ArevaEPRDCPEm Resource

From: BRYAN Martin (EXT) [Martin.Bryan.ext@areva.com]
Sent: Tuesday, May 25, 2010 4:55 PM
To: Tesfaye, Getachew
Cc: DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); GUCWA Len T (EXT)
Subject: Response to U.S. EPR Design Certification Application RAI No. 340, FSARCh. 6, Supplement 3, Part 1 of 4
Attachments: RAI 340 Supplement 3 Response US EPR DC part 1 of 4.pdf

Getachew,

AREVA NP Inc. (AREVA NP) provided a response to 1 of the 5 questions of RAI No. 340 on March 1, 2010. RAI No. 340, Supplement 1 was submitted on April 7, 2010 and provided responses to 2 of the 4 remaining questions. In addition, on April 7, 2010, the schedule for responding to Question 06.02.01-57 was revised to July 15, 2010. On May 12, 2010, the schedule for responding to Question 06.02.01-53 was revised to May 26, 2010.

Because of the file size, AREVA NP is providing the response to Question 06.02.01-53 in four parts. The four files are designated as “RAI 340 Supplement 3 Response US EPR DC Part X of 4.pdf,” where “X” is one of the four parts. The files provide a technically correct and complete response to 1 of the 2 remaining questions.

Attached is file, “RAI 340 Supplement 3 Response US EPR DC Part 1 of 4.pdf.”

The following table indicates the respective pages in the response document, “RAI 340 Supplement 3 Response US EPR DC Part 1 of 4.pdf,” that contain AREVA NP’s responses to the subject questions.

Question #	Start Page	End Page
RAI 340 — 06.02.01-53	2	53

The schedule for a technically correct and complete response to Question 06.02.01-57 is unchanged and provided below.

Question #	Response Date
RAI 340 — 06.02.01-57	July 15, 2010

Sincerely,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
Tel: (434) 832-3016
702 561-3528 cell
Martin.Bryan.ext@areva.com

From: BRYAN Martin (EXT)
Sent: Wednesday, May 12, 2010 4:42 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); GUCWA Len T (EXT)
Subject: Response to U.S. EPR Design Certification Application RAI No. 340, FSARCh. 6, Supplement 2

Getachew,

AREVA NP Inc. (AREVA NP) provided a response to 1 of the 5 questions of RAI No. 340 on March 1, 2010. RAI No. 340, Supplement 1 was submitted on April 7, 2010 and provided responses to 2 of the 4 remaining questions. In addition, on April 7, 2010, the schedule for responding to Question 06.02.01-57 was revised to July 15, 2010.

Because the response to Question 06.02.01-53 is anticipated to include over 200 figures, an additional two weeks is needed to provide a complete and accurate response. As agreed with the NRC staff, the schedule for responding to Question 06.02.01-53 is changed to May 26, 2010. The schedule for responding to Question 06.02.01-57 is unchanged.

The schedule for a technically correct and complete response to the remaining RAI No. 340 questions is provided below.

Question #	Response Date
RAI 340 — 06.02.01-53	May 26, 2010
RAI 340 — 06.02.01-57	July 15, 2010

Sincerely,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
Tel: (434) 832-3016
702 561-3528 cell
Martin.Bryan.ext@areva.com

From: BRYAN Martin (EXT)
Sent: Wednesday, April 07, 2010 2:55 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); GUCWA Len T (EXT)
Subject: Response to U.S. EPR Design Certification Application RAI No. 340, FSARCh. 6, Supplement 1

Getachew,

The proprietary/SUNSI and public versions of the response to RAI No. 340, Supplement 1 are submitted via AREVA NP Inc. letter, “Response to U.S. EPR Design Certification Application RAI No. 340 Supplement 1 “ NRC:10:032, dated April 7, 2010. The enclosure to that letter provides a schedule to provide technically correct and complete response to 2 of the 4 remaining questions in RAI No. 340. The RAI response also contains security-related sensitive information that should be withheld from public disclosure in accordance with 10 CFR 2.390. In addition, an affidavit to support withholding of information that AREVA considers proprietary from public disclosure, per 10CFR2.390(b), is provided as an enclosure to that letter.

A public version with the proprietary and security-related sensitive information redacted is also provided as an enclosure to that letter.

The following table indicates the respective pages in the response document that contain AREVA NP’s response to the subject questions:

Question #	Start Page	End Page
RAI 340 — 06.02.01-54	2	10

RAI 340 — 06.02.01-56	11	11

The schedule for a technically correct and complete response to Question 06.02.01-53 is unchanged and provided below. The response to Questions 06.02.01-57 is dependent upon the results of ongoing GSI-191 head loss testing and evaluations which will demonstrate sump strainer performance. Because of the ongoing activities, AREVA NP is not providing a response at this time. The schedule for a technically correct and complete response to Question 06.02.01-57 has been revised and is provided below.

Question #	Response Date
RAI 340 — 06.02.01-53	May 12, 2010
RAI 340 — 06.02.01-57	**July 15, 2010**

Sincerely,

Martin (Marty) C. Bryan
Licensing Advisory Engineer
AREVA NP Inc.
Tel: (434) 832-3016
Martin.Bryan.ext@areva.com

From: BRYAN Martin (EXT)
Sent: Monday, March 01, 2010 3:23 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen V (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); ROMINE Judy (AREVA NP INC); GUCWA Len T (EXT)
Subject: Response to U.S. EPR Design Certification Application RAI No. 340, FSARCh. 6

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 340 Response US EPR DC.pdf" provides a technically correct and complete response to 1 of the 5 questions.

The following table indicates the respective pages in the response document, "RAI 340 Response US EPR DC.pdf," that contains AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 340 — 06.02.01-53	2	2
RAI 340 — 06.02.01-54	3	3
RAI 340 — 06.02.01-55	4	11
RAI 340 — 06.02.01-56	12	12
RAI 340 — 06.02.01-57	13	13

A complete answer is not provided for 4 of the 5 questions. The schedule for a technically correct and complete response to these questions is provided below.

Question #	Response Date
RAI 340 — 06.02.01-53	May 12, 2010
RAI 340 — 06.02.01-54	April 7, 2010
RAI 340 — 06.02.01-56	April 7, 2010
RAI 340 — 06.02.01-57	April 7, 2010

Sincerely,

Martin (Marty) C. Bryan
Licensing Advisory Engineer
AREVA NP Inc.
Tel: (434) 832-3016
Martin.Bryan@areva.com

From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Friday, January 29, 2010 10:23 AM
To: ZZ-DL-A-USEPR-DL
Cc: Jensen, Walton; Jackson, Christopher; Snodderly, Michael; Carneal, Jason; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 340 (4094), FSARCh. 6

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on December 6, 2009, and discussed with your staff on January 20, 2010. Drat RAI Questions 06.02.01-53 was modified as a result of that discussion. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a date for receipt of this information will be provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

Thanks,
Getachew Tesfaye
Sr. Project Manager
NRO/DNRL/NARP
(301) 415-3361

Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 1454

Mail Envelope Properties (BC417D9255991046A37DD56CF597DB710641DD19)

Subject: Response to U.S. EPR Design Certification Application RAI No. 340, FSARCh. 6, Supplement 3, Part 1 of 4
Sent Date: 5/25/2010 4:55:25 PM
Received Date: 5/25/2010 4:55:54 PM
From: BRYAN Martin (EXT)

Created By: Martin.Bryan.ext@areva.com

Recipients:
"DELANO Karen V (AREVA NP INC)" <Karen.Delano@areva.com>
Tracking Status: None
"ROMINE Judy (AREVA NP INC)" <Judy.Romine@areva.com>
Tracking Status: None
"BENNETT Kathy A (OFR) (AREVA NP INC)" <Kathy.Bennett@areva.com>
Tracking Status: None
"GUCWA Len T (EXT)" <Len.Gucwa.ext@areva.com>
Tracking Status: None
"Tesfaye, Getachew" <Getachew.Tesfaye@nrc.gov>
Tracking Status: None

Post Office: AUSLYNCMX02.adom.ad.corp

Files	**Size**	**Date & Time**
MESSAGE	8031	5/25/2010 4:55:54 PM
RAI 340 Supplement 3 Response US EPR DC part 1 of 4.pdf	7316627	

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

Response to

Request for Additional Information No. 340, Supplement 3

01/29/2010

U.S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 06.02.01 - Containment Functional Design
Application Section: 06.02.01

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

Question 06.02.01-53:

One purpose of the GOTHIC multi-node calculations is to predict natural circulation flow patterns and heat transfer in the containment. Chapter 9.0 of Technical Report ANP-10299, Revision 1, presents a sample containment calculation for LOCA. Detailed computer outputs for pressure, temperature and flow rate are provided in the Response to RAI No. 1, Supplement 7. This calculation assumes opening of containment doors as expected. AREVA's safety analysis method does not take credit for opening of non-safety doors.

Please provide detailed results, similar to the RAI 1, Supplement 7 data, for a DE CLPS LOCA with non-safety doors closed. Also, provide discussion and illustration of flow patterns observed during the early blowdown phase and just prior to initiation of hot leg injection. Discuss observed thermal stratification in the entire containment (do not limit the discussion to the dome).

Also provide data on calculated non-condensable distribution in the containment during the event and on heat transfer rates at various parts of the containment. What was the integrated energy deposition to major heat sinks? Discuss the above results.

Response to Question 06.02.01-53:

The following plots are provided to illustrate the flow patterns observed in the limiting U.S. EPR FSAR cold leg pump suction analysis (U.S. EPR FSAR Table 6.2.1-1: Case 40) where all of the non-safety doors remained closed for the duration of the transient. A representative nodalization diagram is shown in AREVA NP technical report ANP-10299, Rev. 2, "Applicability of AREVA NP Containment Response Evaluation Methodology to the U.S. EPR™ for Large Break LOCA Analysis," Figure 9-7. The flow circulation patterns are shown in Figures 06.02.01-53-1 through 06.02.01-53-41. The blowdown phase dominates the response as the later portions of the event evolve to a steady-state condition. The magnitude of the circulation patterns in the containment is significant for the first 30 seconds after the break coincident with the high break flow rates during the blowdown phase. Immediately following the opening of the rupture foils located at the top of the steam generator (SG) cubicles, vapor rapidly exits from the equipment rooms to the dome and is then distributed throughout the containment. Flow from the dome to the middle annulus rooms is shown in Figures 06.02.01-53-30 and 06.02.01-53-32. There is also flow passing from the loop 1 and 2 upper annulus room to the dome, as shown in Figure 06.02.01-53-33. Initially, the flow direction is from the dome to the upper annulus room; however, after several seconds into the transient, the flow reverses. The flow circulation patterns during blowdown are also shown in Figure 06.02.01-53-42.

Hot leg injection is initiated 3600 seconds into the transient. At this point, most of the containment is in equilibrium and the magnitude of the flow throughout the building is reduced relative to the flows experienced during blowdown. Prior to hot leg injection, the locations that experienced the greatest circulation occurs from the middle annulus rooms to the lower annulus rooms, as shown in Figures 06.02.01-53-28 and 06.02.01-53-29. Flows from the dome to the middle annulus rooms, as shown in Figures 06.02.01-53-30 and 06.02.01-53-32 have decreased. After hot leg injection and the subsequent termination of steam from the break, there is little flow circulation in the containment. Steam continues to condense on the heat structures distributed throughout the containment and the local pressure in each node decreases.

Figures 06.02.01-53-43 through 06.02.01-53-54 show the temperature response in various lumped parameter cells in the model while Figures 06.02.01-53-55 through 06.02.01-53-66 show the temperature distribution in the subdivided dome at a variety of elevations. Because the blowdown occurs in the loop 3 lower equipment room, the room results in a higher initial temperature, as shown in Figure 06.02.01-53-44. The six safety-grade doors identified in U.S. EPR FSAR Tier 2, Table 6.2.1-18 are not credited in this analysis. Therefore, throughout the duration of the transient, the pressurizer area has a higher temperature than the surge line area, which is shown in Figure 06.02.01-53-48. For the other lumped parameter cells, the temperatures reach a common value following hot leg injection. In the dome, the peripheral temperatures generally have a higher temperature than in the center. However, there is less stratification in the dome as the elevation is increased, as shown in Figure 06.02.01-53-63. Figures 06.02.01-53-65 and 06.02.01-53-66 show the temperature increases with elevation during the blowdown period. Later in the transient the temperatures converge.

Figures 06.02.01-53-67 through 06.02.01-53-78 provide the containment pressure response in both the equipment area and the accessible space. Figures 06.02.01-53-79 through 06.02.01-53-90 represent the liquid volume fractions in the lumped parameter nodes. These figures show that the in-containment refueling water storage tank (IRWST) level remains relatively constant during the event and show where liquid may be held in the GOTHIC model.

Figures 06.02.01-53-91 through 06.02.01-53-148 provide the air, steam, and nitrogen volume fractions. In the legend for each plot, “1Rx” refers to the air volume fraction in node x, “SRx” refers to the steam volume fraction in node x, and “2Rx” refers to the nitrogen volume fraction in node x. The air volume fractions decrease during blowdown and begin to increase again following hot leg injection as the production of steam in the core is terminated. The plots for steam volume fractions show a decrease following hot leg injection as the heat conductors in each node continue to condense the steam. The plots show that the air and steam volume fractions are evenly distributed throughout most of the containment at the end of the transient. However, the reactor cavity, surge line, CVCS, SG blowdown, access, hot piping penetration, and stairwell areas result in a higher air volume fraction than the rest of the containment. The nitrogen volume throughout the containment spikes at the end of blowdown, but never rises above 5 percent.

Figures 06.02.01-53-149 through 06.02.01-53-186 show the heat conductor surface temperatures. Figures 06.02.01-53-187 through 06.02.01-224 show the heat conductor heat rates for a variety of conductors spread throughout the containment. Figures 06.02.01-53-225 through 06.02.01-53-228 show the temperature profiles of the conductors in the annular walls. The temperature profiles are taken at 30 seconds (just after blowdown), at 3600 seconds (just prior to hot leg injection), and at 86,400 seconds (at the end of the transient). The major heat sinks for energy deposition are the containment walls. Figures 06.02.01-53-225 and 06.02.01-53-226 show that the B-side of the thermal conductor temperatures are close to ambient temperature even at the end of the transient. Thus, the containment is not saturated and has not reached the energy deposition limit.

FSAR Impact:

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

Figure 06.02.01-53–1—Vapor Flow from the Equipment Area to the Containment Dome via the Rupture and Convection Foils

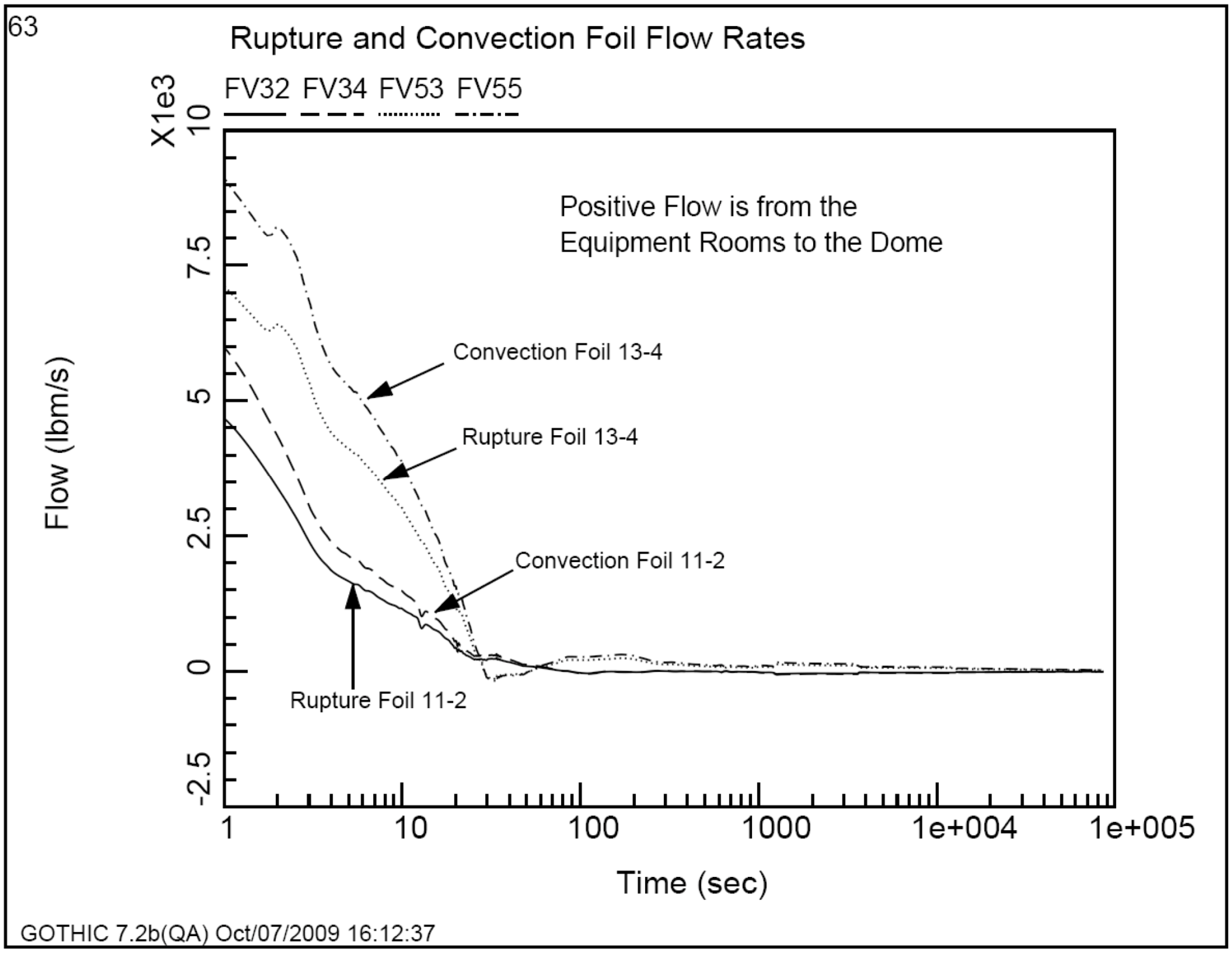


Figure 06.02.01-53–2—Vapor Flow from the Annulus Region to the Equipment Area via the Dampers

