ADS Non-Critical DVI-2 Liquid Injection Flow Comparison

— Original AP1000  
- - - Updated AP1000



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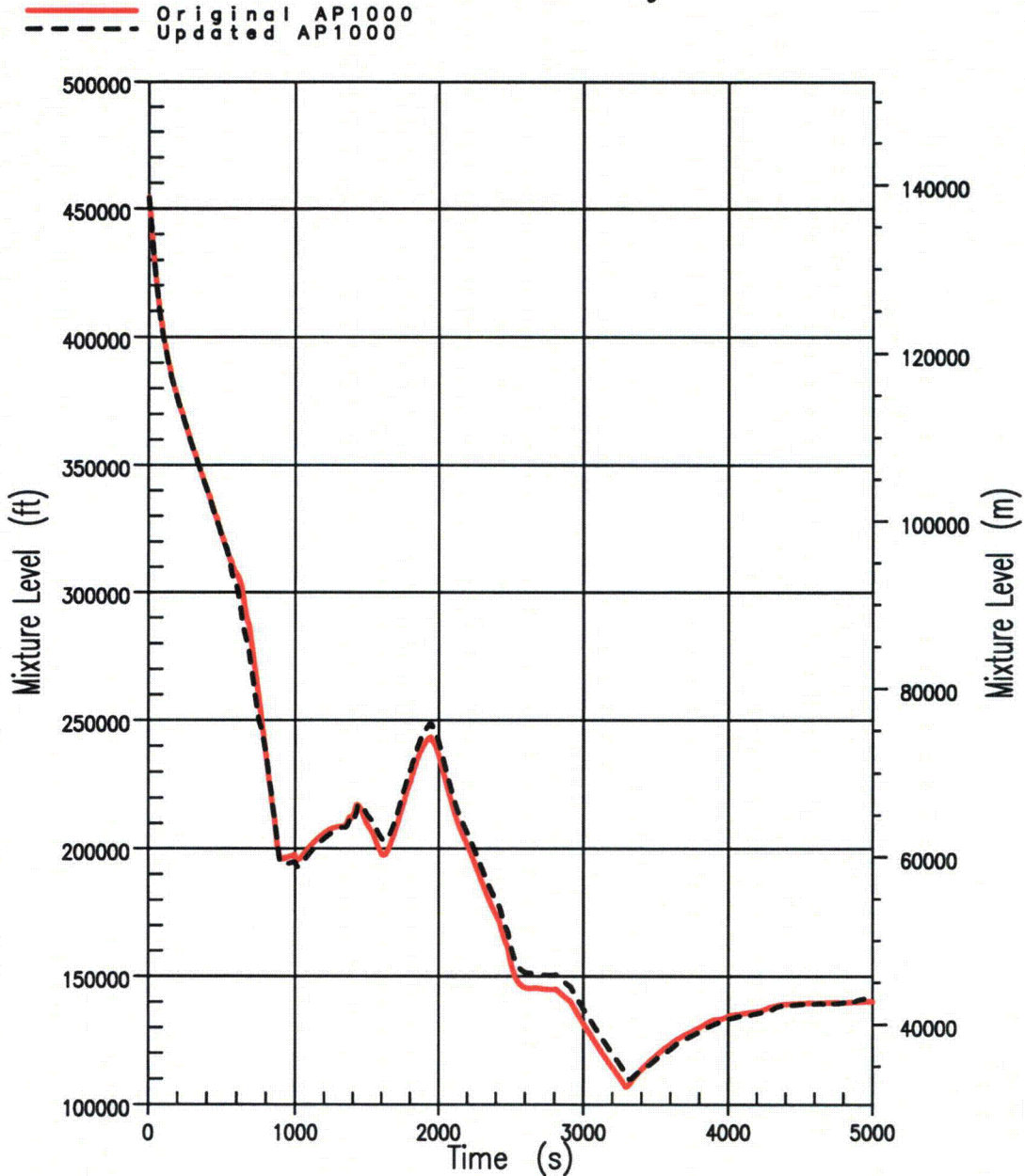
Figure 6.3-18 2-Inch Cold Leg Break, DVI-2 Injection Flow



# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

### AP1000 2inch Break, 14.7 psi, ADS Non-Critical RCS Inventory



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Figure 6.3-19 2-Inch Cold Leg Break, RCS Inventory

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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**Design Control Document (DCD) Revision:**

None

**PRA Revision:**

None

**Technical Report (TR) Revision:**

None