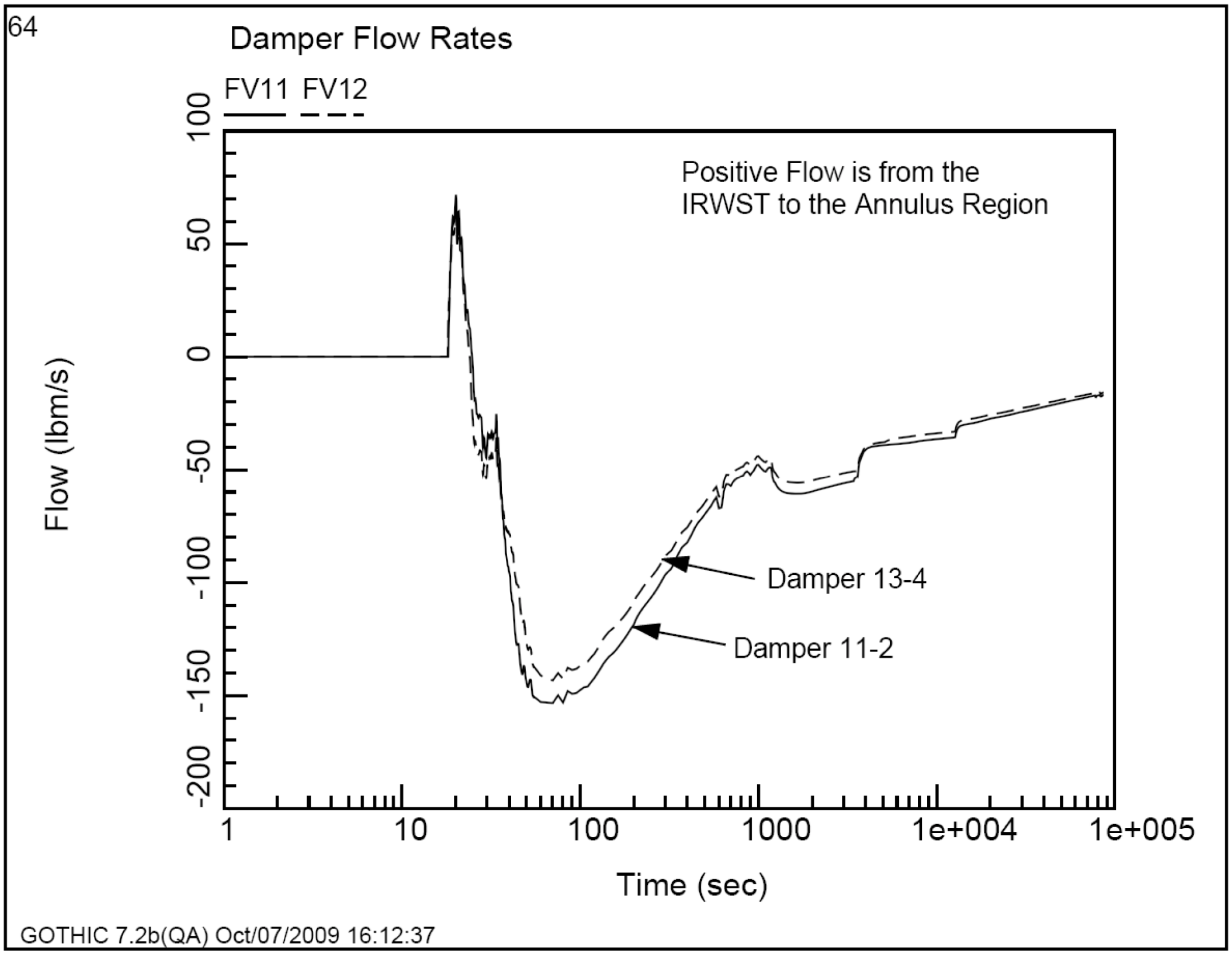


Figure 06.02.01-53–3—Flow into the Spreading Room via Drain Paths

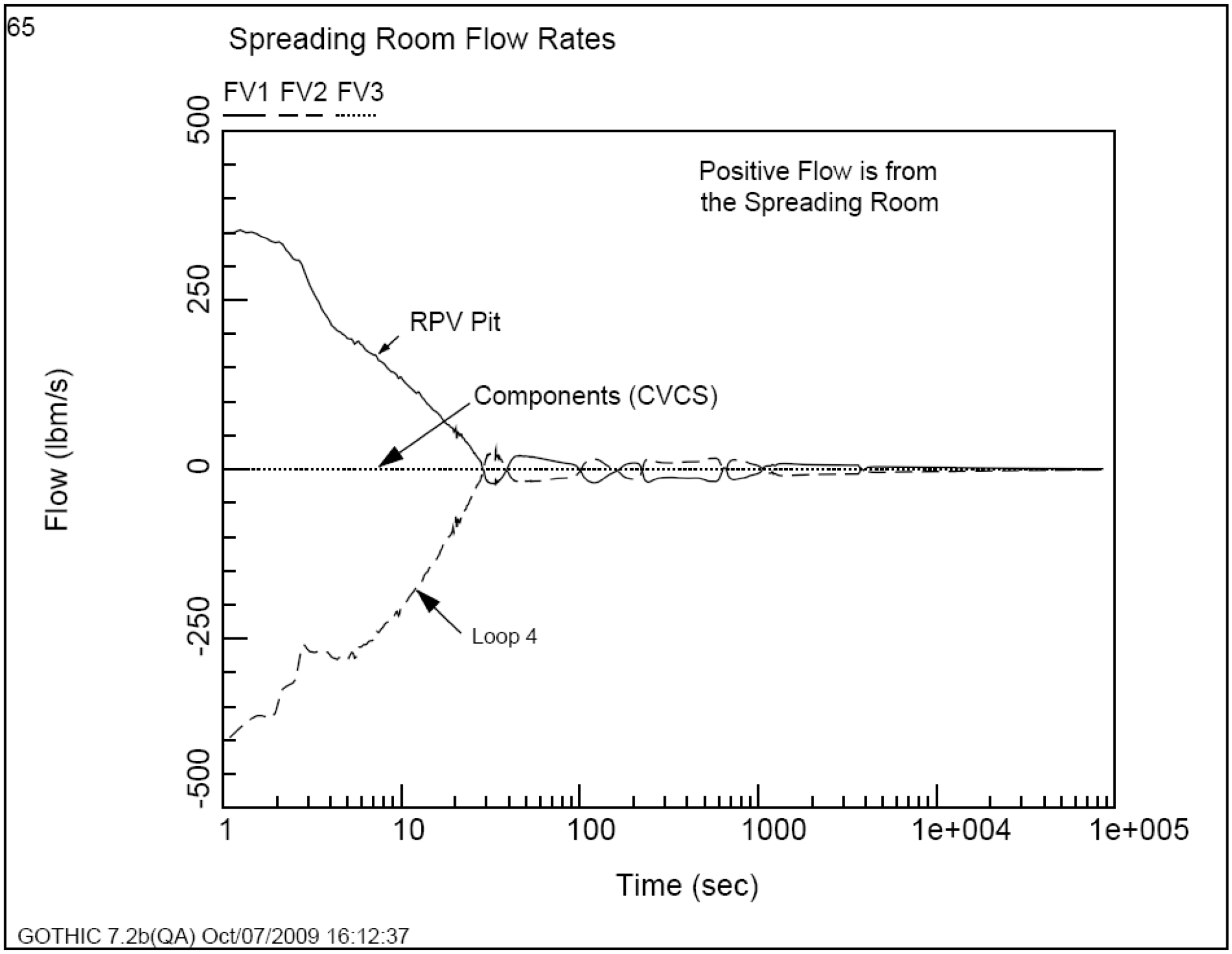


Figure 06.02.01-53–4—Vapor Flow into the IRWST via Drain Paths

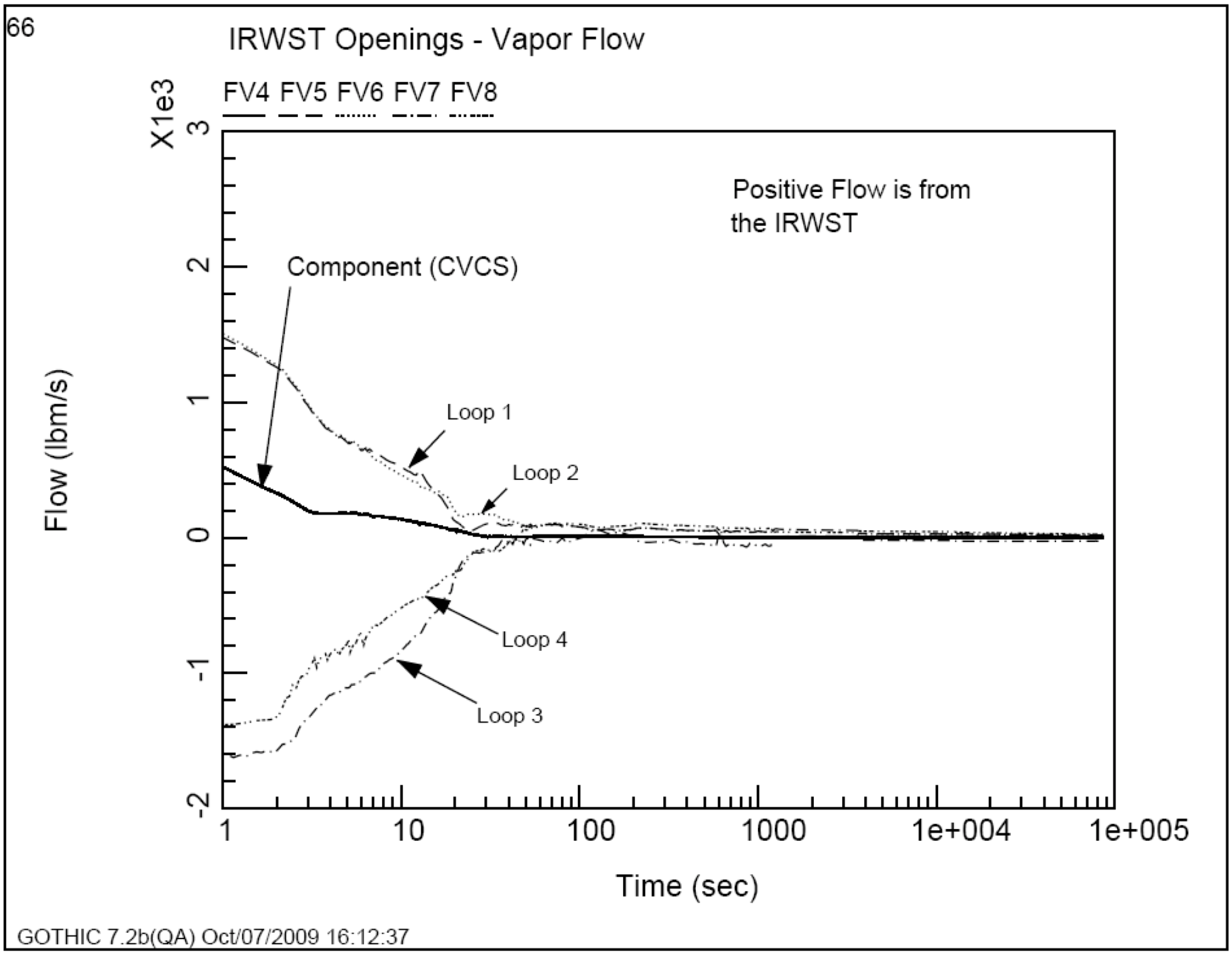


Figure 06.02.01-53–5—Vapor Flow into the IRWST via Drain Paths

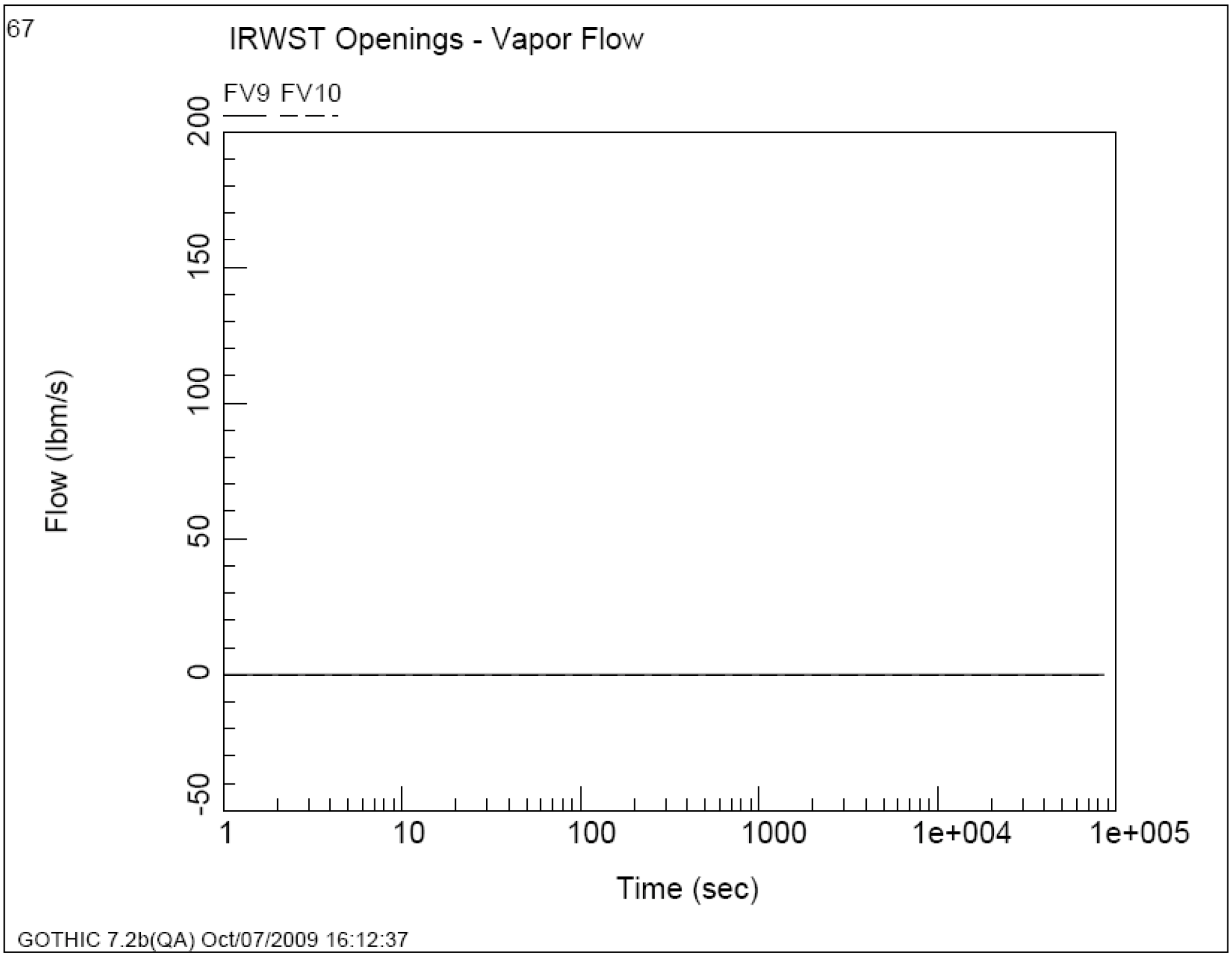


Figure 06.02.01-53–6—Water Flow into the IRWST via Drain Paths

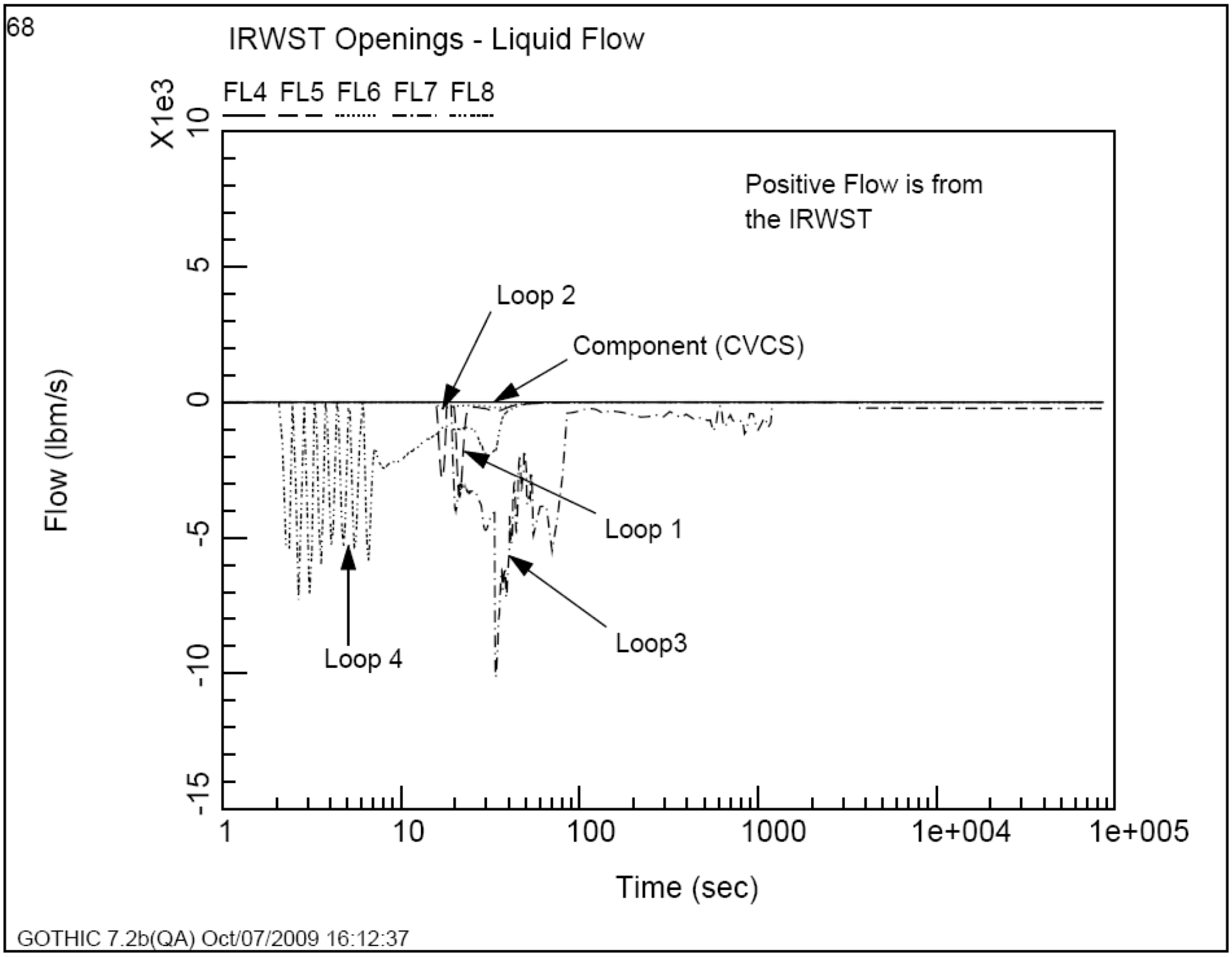


Figure 06.02.01-53–7—Water Flow into the IRWST via Drain Paths

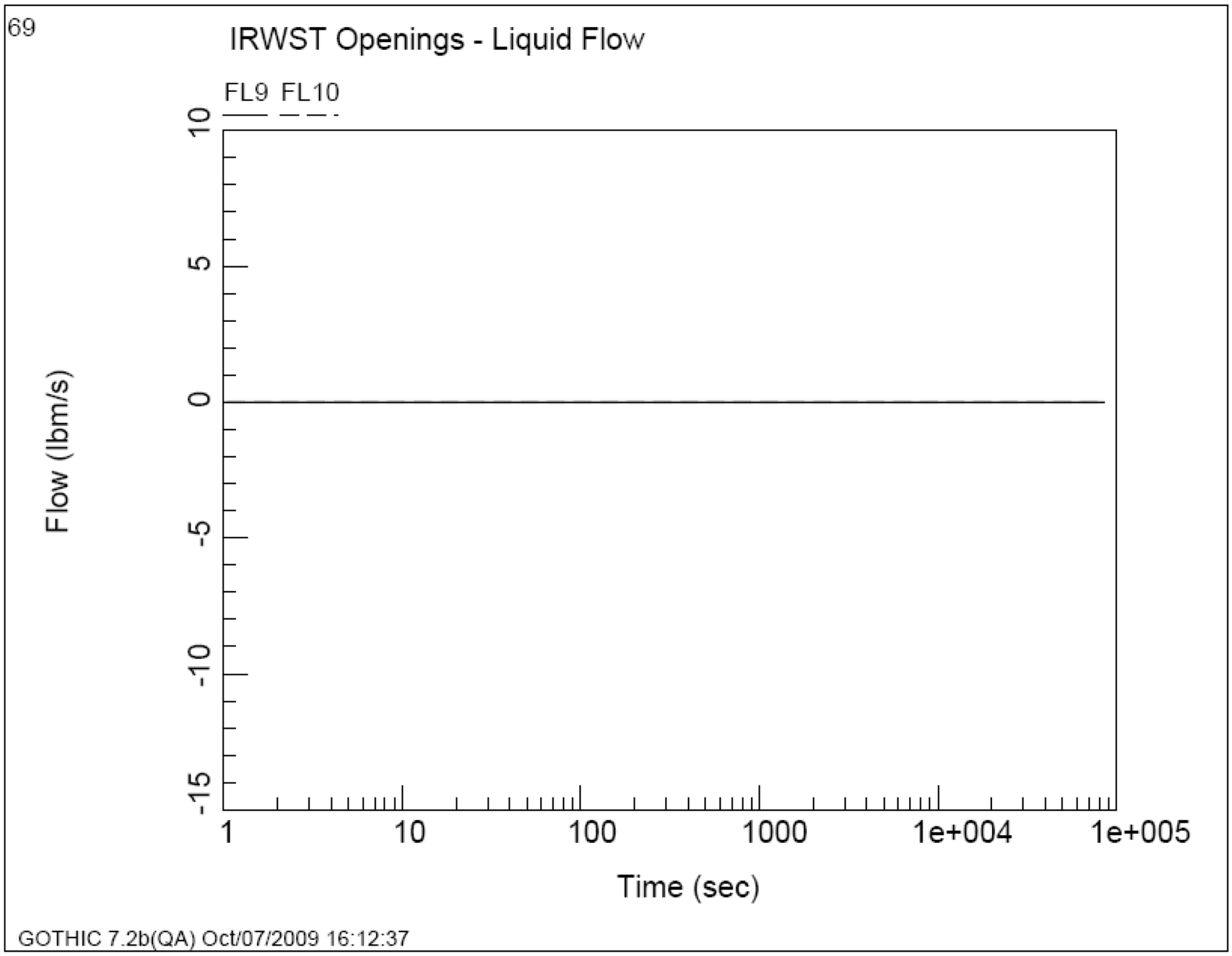


Figure 06.02.01-53–8—Flow from the Loop 1 Lower Equipment Room to Adjacent Rooms

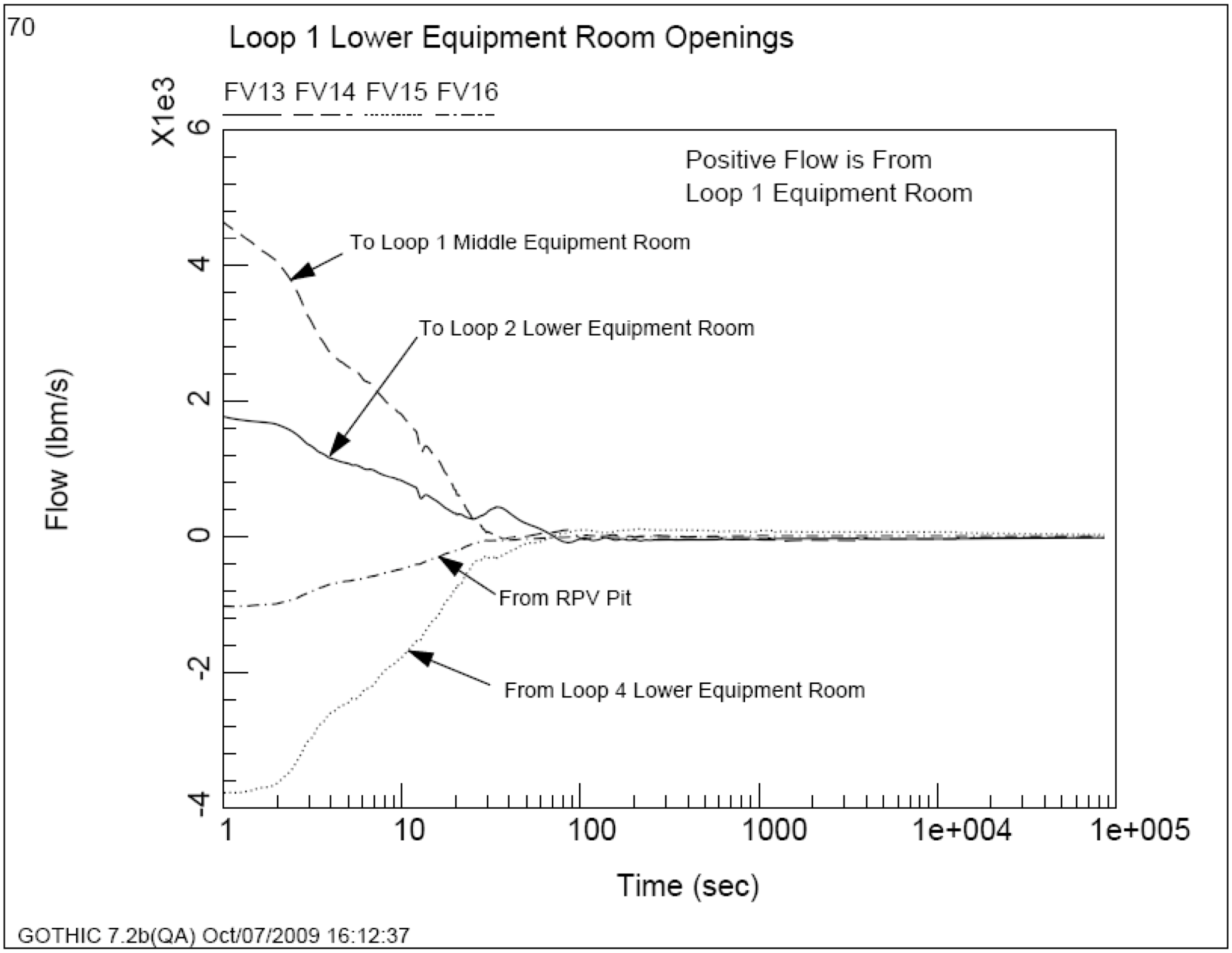


Figure 06.02.01-53–9—Flow from the Loop 1 Lower Equipment Room to Adjacent Rooms

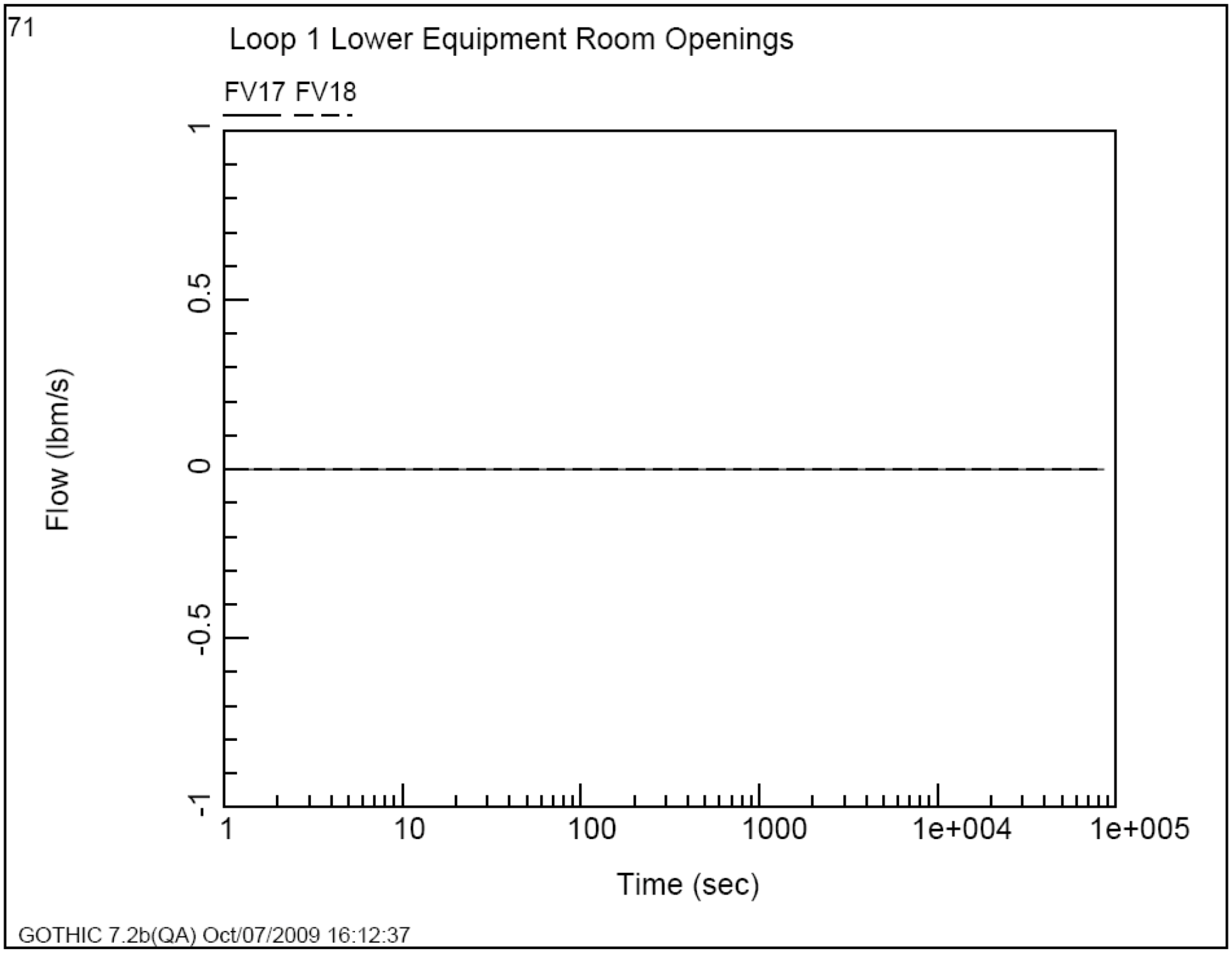


Figure 06.02.01-53–10—Flow from the Loop 2 Lower Equipment Room to Adjacent Rooms

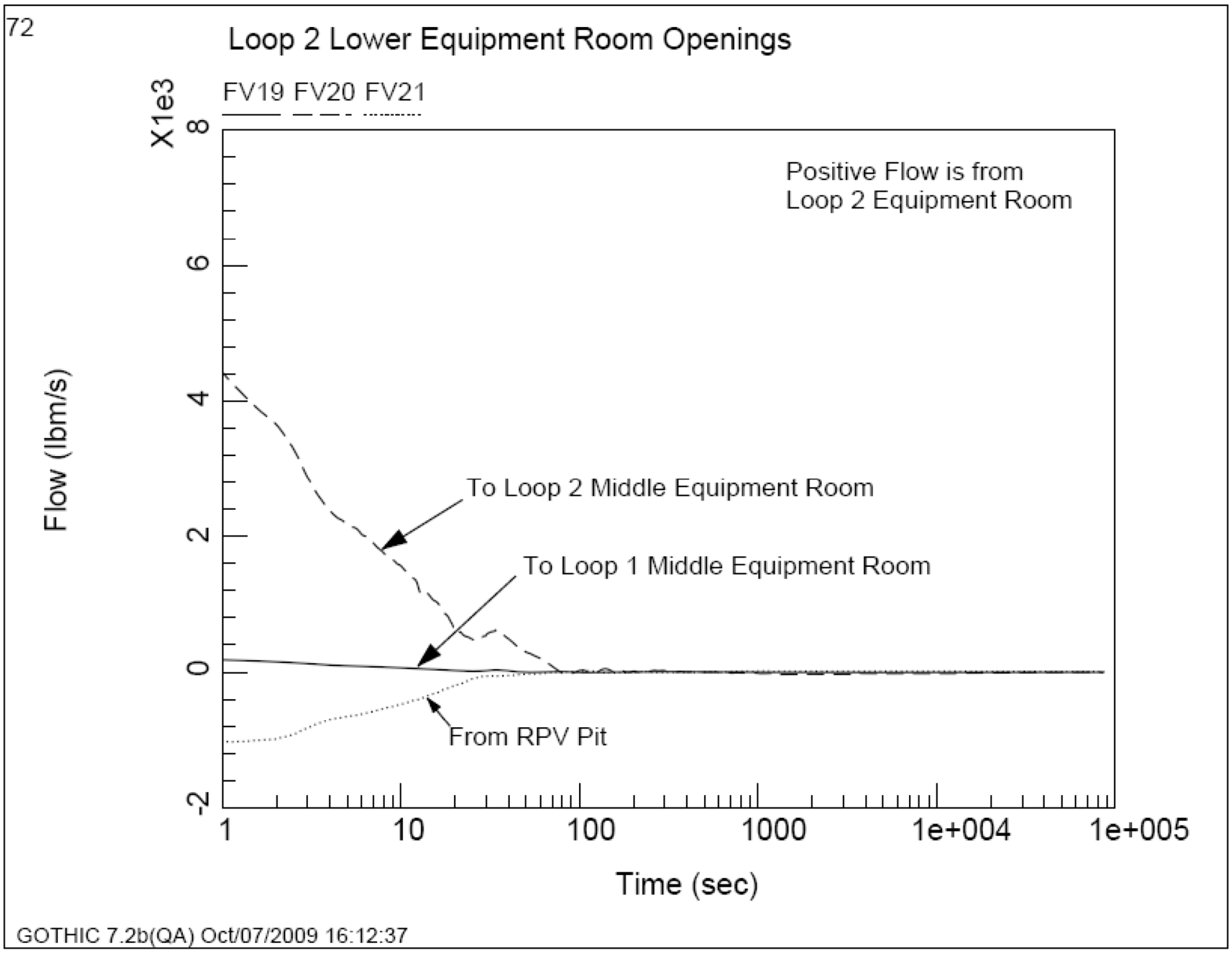


Figure 06.02.01-53–11—Flow from the Loop 2 Lower Equipment Room to Adjacent Rooms

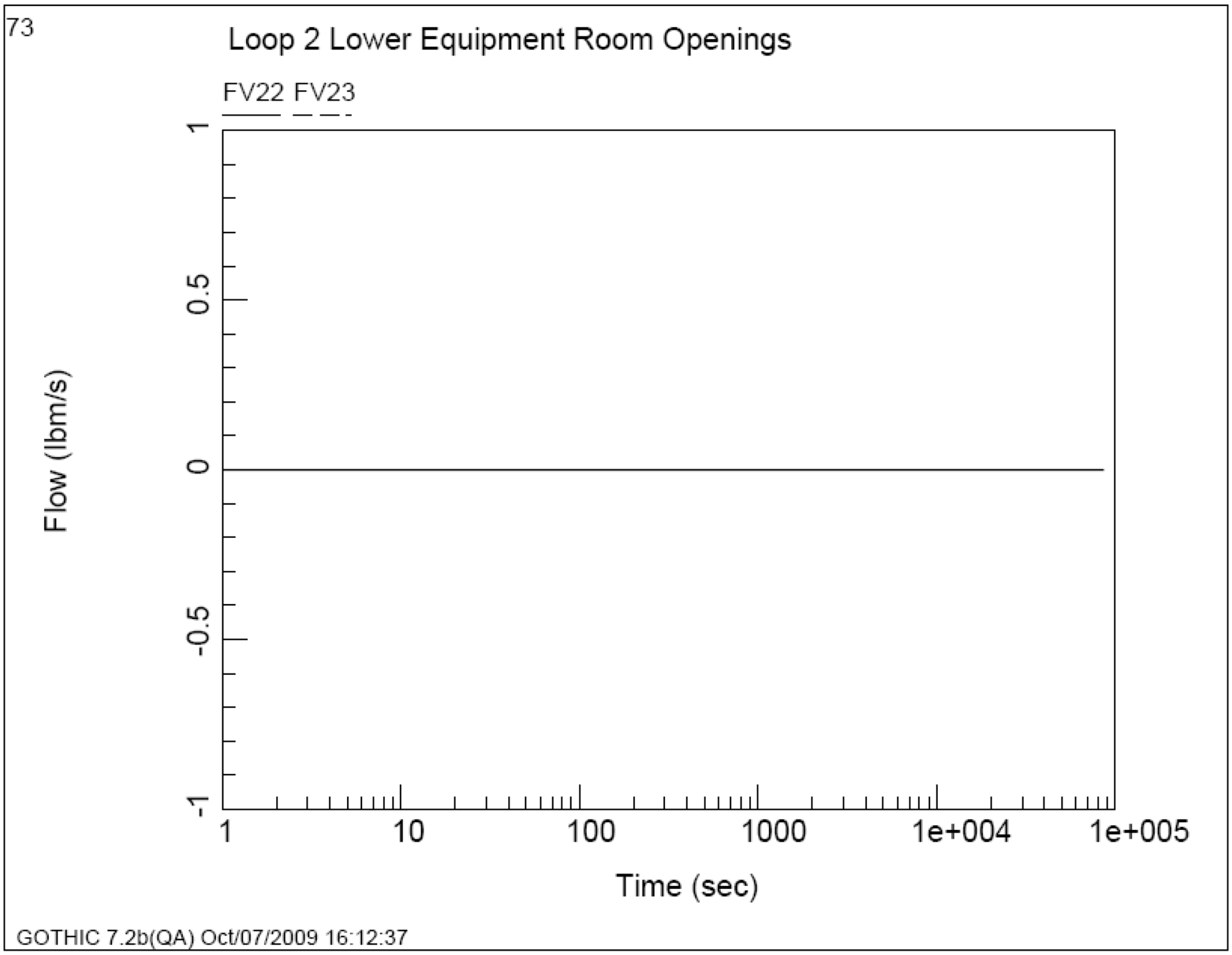


Figure 06.02.01-53–12—Flow from the Loop 1 Middle Equipment Room to Adjacent Rooms

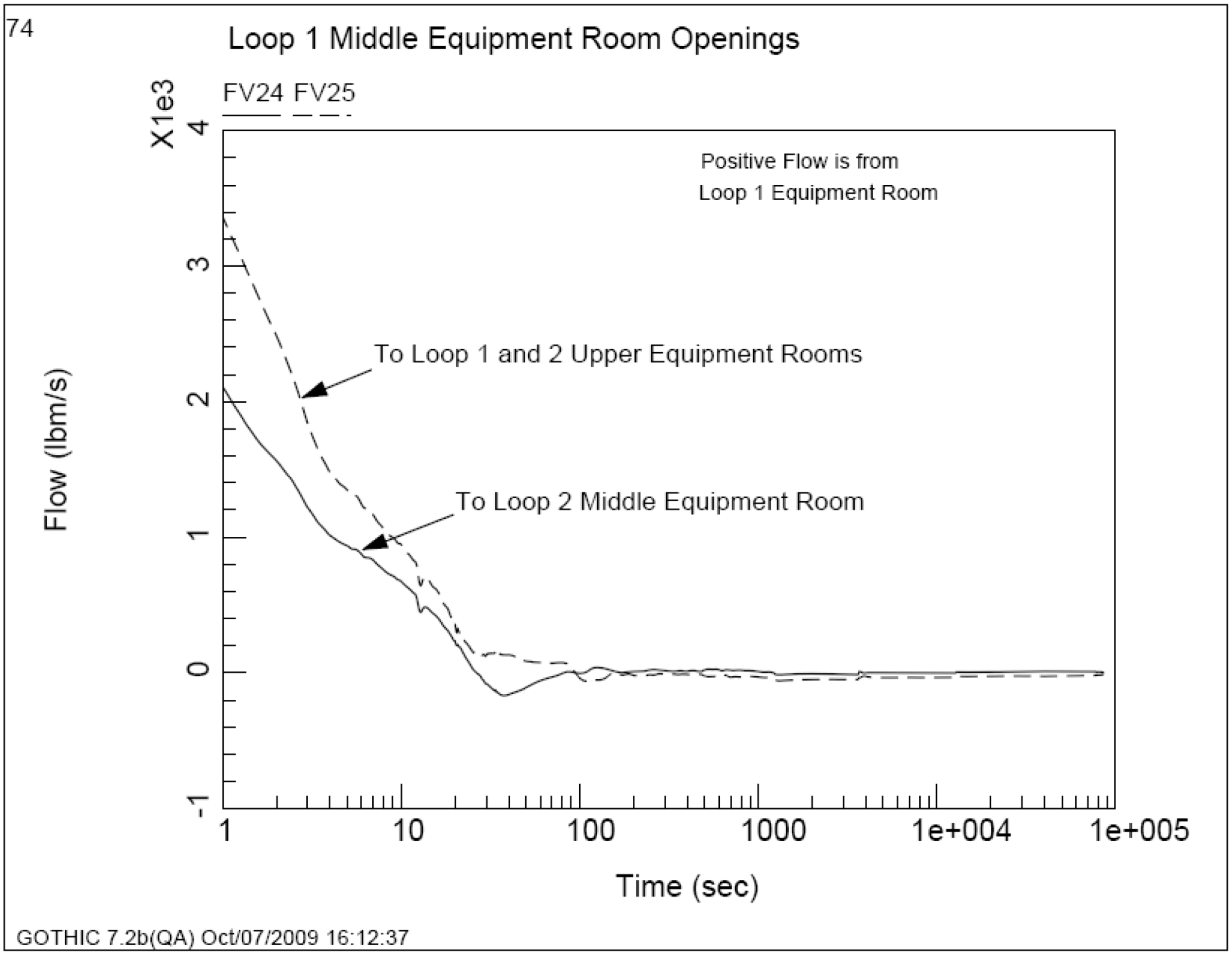


Figure 06.02.01-53–13—Flow from the Loop 1 Middle Equipment Room to Adjacent Rooms

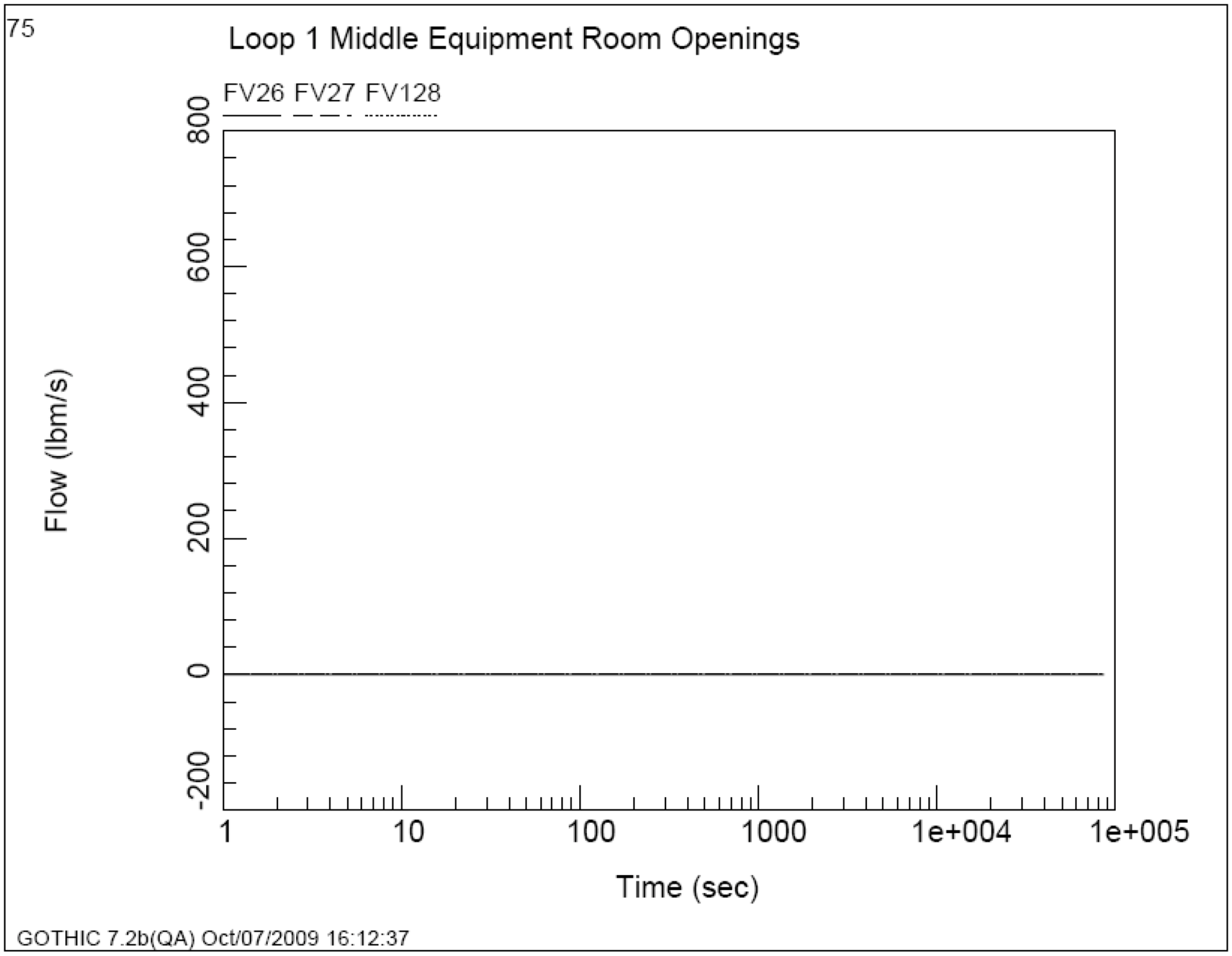


Figure 06.02.01-53–14—Flow from the Loop 2 Middle Equipment Room to Adjacent Rooms

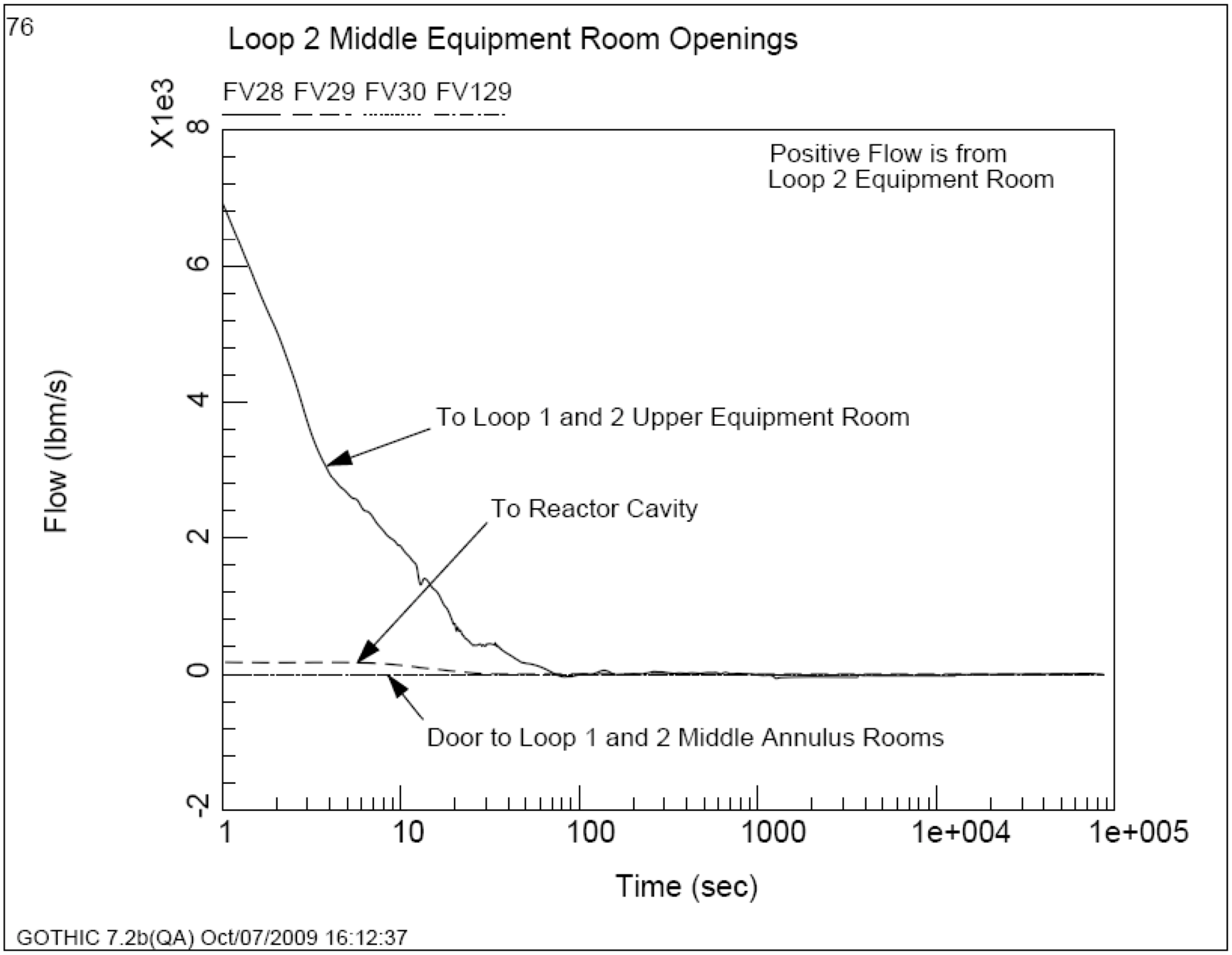


Figure 06.02.01-53–15—Flow from the Loop 1 and 2 Upper Equipment Room to Adjacent Rooms

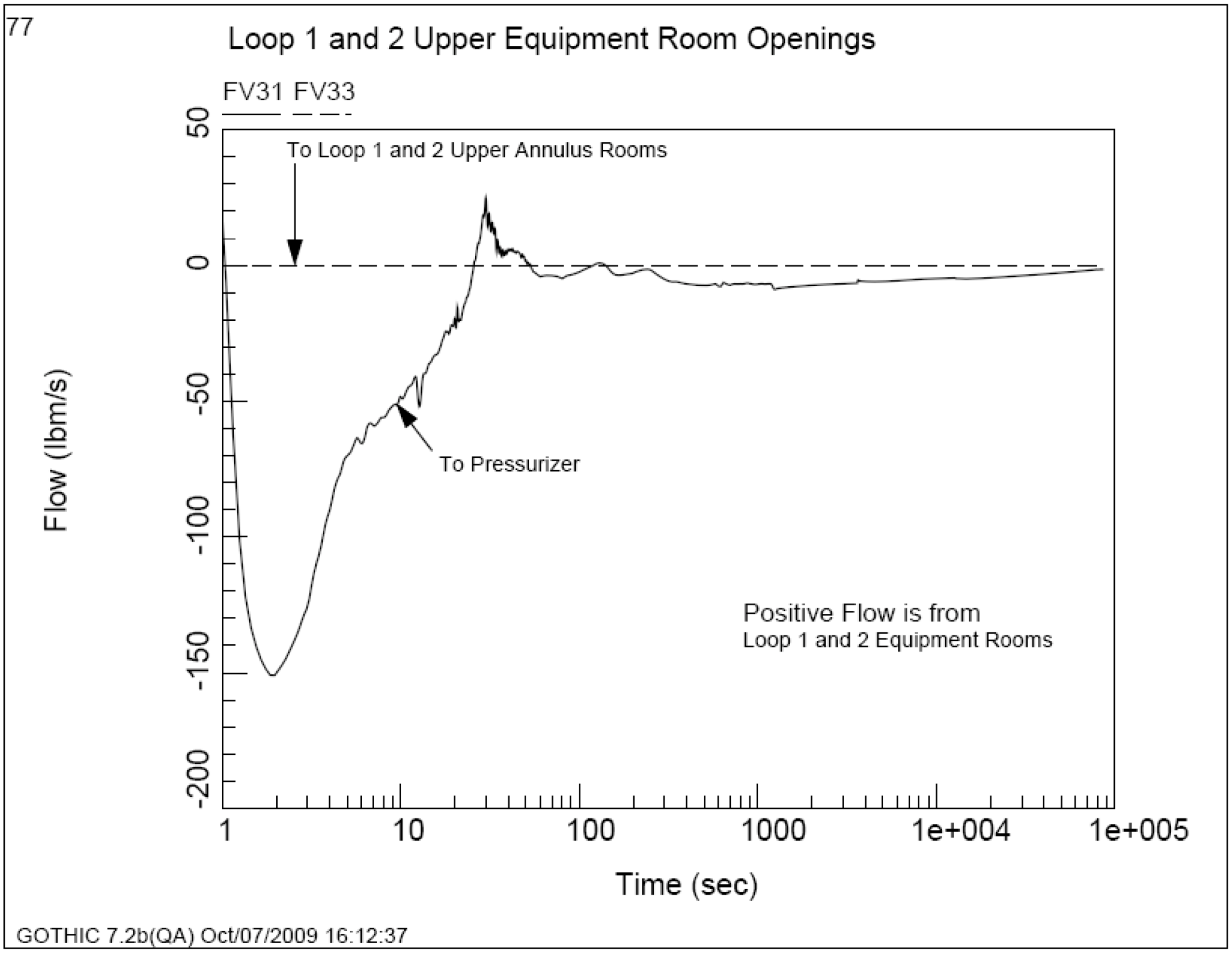


Figure 06.02.01-53–16—Flow from the Reactor Pressure Vessel Pit to Adjacent Rooms

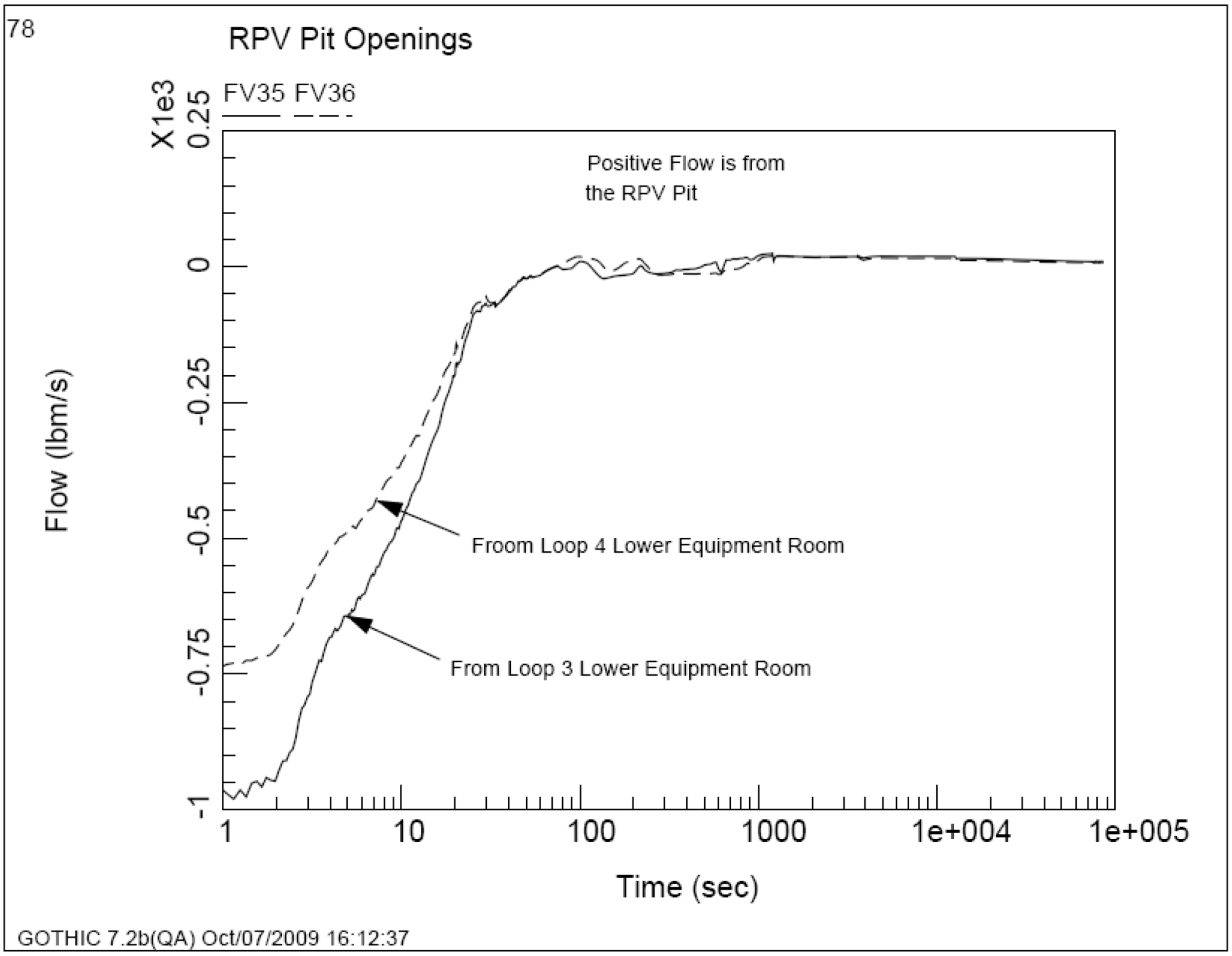


Figure 06.02.01-53–17—Flow from the Reactor Cavity to Adjacent Rooms

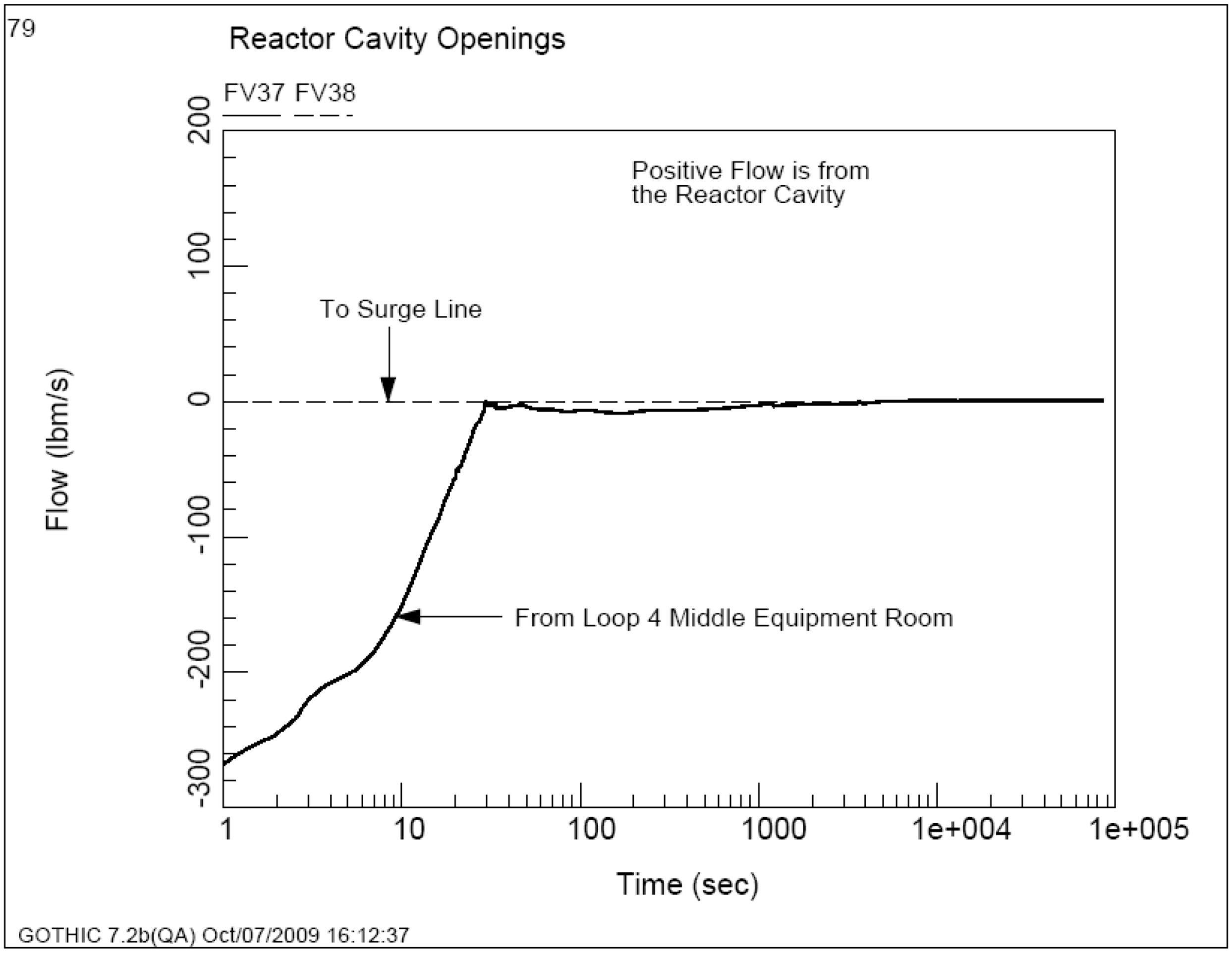


Figure 06.02.01-53–18—Flow from the Loop 3 Lower Equipment Room to Adjacent Rooms

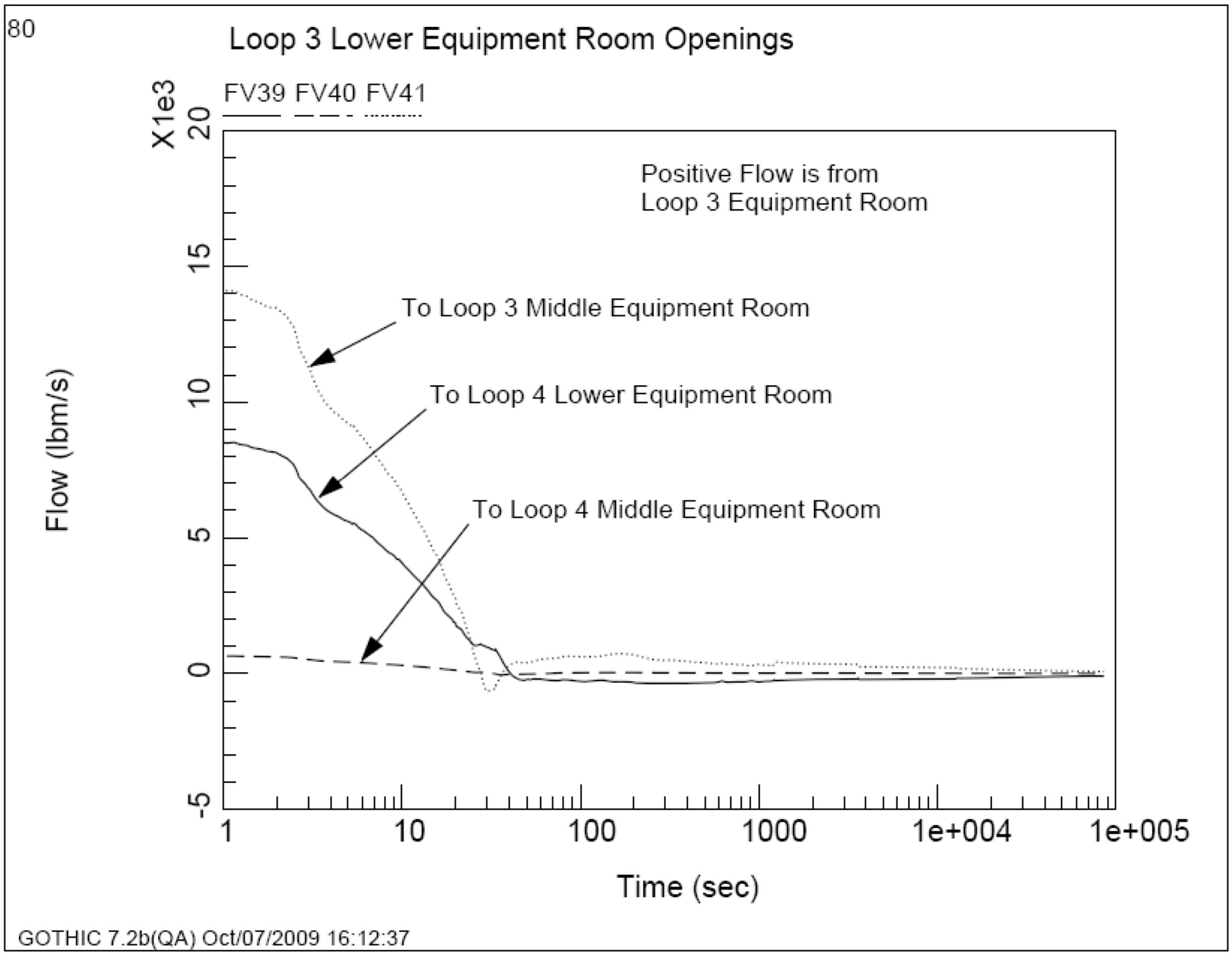


Figure 06.02.01-53–19—Flow from the Loop 3 Lower Equipment Room to Adjacent Rooms

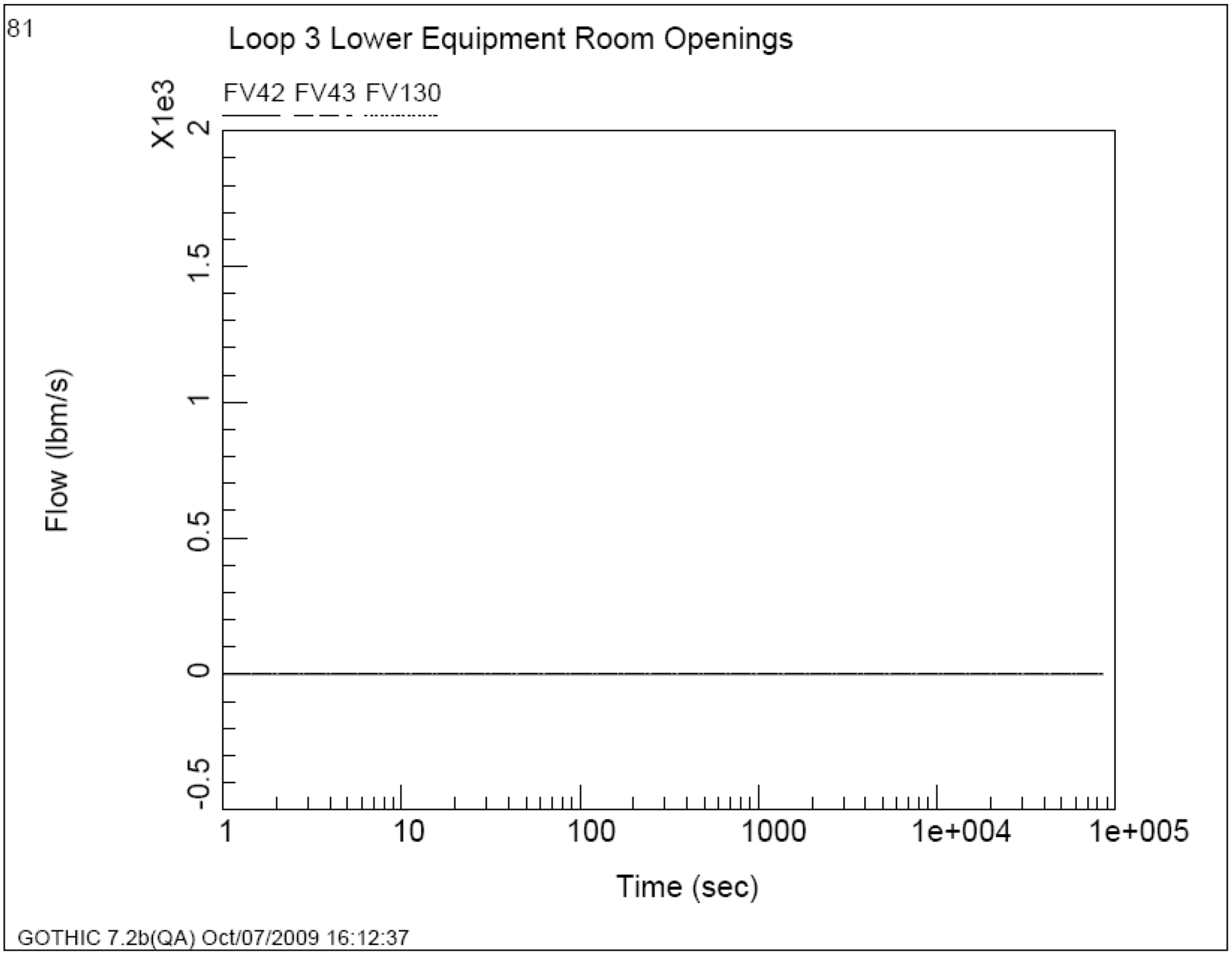


Figure 06.02.01-53–20—Flow from the Loop 4 Lower Equipment Room to Adjacent Rooms

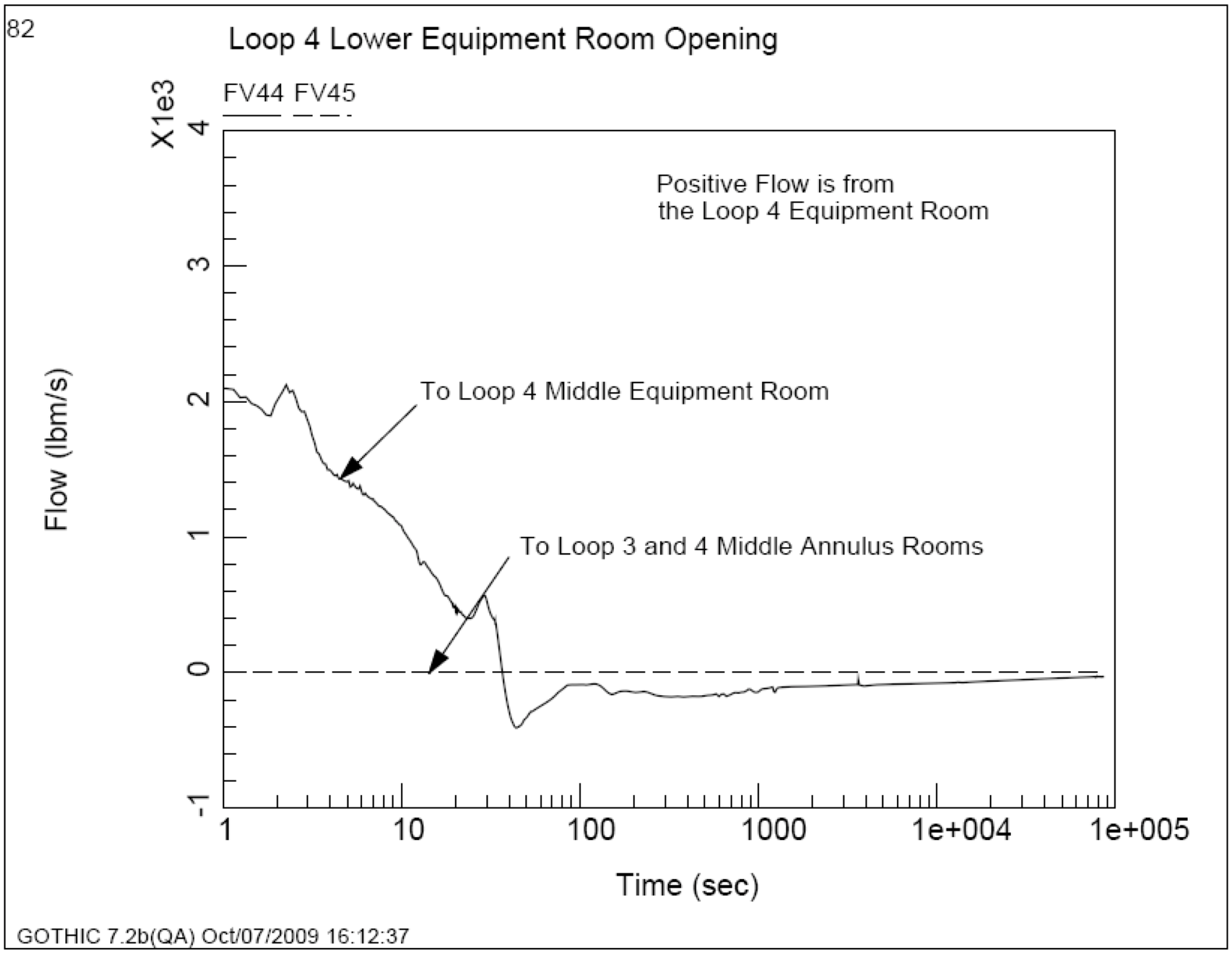


Figure 06.02.01-53–21—Flow from the Loop 3 Middle Equipment Room to Adjacent Rooms

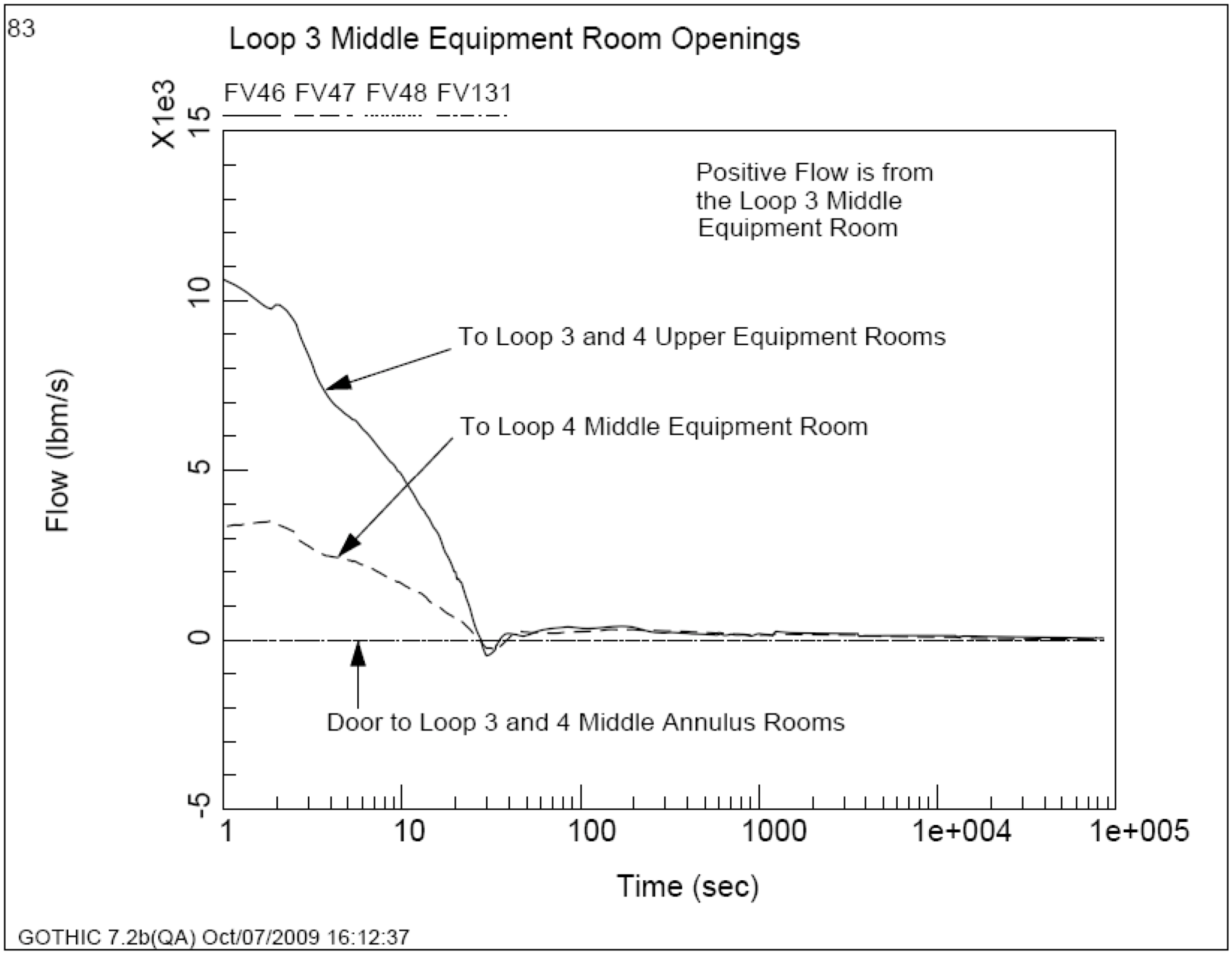


Figure 06.02.01-53–22—Flow from the Loop 4 Middle Equipment Room to Adjacent Rooms

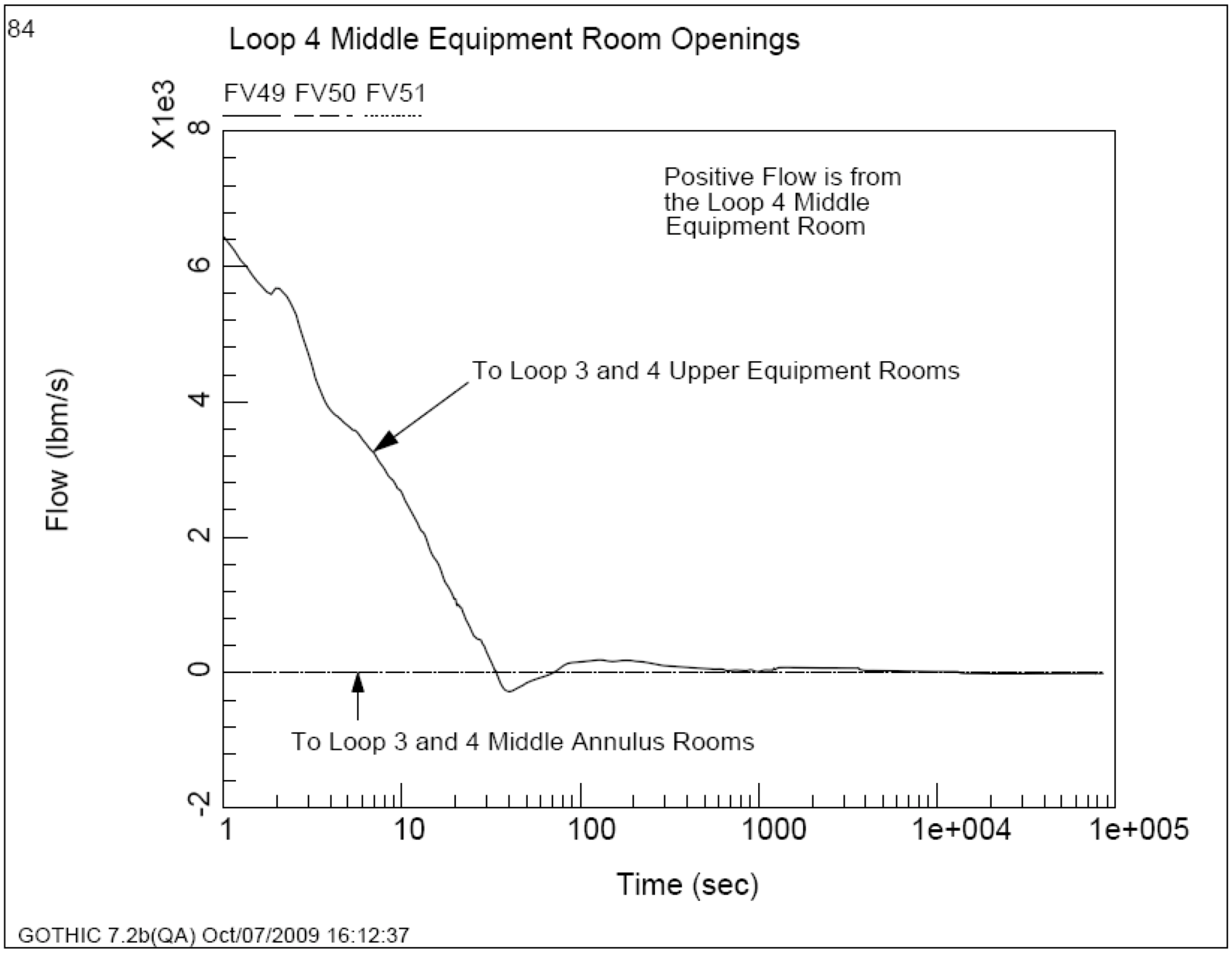


Figure 06.02.01-53–23—Flow from the Loop 3 and 4 Upper Equipment Room to Adjacent Rooms

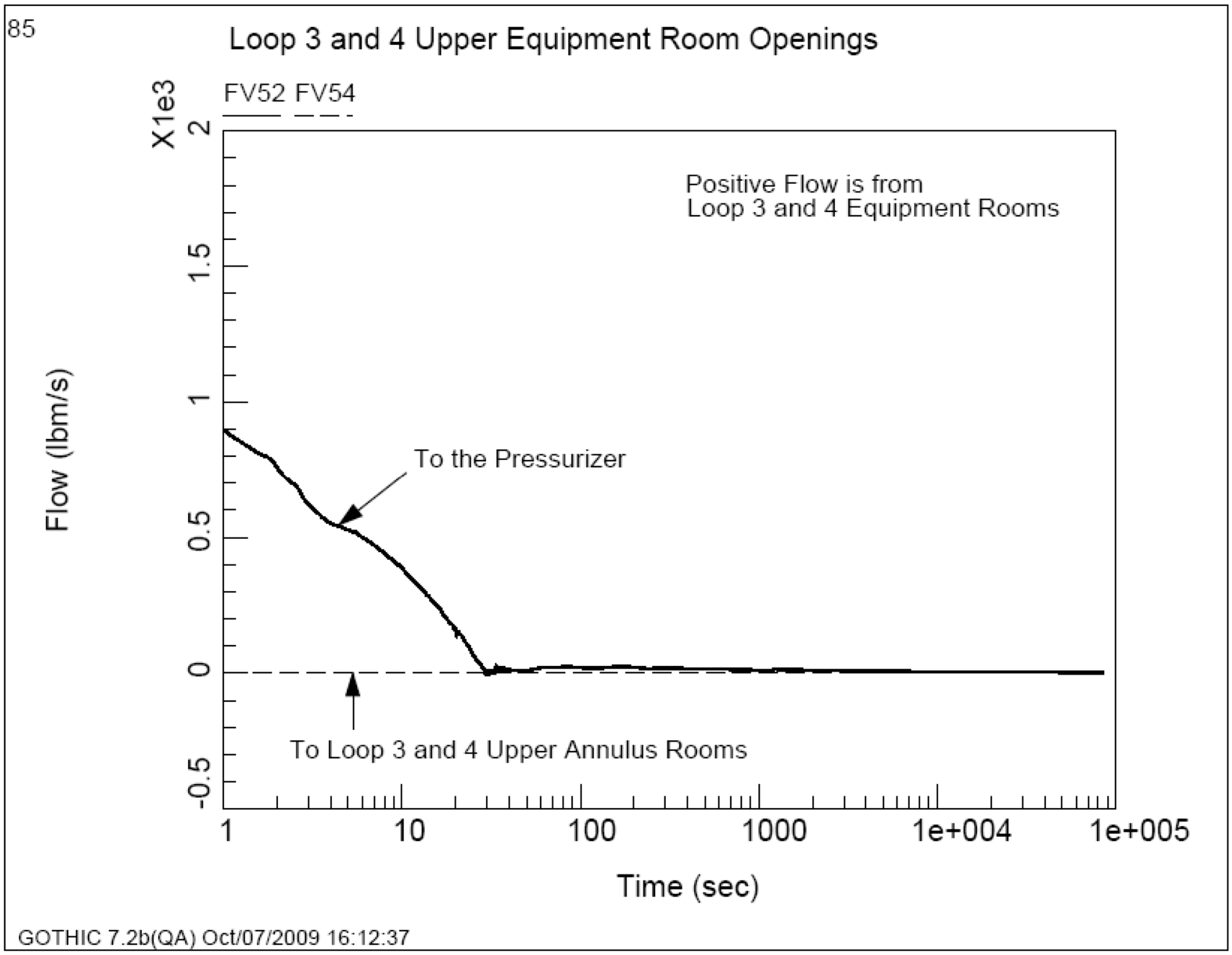


Figure 06.02.01-53–24—Flow from the Pressurizer Surge Line Room to Adjacent Rooms

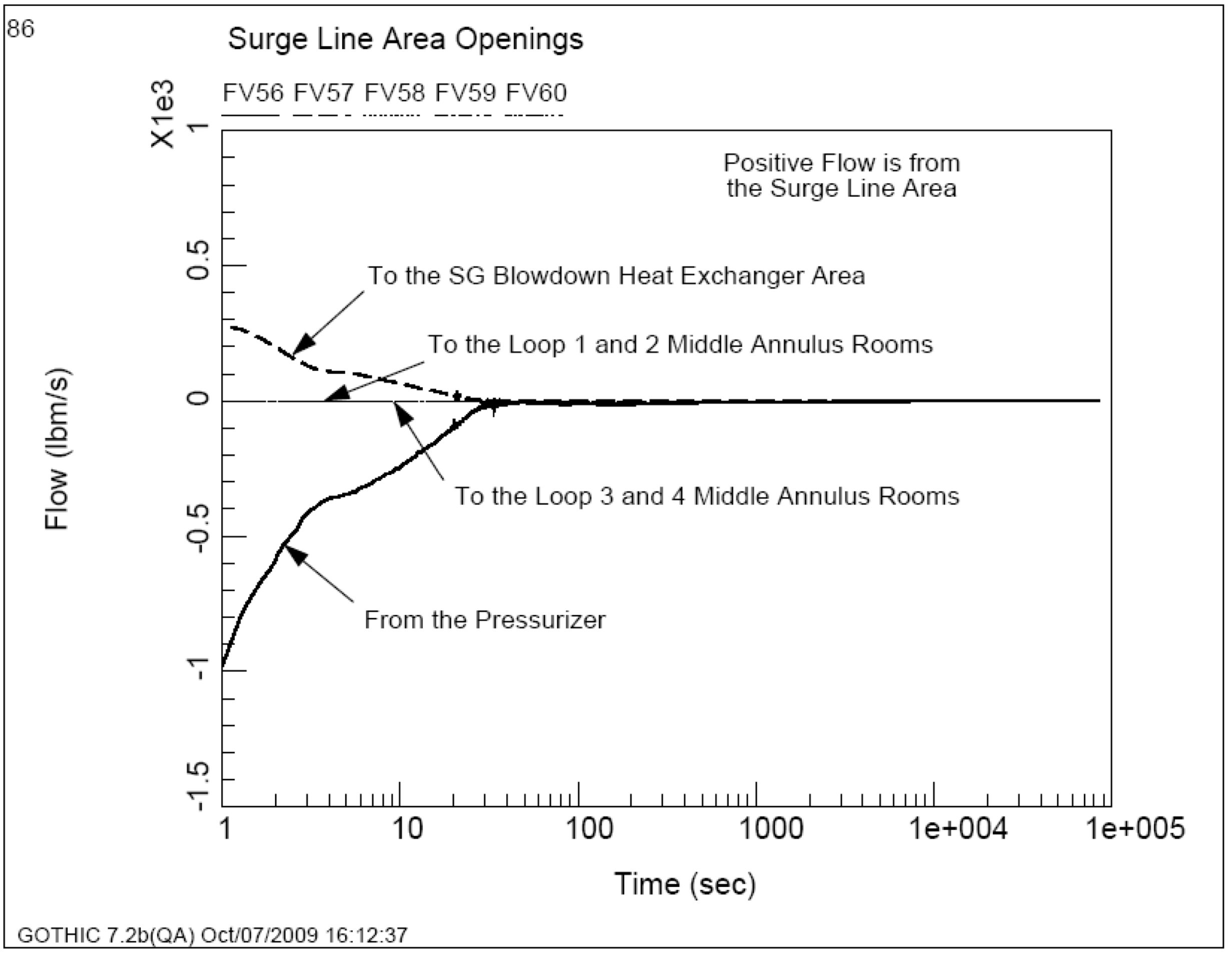
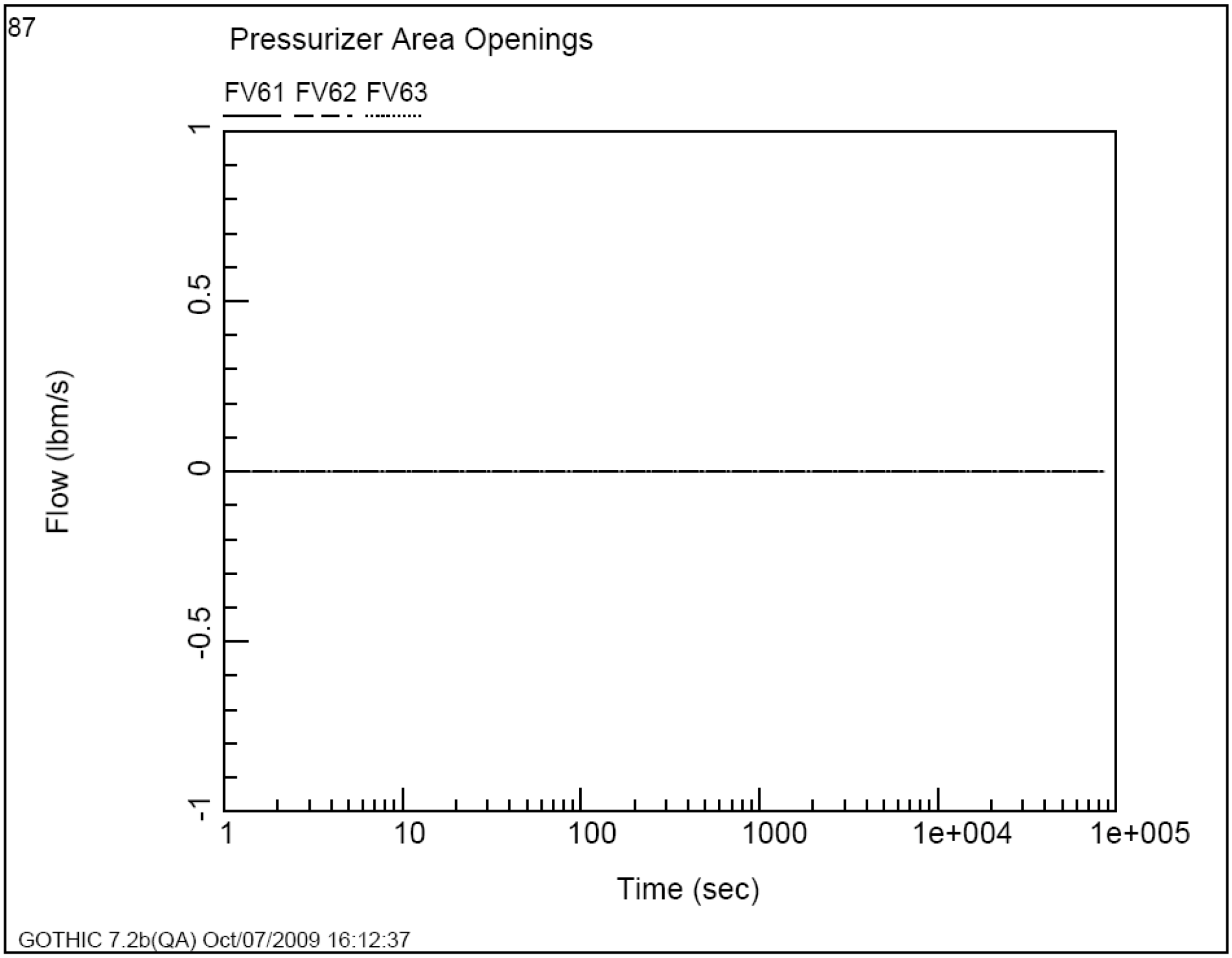


Figure 06.02.01-53–25—Flow from the Pressurizer Room to Adjacent Rooms



Flow Rates Internal to the Accessible Area

Figure 06.02.01-53–26—Flow from the CVCS Room to Adjacent Areas

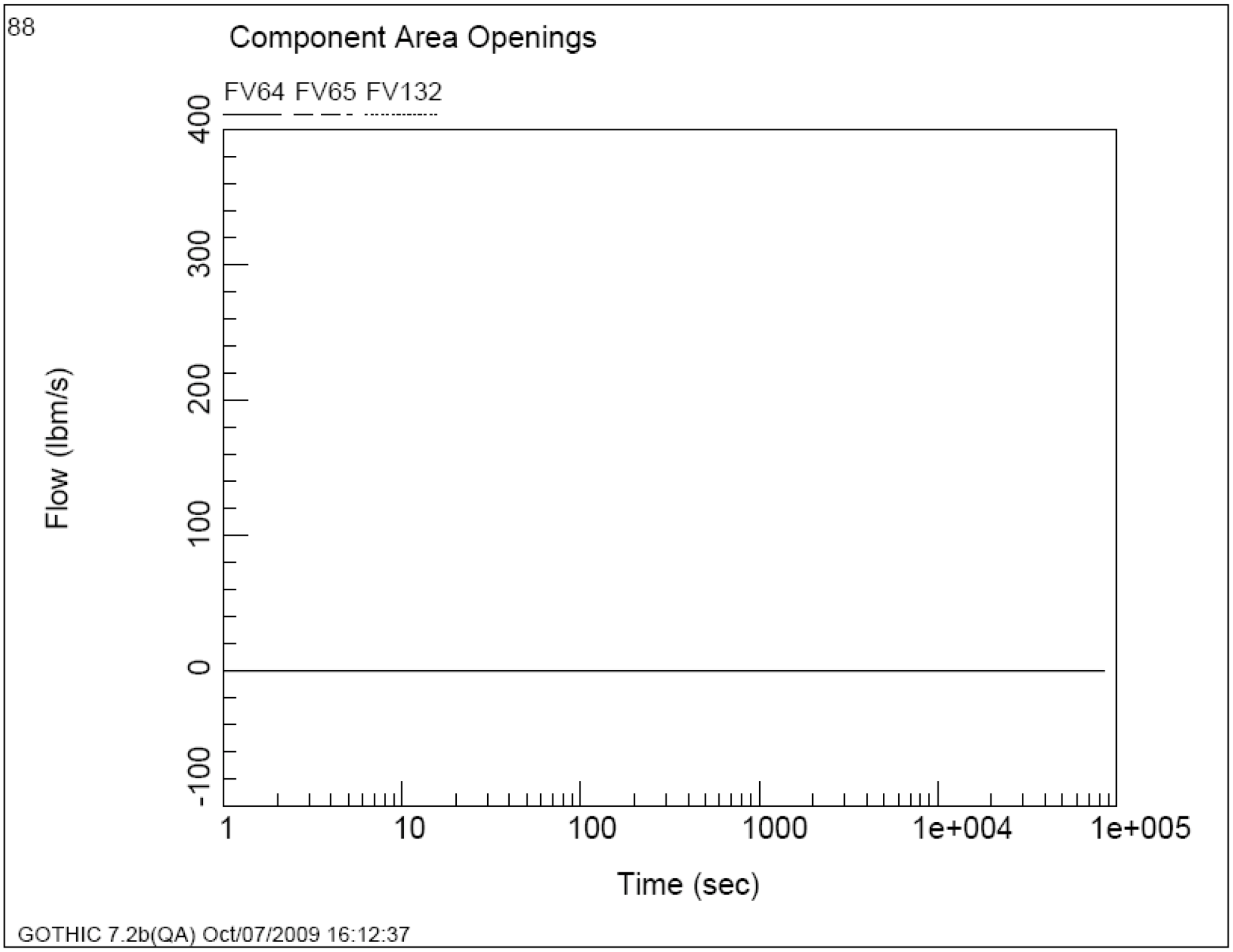


Figure 06.02.01-53–27—Flow from the Steam Generator Blowdown Heat Exchanger Room to Adjacent Areas

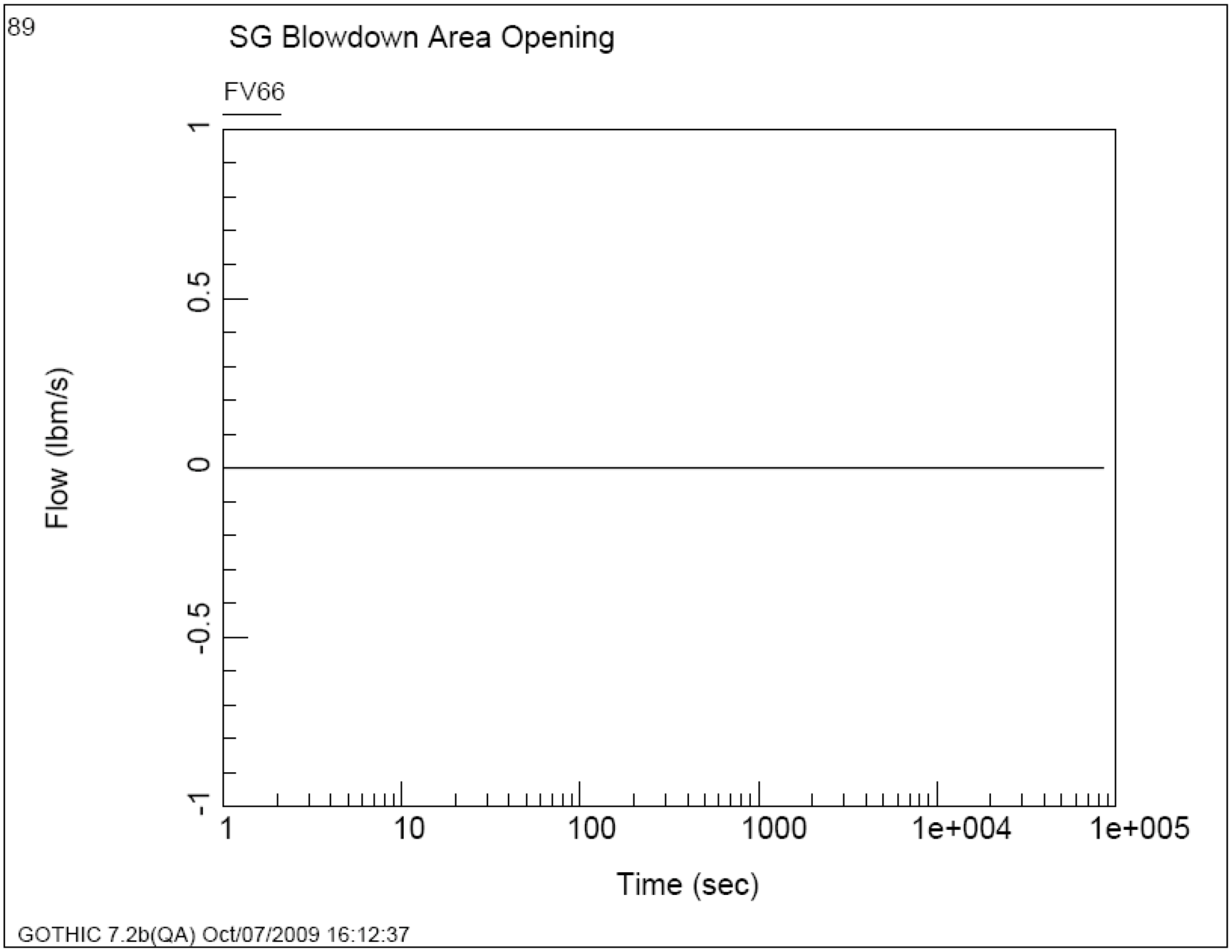


Figure 06.02.01-53–28—Flow from the Loop 1 and 2 Lower Annulus Room to Adjacent Rooms

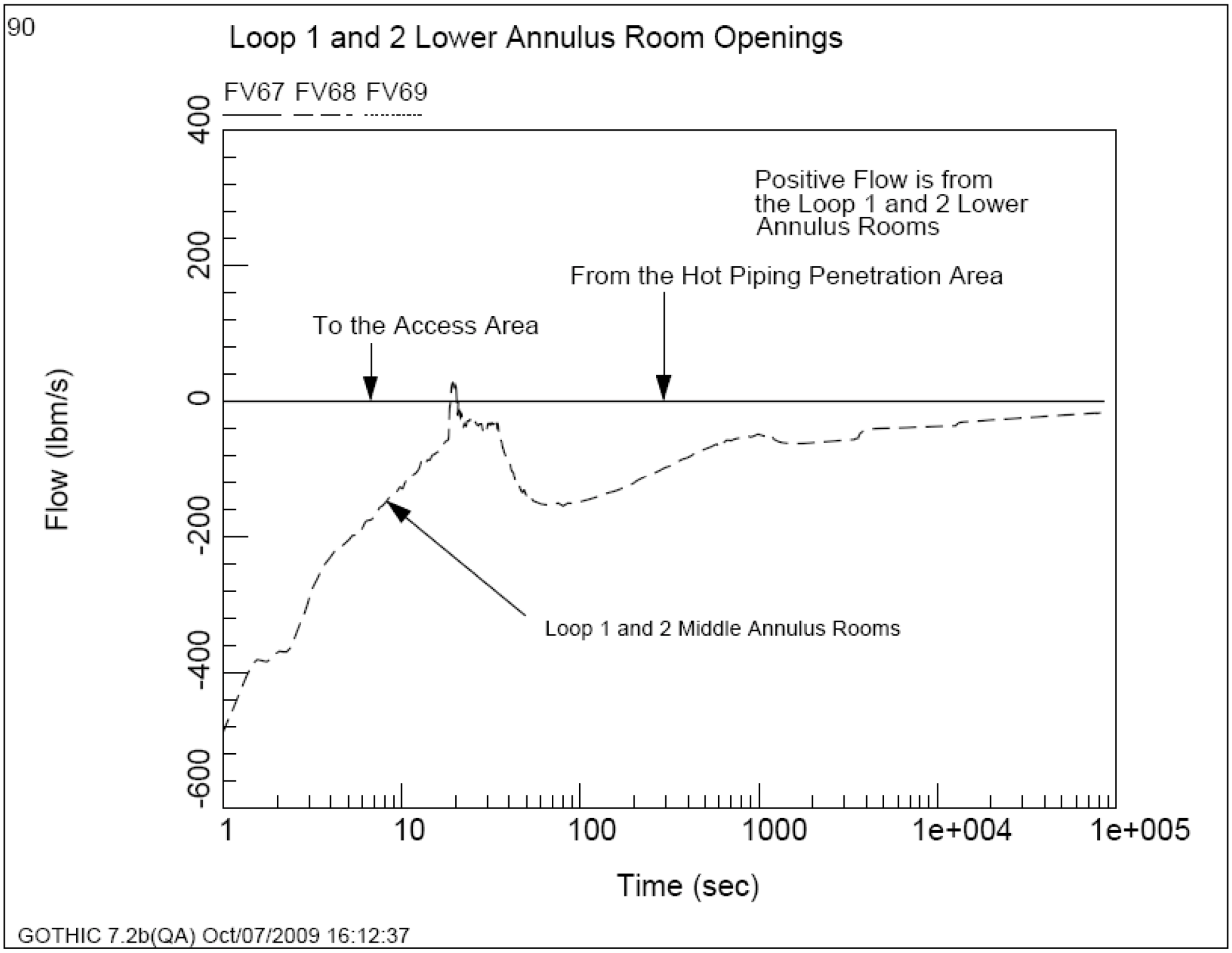


Figure 06.02.01-53–29—Flow from the Loop 3 and 4 Lower Annulus Room to Adjacent Rooms

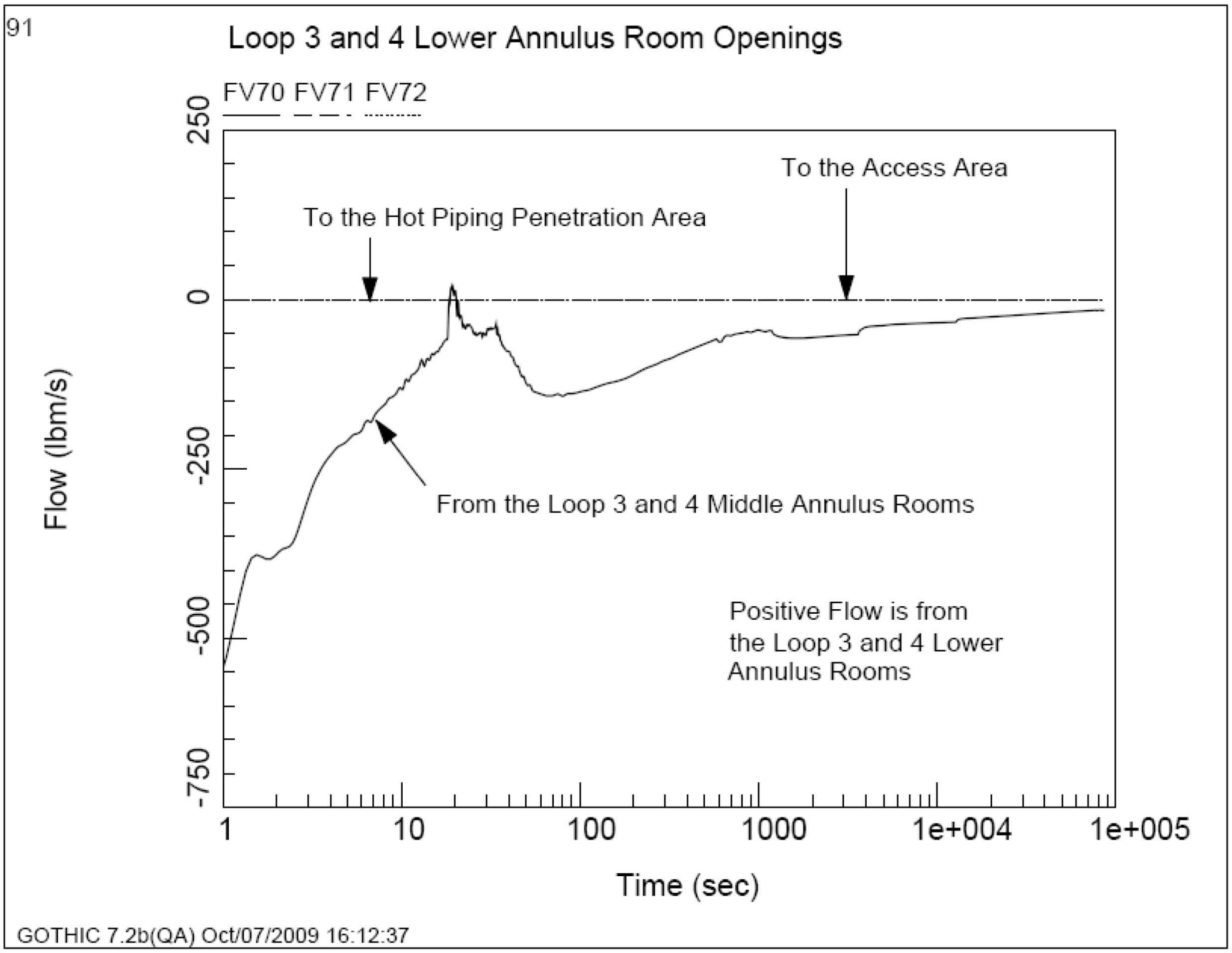


Figure 06.02.01-53–30—Flow from the Loop 1 and 2 Middle Annulus Room to Adjacent Rooms

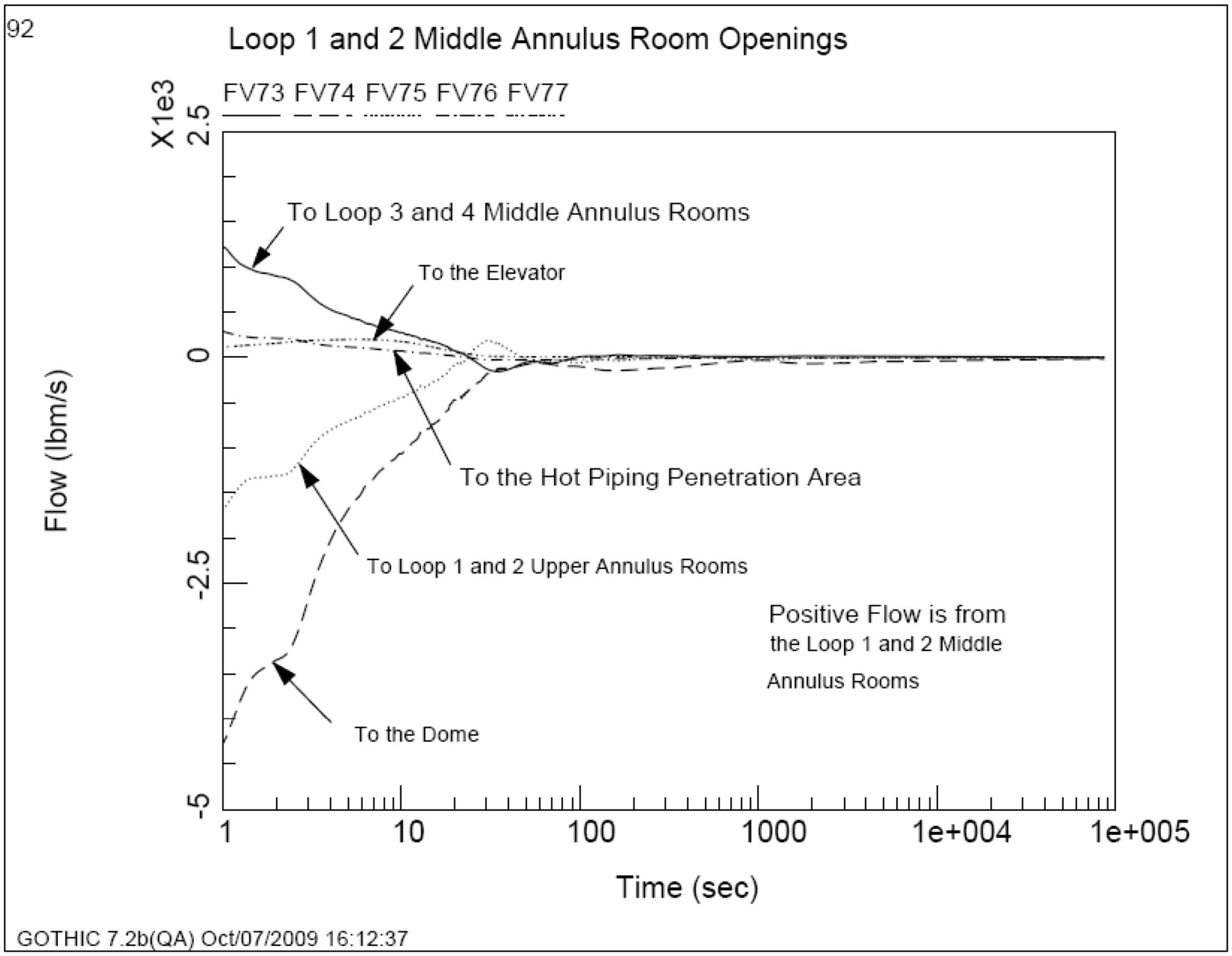


Figure 06.02.01-53–31—Flow from the Loop 1 and 2 Middle Annulus Room to Adjacent Rooms

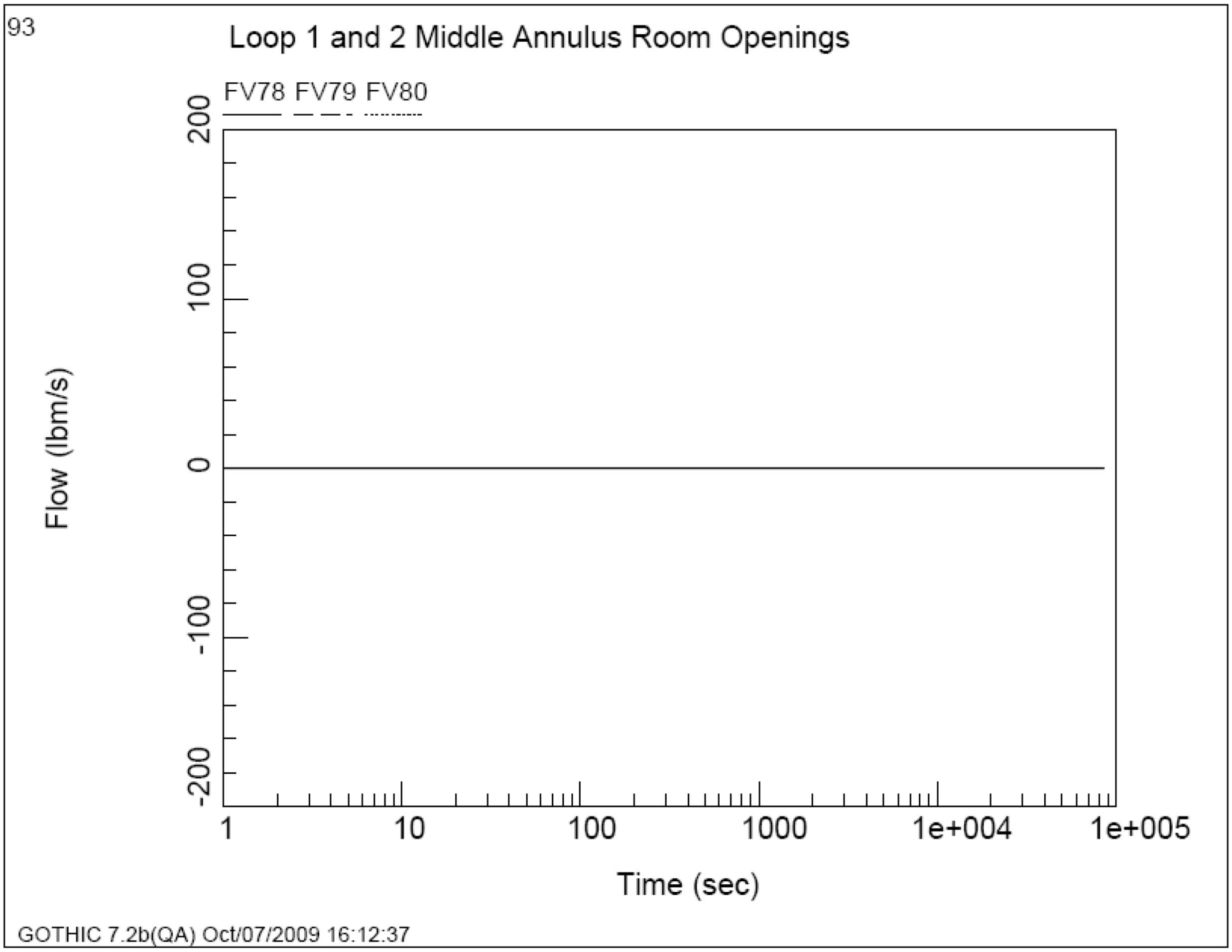


Figure 06.02.01-53–32—Flow from the Loop 3 and 4 Middle Annulus Room to Adjacent Rooms

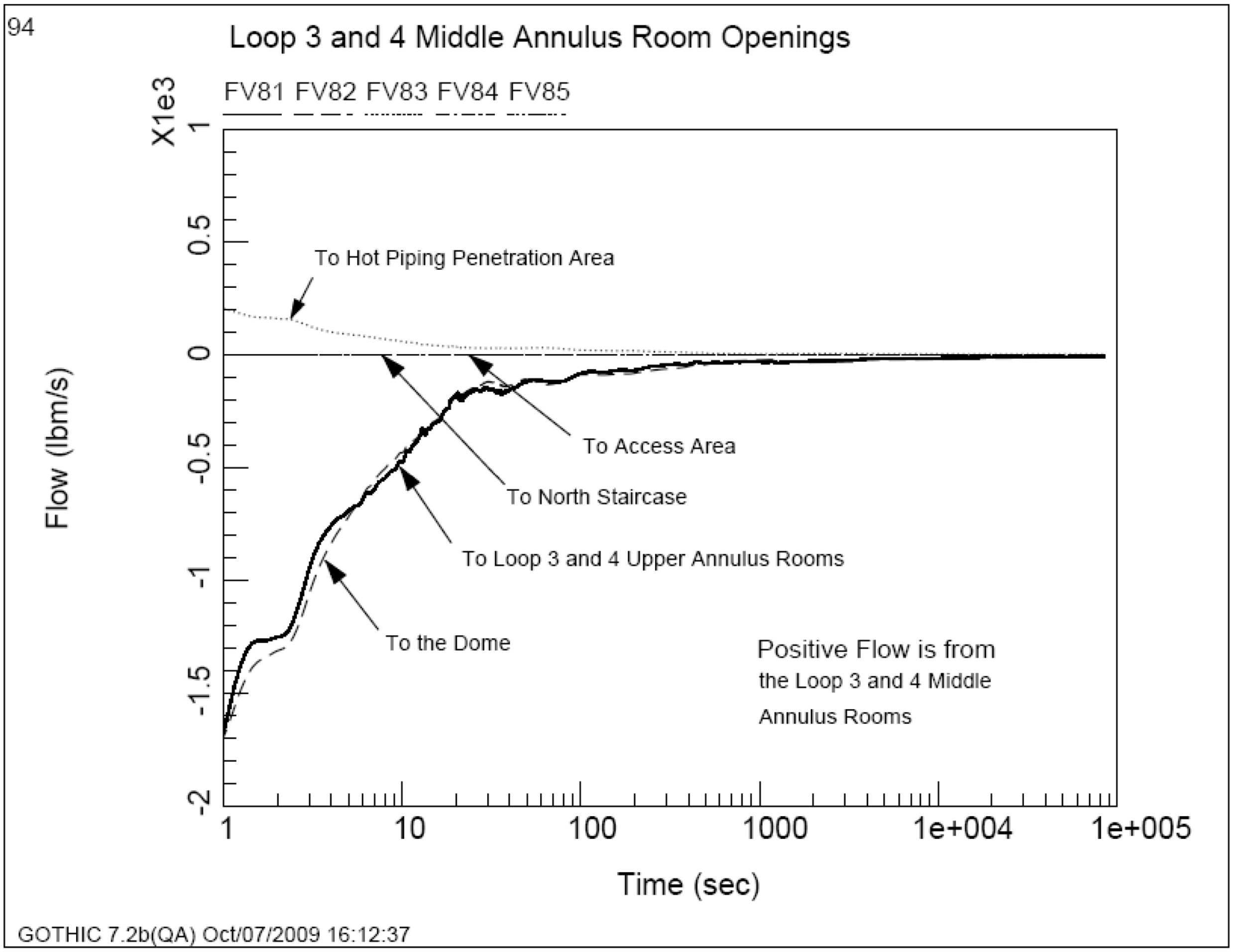


Figure 06.02.01-53–33—Flow from the Loop 1 and 2 Upper Annulus Room to Adjacent Rooms

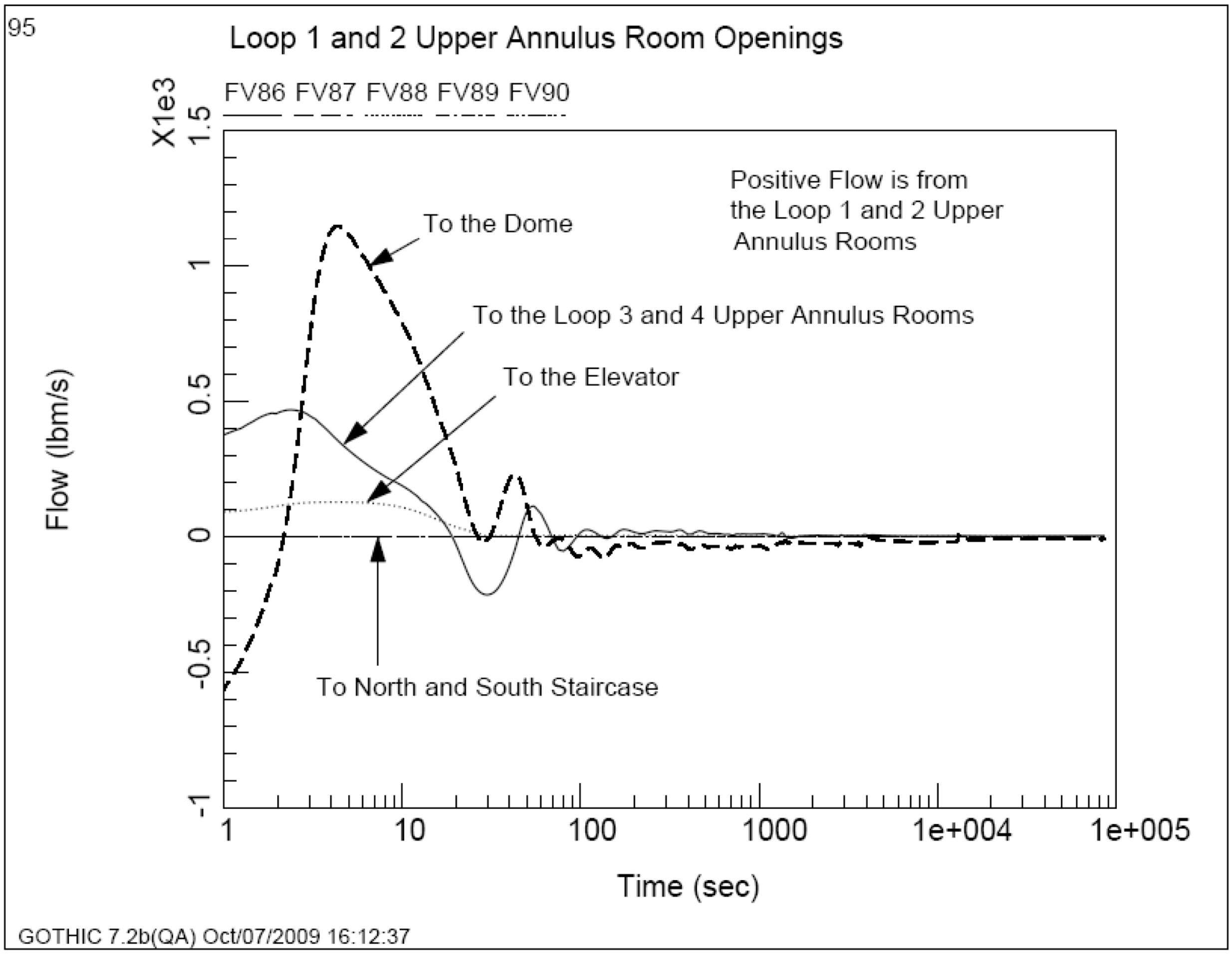


Figure 06.02.01-53–34—Flow from the Loop 3 and 4 Upper Annulus Room to the North Stairwell

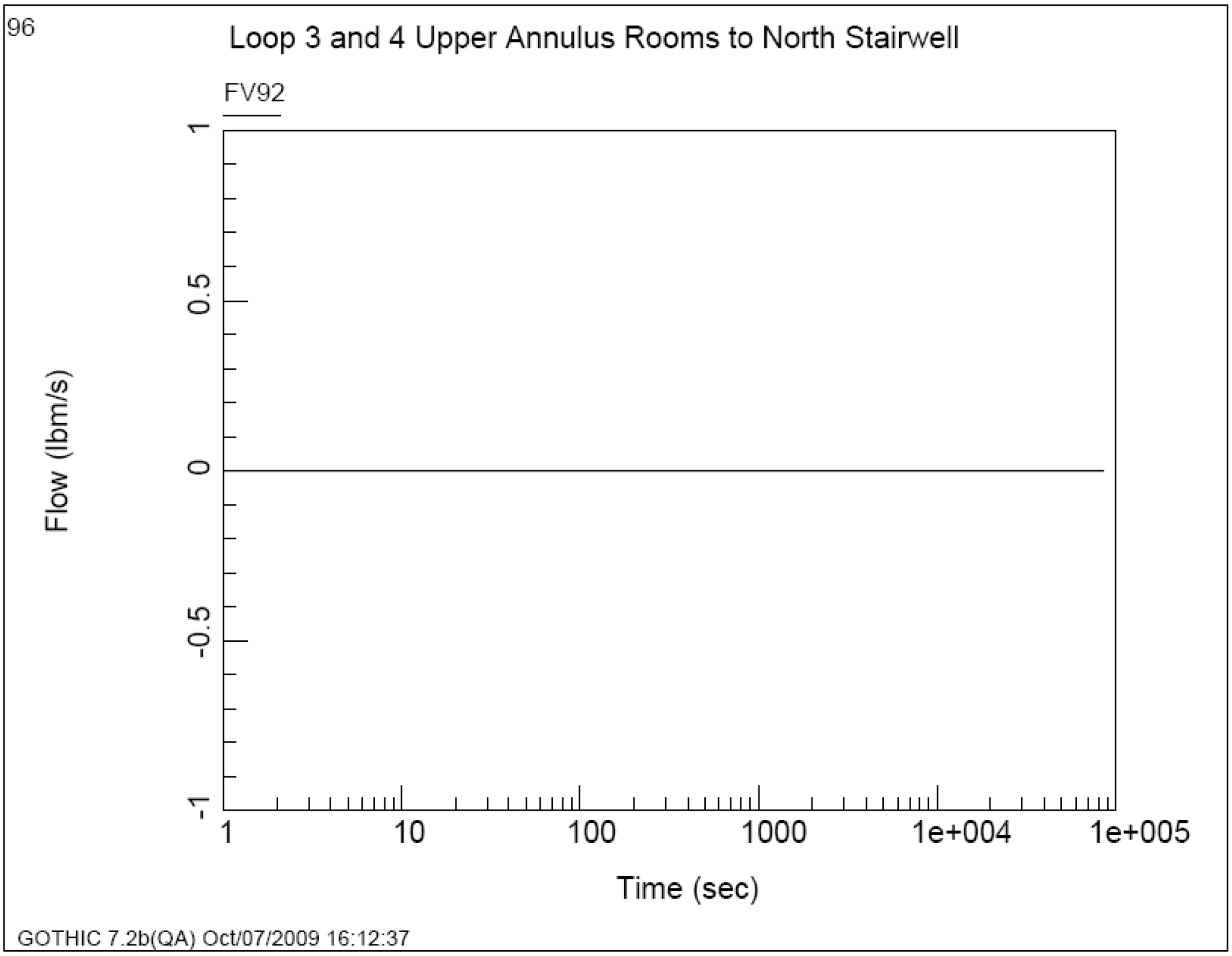


Figure 06.02.01-53–35—Flow from the Loop 1 and 2 Upper Annulus Room to the Containment Dome

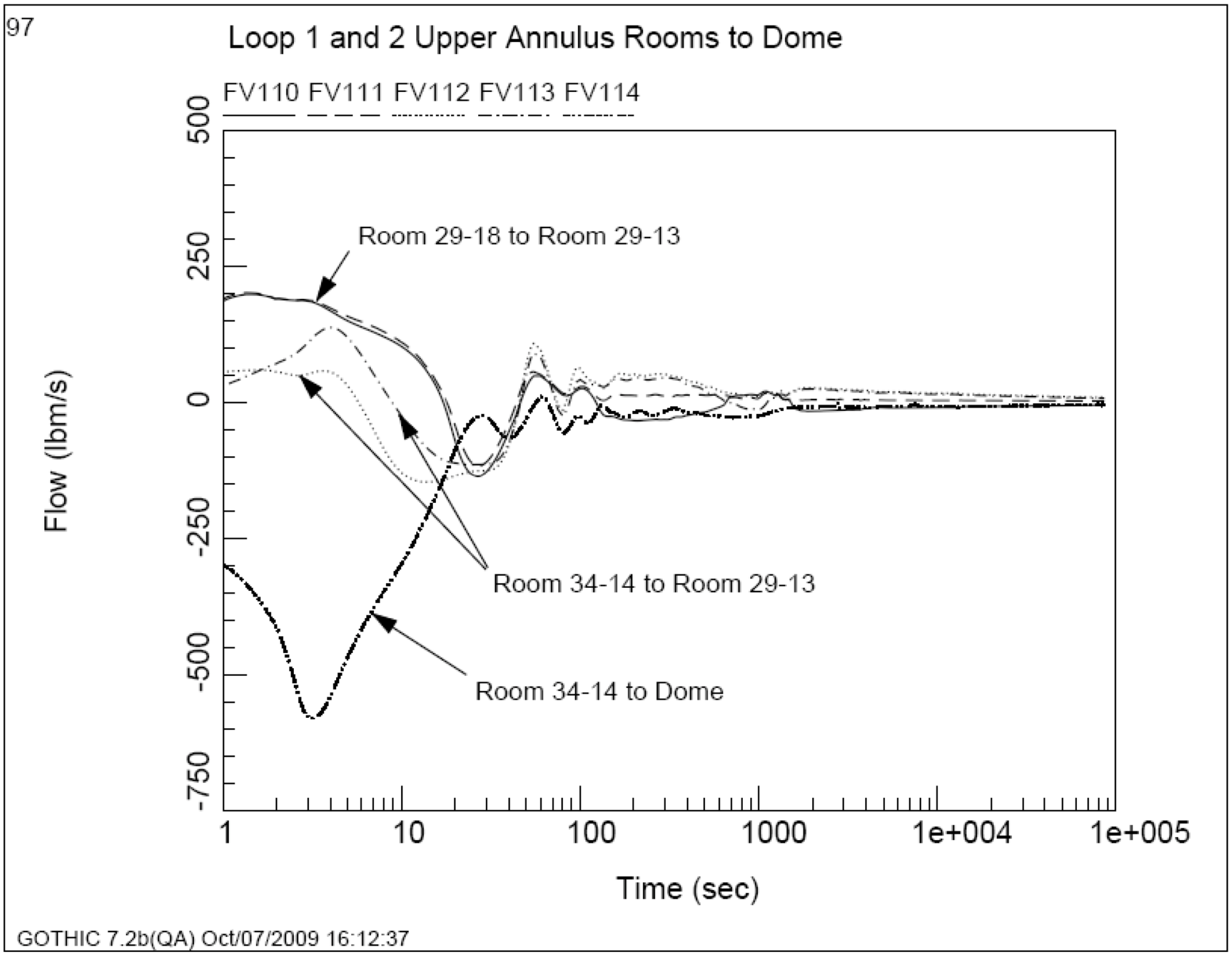


Figure 06.02.01-53–36—Flow from the Loop 1 and 2 Upper Annulus Room to the Containment Dome

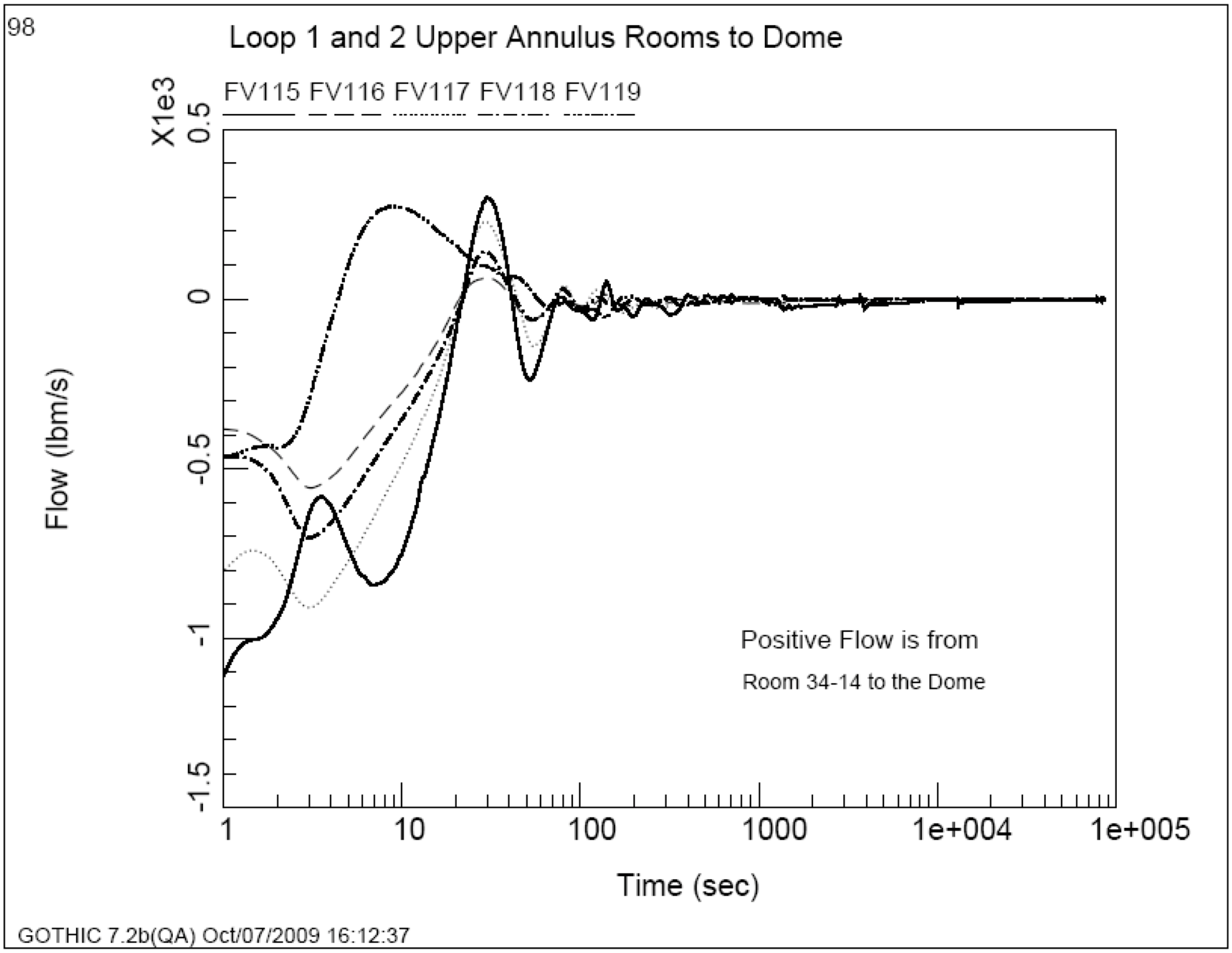


Figure 06.02.01-53–37—Flow from the Loop 3 and 4 Upper Annulus Room to the Containment Dome

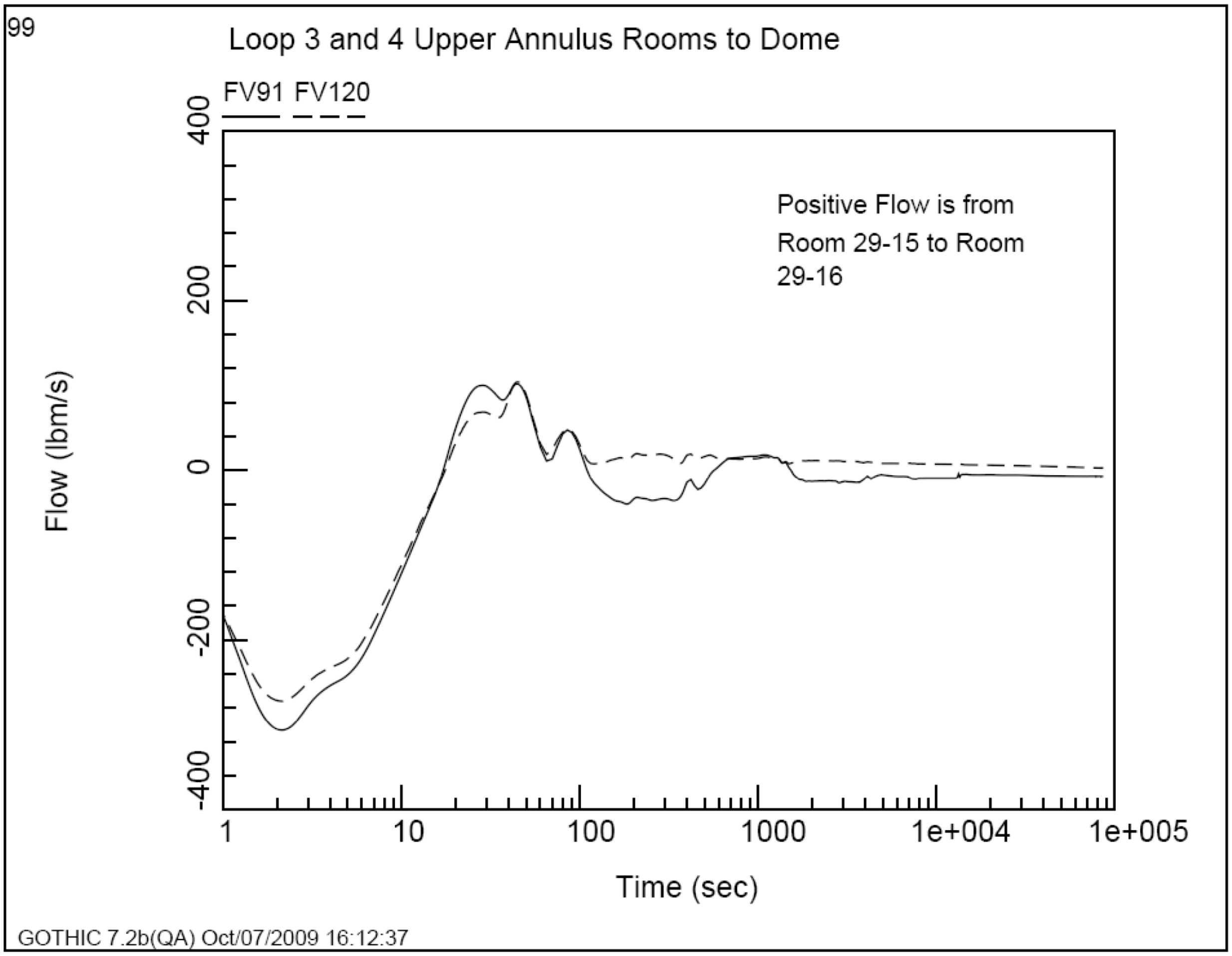


Figure 06.02.01-53–38—Flow from the Loop 3 and 4 Upper Annulus Room to the Containment Dome

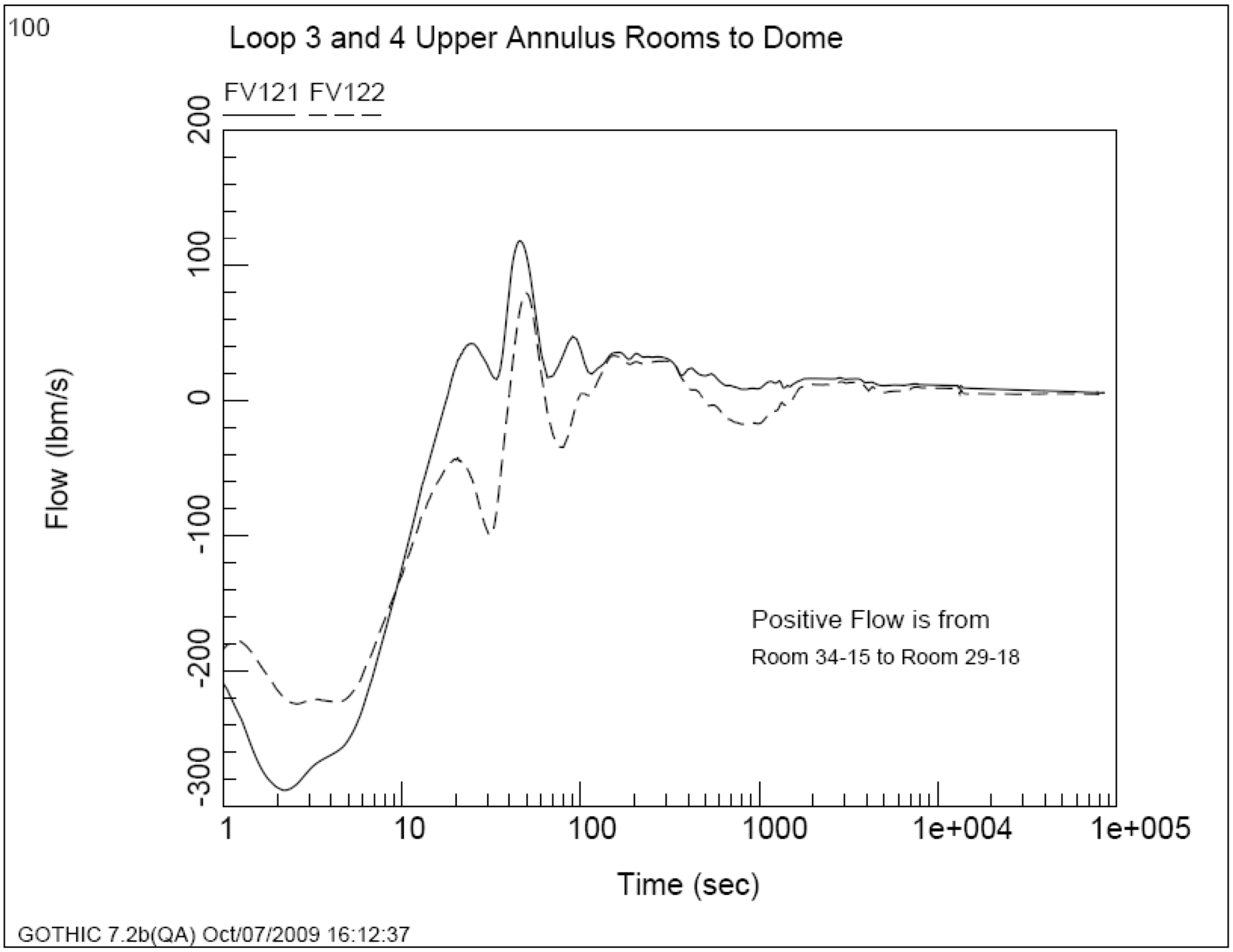


Figure 06.02.01-53–39—Flow from the Loop 3 and 4 Upper Annulus Room to the Containment Dome

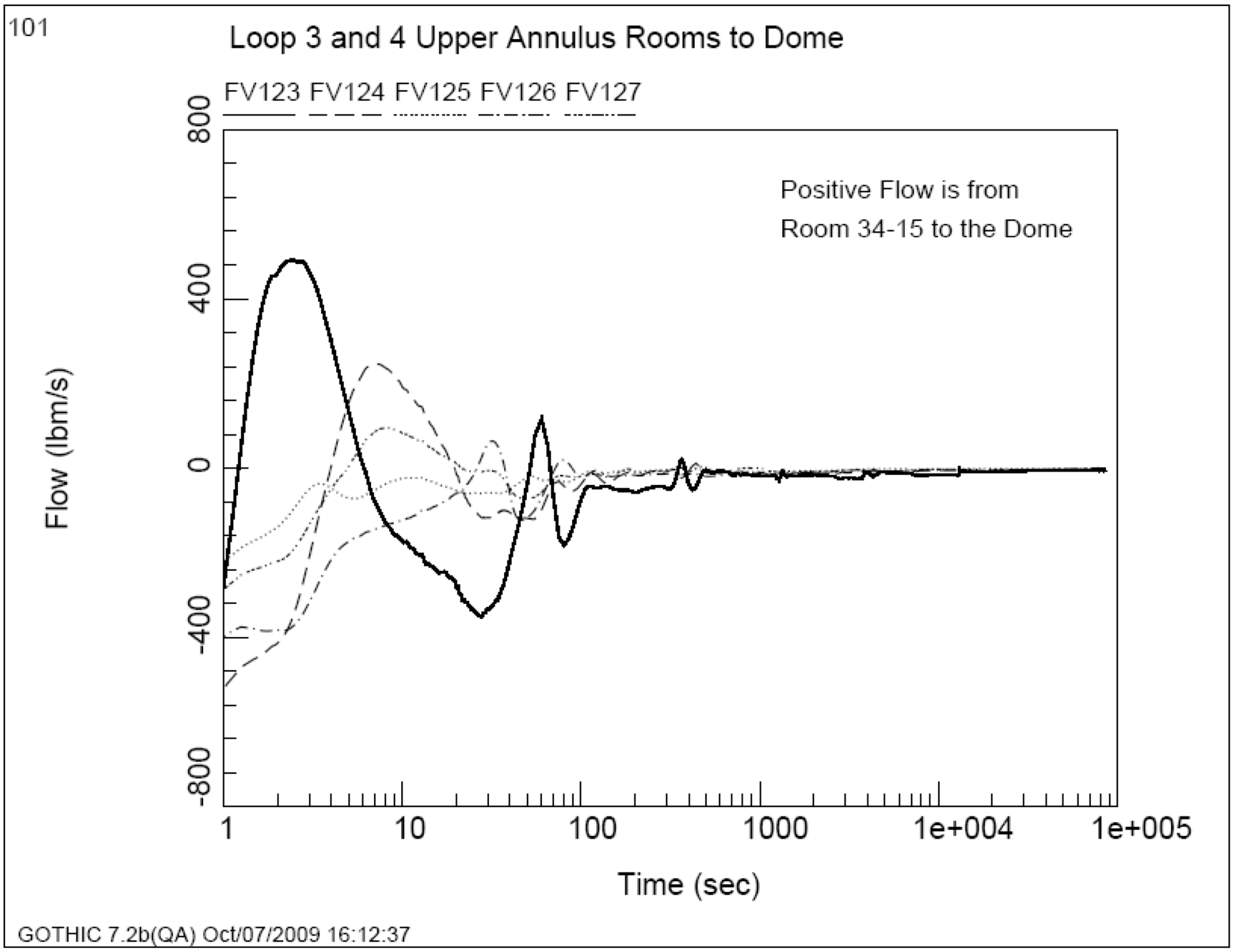


Figure 06.02.01-53–40—Flow from the Containment Dome to the South Stairwell

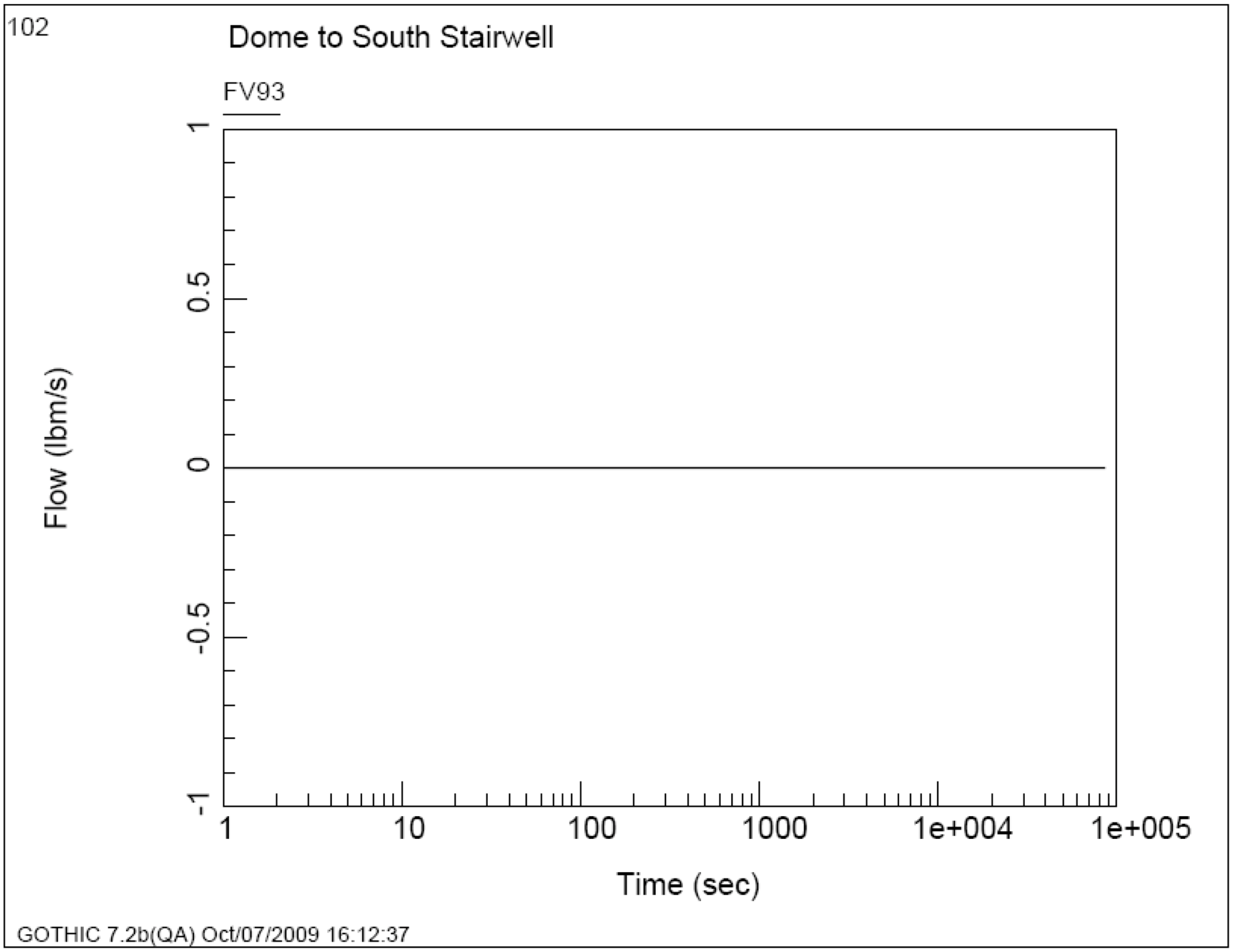


Figure 06.02.01-53–41—Flow from the Access Area to the North Staircase and the Elevator

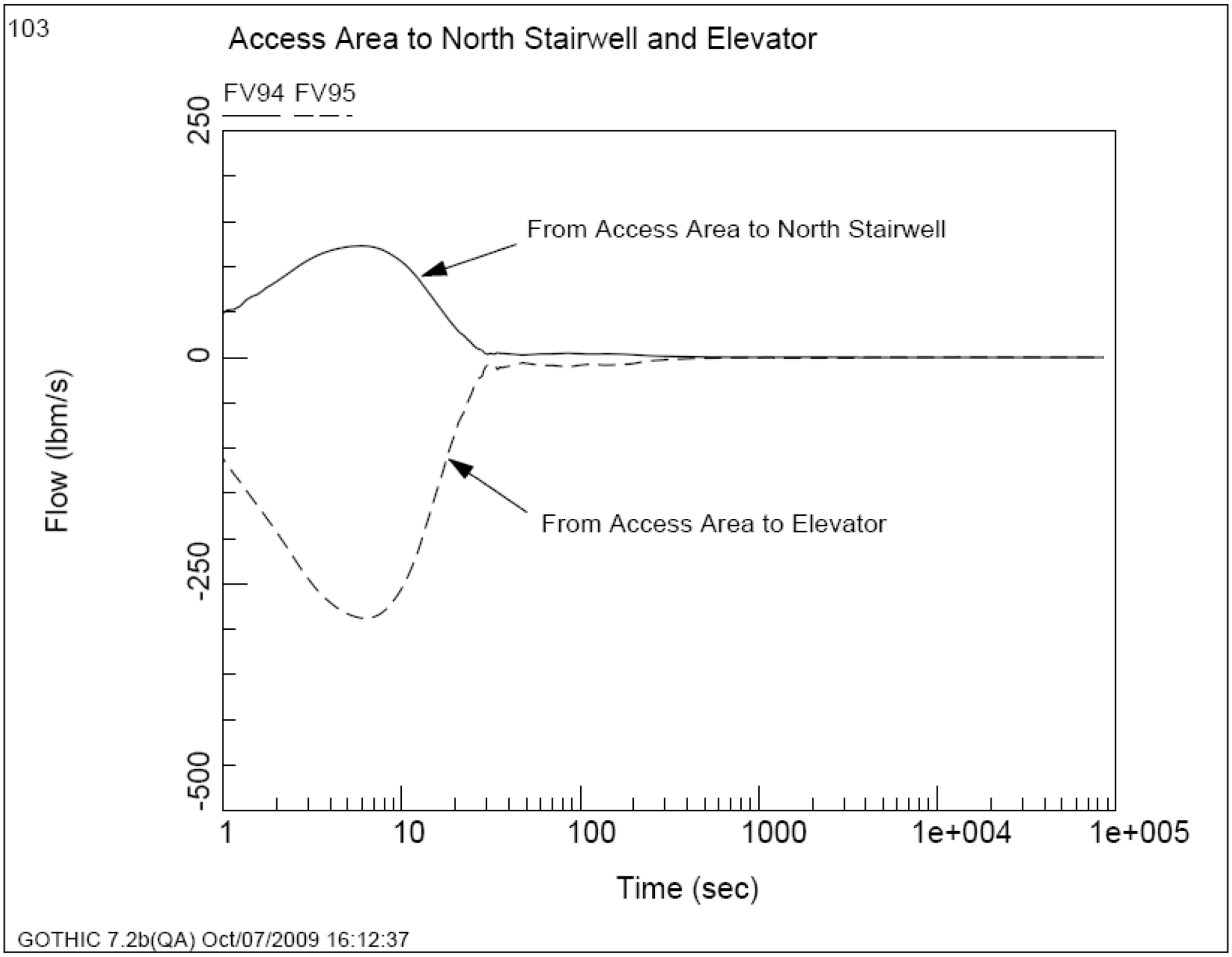


Figure 06.02.01-53–42—Flow Circulation Patterns in the Containment 1 second into Blowdown

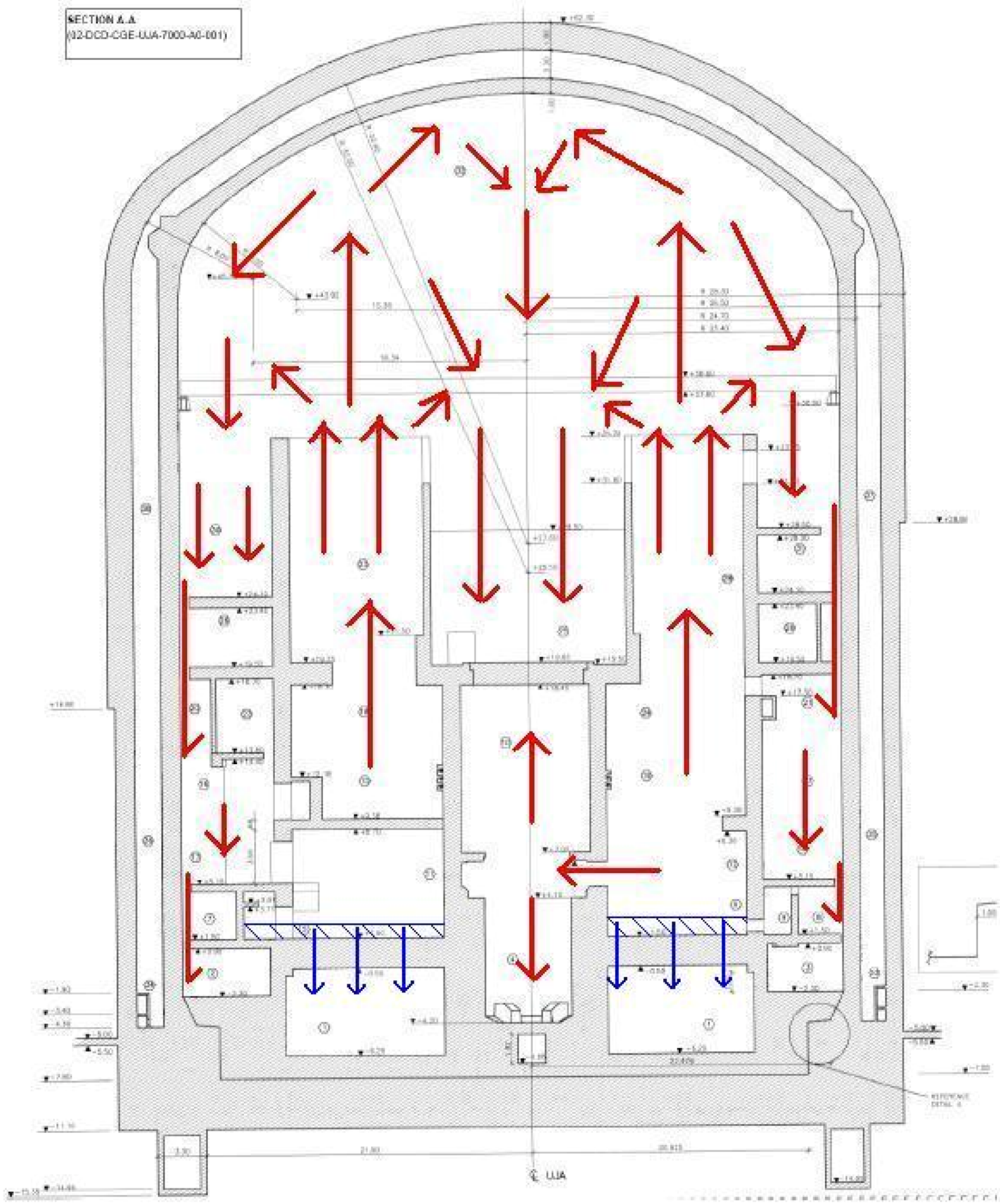


Figure 06.02.01-53-42a—Flow Circulation Patterns in the Containment 5 seconds into Blowdown

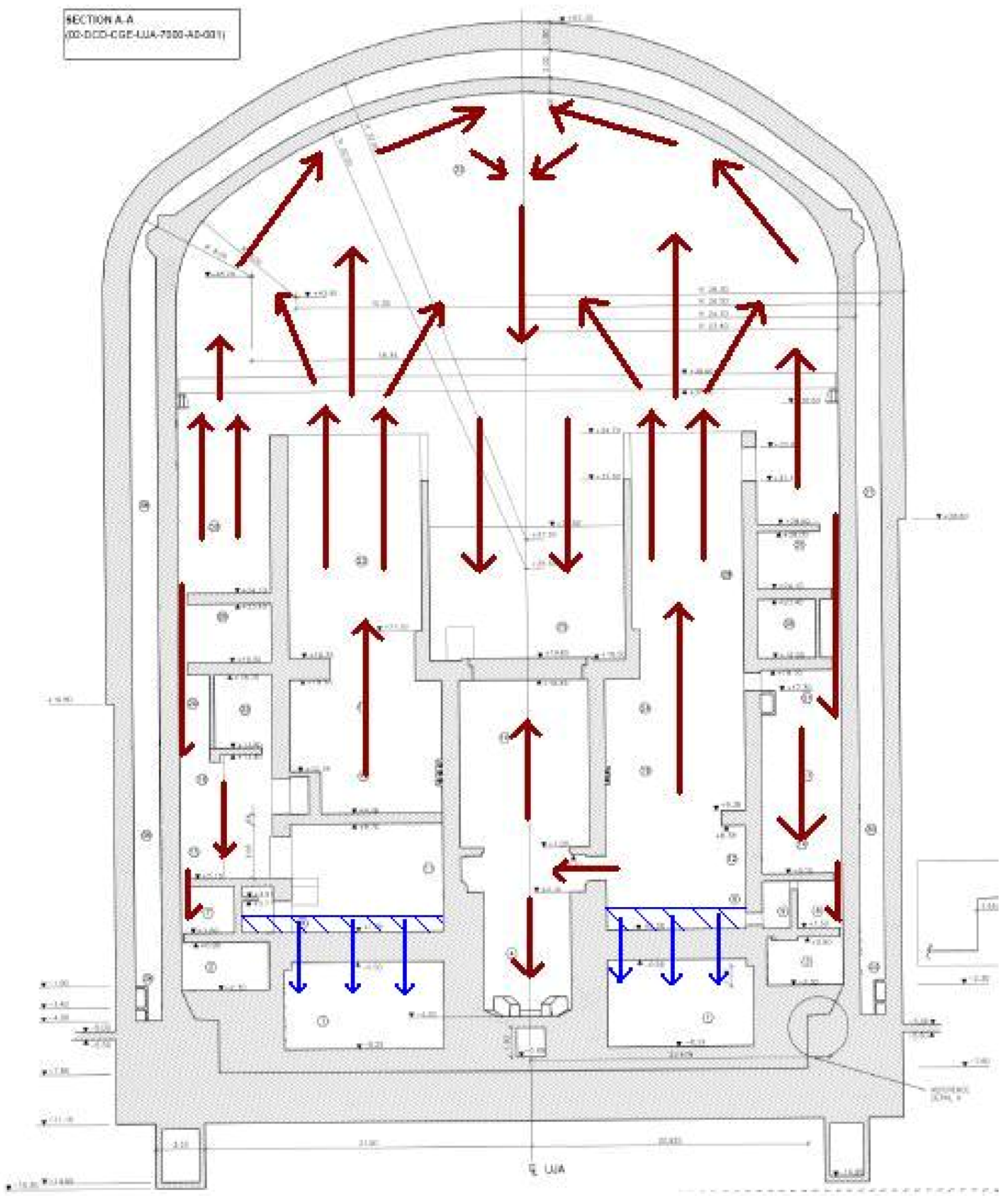


Figure 06.02.01-53–43—Temperature in the Spreading Room and IRWST

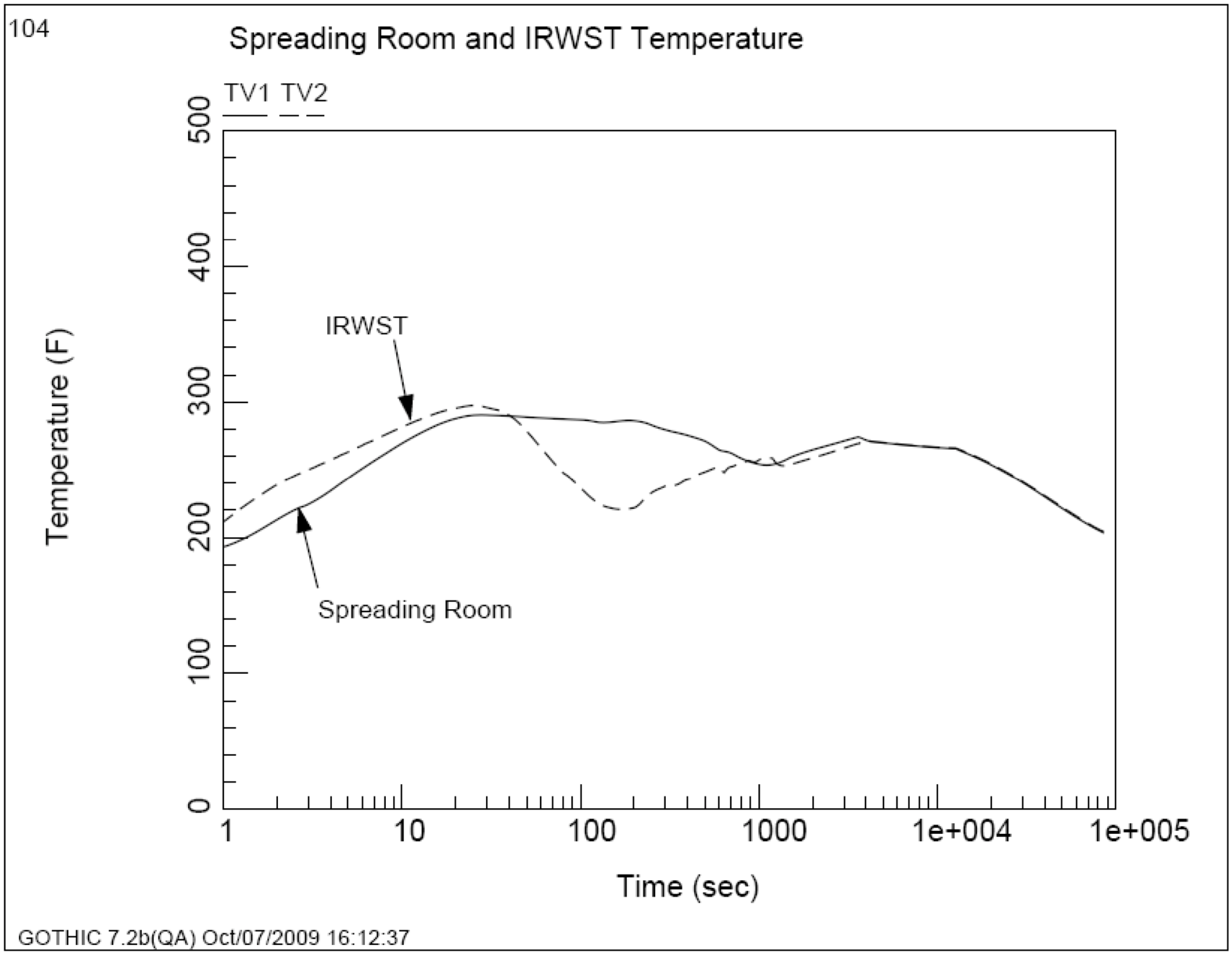


Figure 06.02.01-53–44—Temperature in the Lower Equipment Rooms

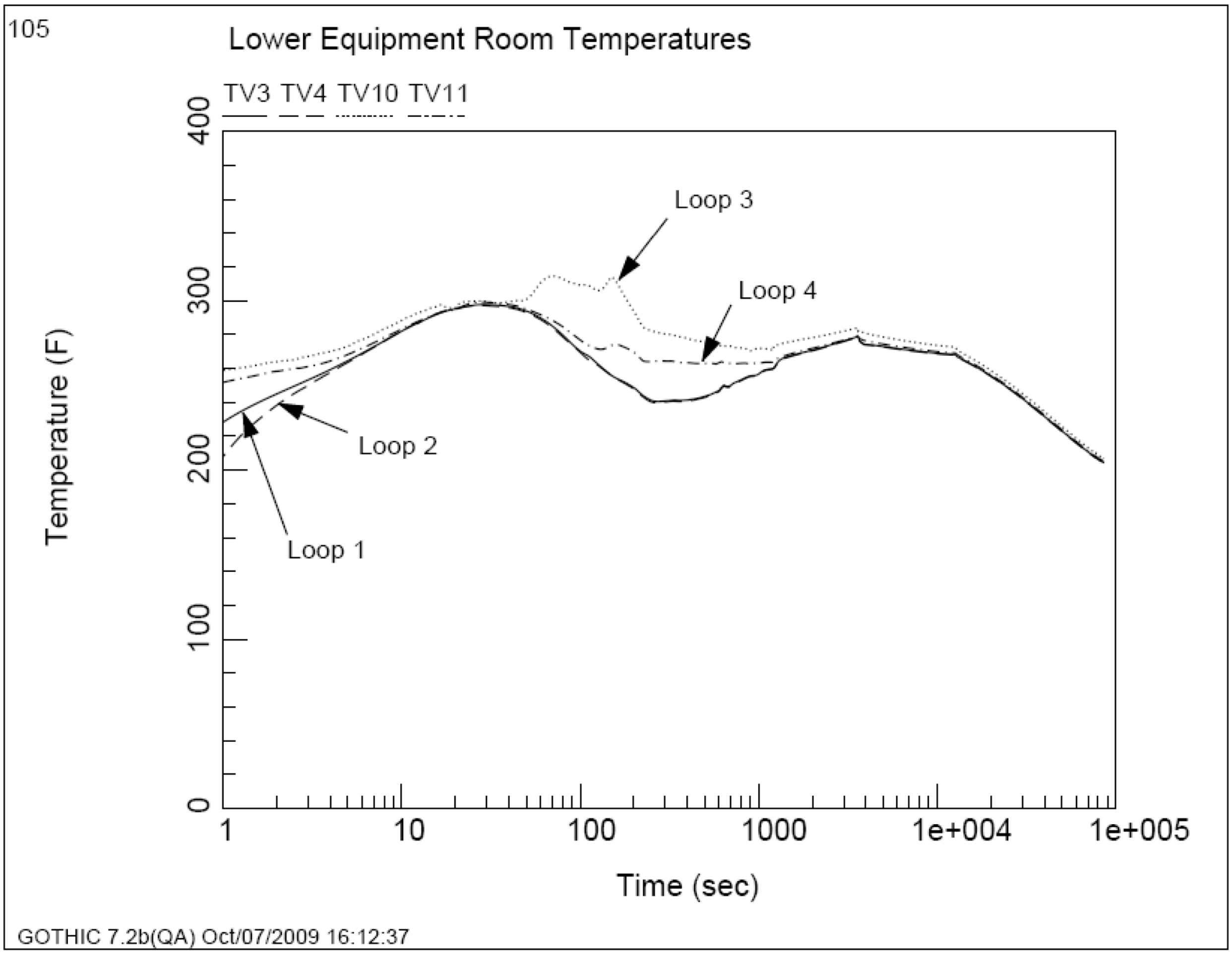


Figure 06.02.01-53–45—Temperature in the Middle Equipment Rooms

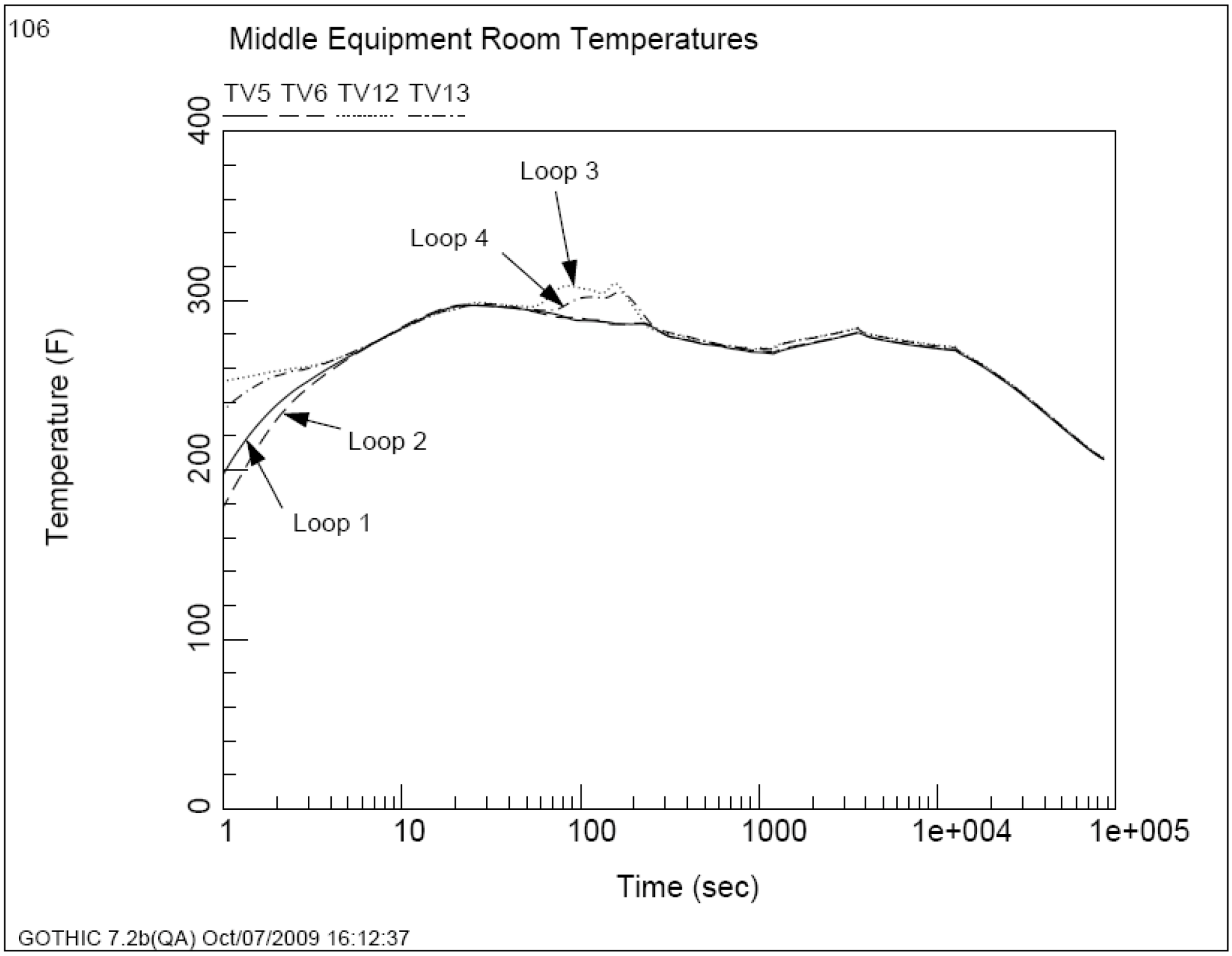


Figure 06.02.01-53–46—Temperature in the Upper Equipment Rooms

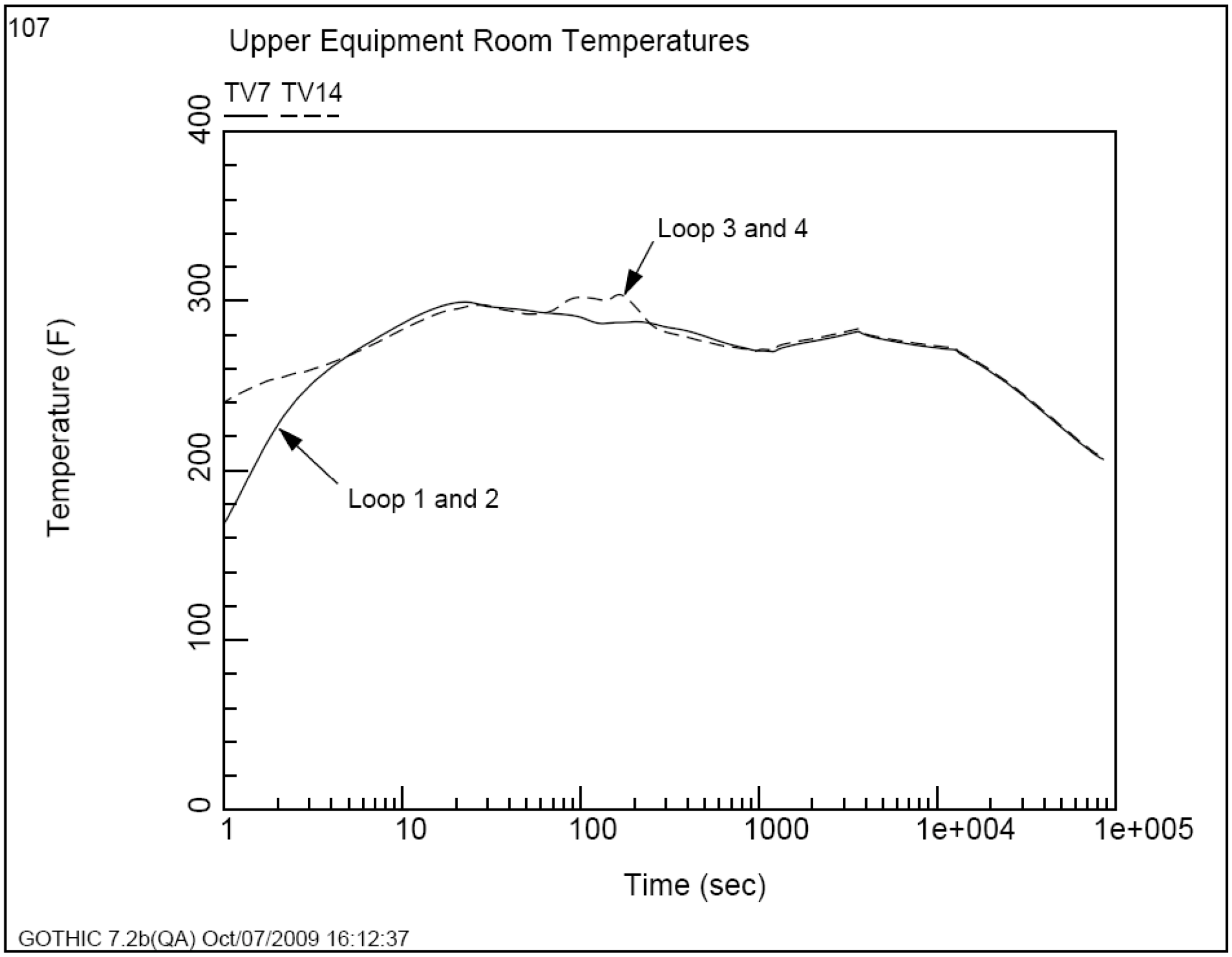


Figure 06.02.01-53–47—Temperature in the Reactor Pressure Vessel Pit and Reactor Cavity

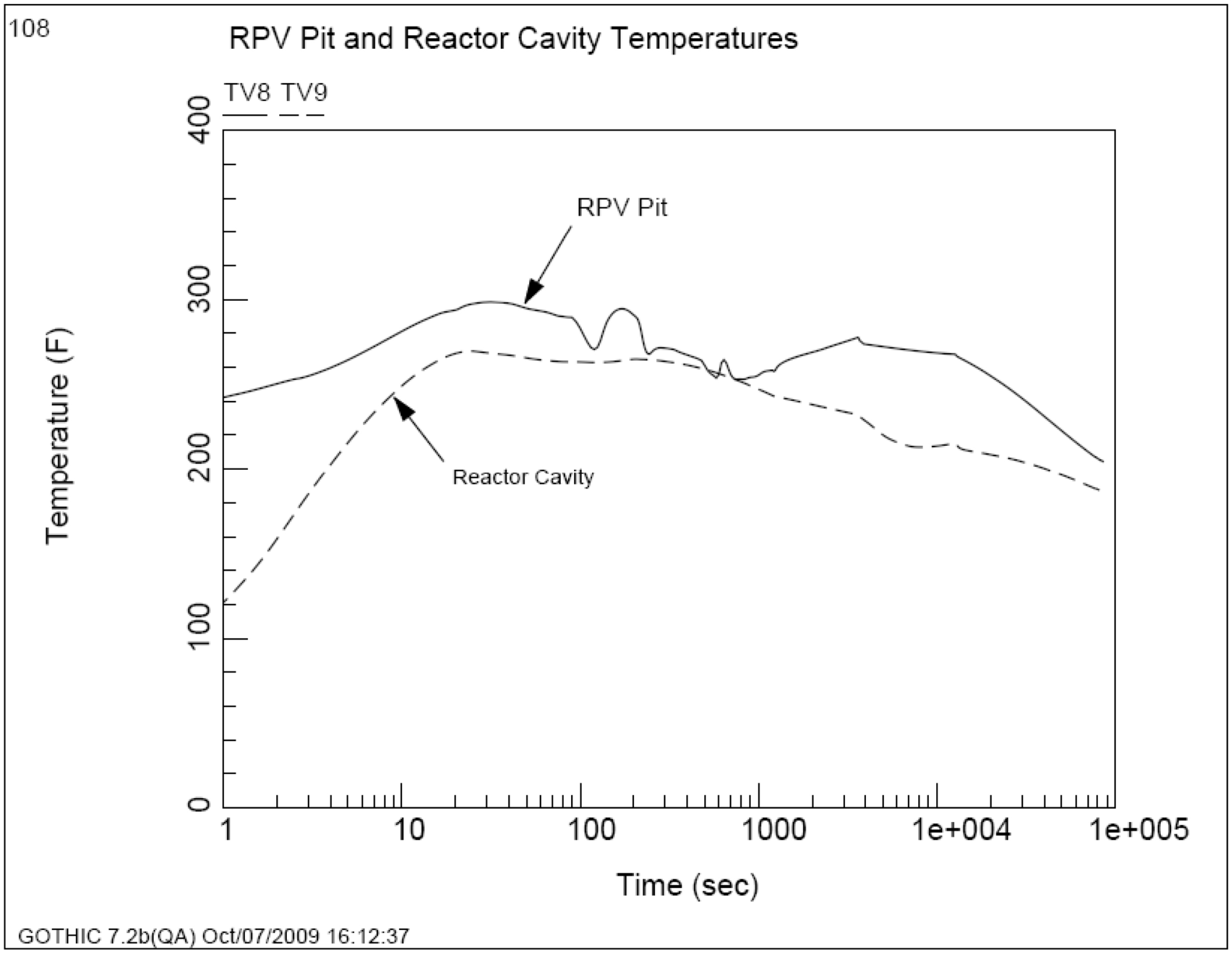


Figure 06.02.01-53–48—Temperature in the Pressurizer and Surge Line Rooms

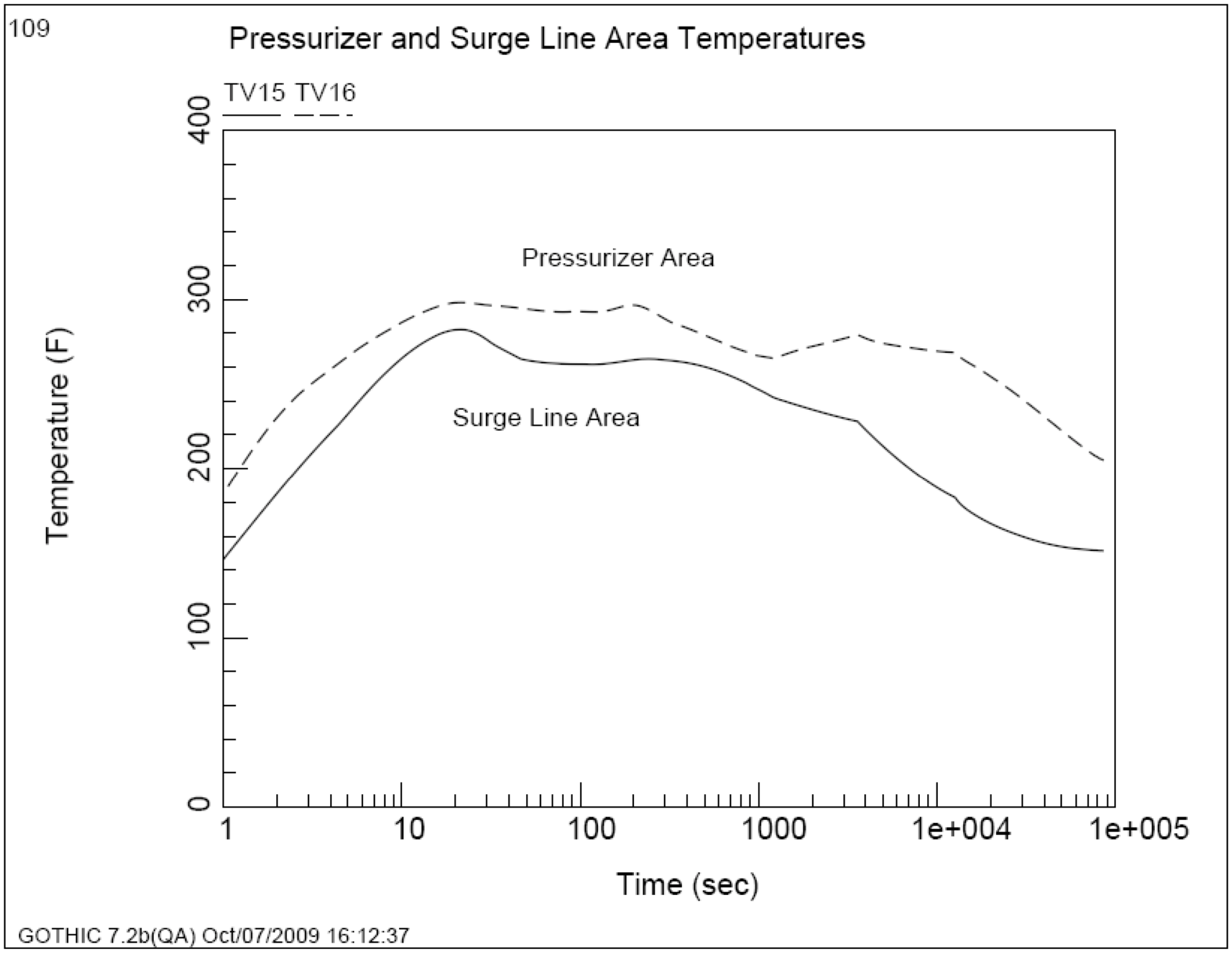


Figure 06.02.01-53–49—Temperature in the CVCS and Steam Generator Blowdown Heat Exchanger Rooms