Critique Report

EVENT			
Event Title	LWS#1 HOG Leak Event	**Date/Time of Event**	3/6/2025 @ 0648 hrs
Event Number*	RER SNS-4362	**ACTS Issue Number**	.48805
CRITIQUE			
Date/Time of Critique	3/7/2025 1pm	**Critique Owner**	Mike Dayton
Critique Facilitator	Jeff Killian	**Critique Recorder**	Samantha Milligan
Critique DRAFT Date**	3/12/2025	**Critique ISSUE Date**	3/20/2025

* (e.g., Occurrence, RER, Etc. or N/A) ** (Date sent out for comments)

Brief Event Description

Four personnel were contaminated uniformly on their skin and clothing as activated gases were vented into Light Water System (LWS1) Room TA-B103 of building 8700. The vented gases were from the Hot Off Gas (HOG) system that contains activated gases of Carbon-11 (C-11), H-3, and noble gases. The personnel were inside TA-B103 to perform maintenance, to respond to a G64 alarm, and to secure the leak.

Evaluation of the event determined it was not reportable to the Department of Energy (DOE) Occurrence Reporting and Processing System (ORPS).

Event Timeline

Date	Time	Description
11/15/2024		HOG Design modification installed and placed in service.
3/4/2025		On -shift technician (OST) noticed LWS1 drain tank TK-1030 was increasing in pressure and received high pressure warning alarm. OST secured Nitrogen flow to tank to lower pressure. Pressure did not stop increasing. OST entered work request to troubleshoot Pressure Regulating Valve (PRV).
3/5/2025	1315 hrs	PRV trouble shooting begins: Installed Pressure gauge to measure tank pressure and adjusted PRV.
	1323 hrs	Removed PY- 1053 (Pressure Guage).
	1345 hrs	Re-installed PY-1053.
	1400 hrs	Isolated N2 line and vented off tank into room.
3/6/2025	0610 hrs	PRV trouble shooting continues: Pre-Job brief WO 1682624 Target Systems Technical Manager (TSTM), Task leader (TL), Research Mechanic Mechanical (RM-M).
	0645 hrs	RM-M started work on the LWS1 inside TA-B103 in the basement of building 8700. The LWS1 piping is connected to the HOG System where work was performed. Began disassembly of top ball valve.

		Area monitor Alarms. Hand tightened bolts and left the area.
	0645-0648 hrs	RM-M informed TL of leak. RM-M and TL entered TA-B103 to verify leak location then exited room. OST received a call from the CCR informing that the vault 1 G64 went into alarm.
	0648 hrs	RCT1 and RCT2 were informed of the G64 alarm CCR and went to TA-B103 to investigate.
	0655 hrs	0655 OST called Target Operations Group leader to inform them. OST knew the TL and RM-M were working in that area, so they went to go inform them. TL and RM-M were already aware and had left area.
	0655 hrs	RCT1 and RCT2 entered TA-B103 on RWP SNS-18200 and measured a dose rate of 60 mrem/hr at the HOG piping.
	0659 hrs	Target Operations Group leader called to ask what the pressure in LWS1 drain tank. Informed him it was 0 in H2O. GL instructed OST to add nitrogen to raise the pressure. GL suspect HOG was pushing backwards in LWS #1 room.
	0705 hrs	GL contacted RSO and inform them of the suspected cause of the alarm. GL and RSO discussed what actions to take. OST checked system conditions via conversation outside TA-B103 with the mechanics to check to see if the system integrity was restored. OST was informed that system integrity was not restored. OST was informed that there was gas coming out of connection they loosened, and they would have to re-tighten it to stop it.
	0705 hrs	RM-M and TSTM logged onto an RWP SNS-21876. RM-M returned and entered TA-B103 with RCT1 and wrench tightened the HOG piping to secure the leak of gases. RCT3, TL, and TSTM were also near, outside the room to provide support. Radiation levels lowered at this point but did not return to pre-incident levels of around 0.5 mrem/h staying around 0.9 mrem/h. The RCT3 informed team that the area needs to be cleared due to the C-11 in the air.

		OST went to the CCR and waited for the C-11 to decay away (20 minute half-life).
	0710 hrs	RCT1 noted that dose rates in the room were lowering.
	0715 hrs	RCT3 called the Radiation Protection Organization Manager to report the event.
	0725 hrs	Target Operations GL informed Target and Mechanical Section Head (SH) of the issue. SH informs Research Accelerator Division (RAD) Director/Spallation Neutron Source (SNS) Operations Manager of the issue.
	0730 hrs	Activity was detected on RM-M, RCT1, RCT2, and TL by whole body direct frisk. All personnel exited the basement, and access was secured to the basement.
	0730 hrs	Target Operations GL informed Target Systems Group leader of issue. RSO, SH, and RPO Group lead discussed the event and ORPS reportability.
	0735 hrs	Whole body frisk surveys of six personnel were performed with no activity detected. These personnel were inside the basement in rooms down the hall from TA-B103.
	0742 hrs	RM-M, TL, RCT1, and RCT2 were taken to the Decon Room TA-113. Contaminated clothing was removed from the four contaminated personnel. Activity was detected uniformly on their body. Personnel were contaminated from 15,000 dpm/100 cm^2 to 2,000 dpm/100 cm^2.
	0755 hrs	A contaminated clothing item was taken for a gamma spectroscopy measurement. Activity was verified to be from C-11.
	0830 hrs	Contamination levels on RM-M and TL decayed to background levels by direct frisk. RM-M and TL cleared a whole-body frisk through the Argos Personnel Contamination Monitor (PCM). Their clothing was also cleared by direct frisk.
	0845 hrs	Contamination levels on RCT1 and RCT2 decayed to background levels by direct frisk. RCT1 and RCT2 cleared a whole-body frisk through the PCM Their clothing was also cleared by direct frisk.
	1000 hrs	RCTs performed radiological surveys of all accessible areas of the basement except for TA-B103 with no activity detected. Access to the basement was reopened except for TA-B103. Indications show there is still some leakage of HOG gases into TA-B103.
	1432 hrs	RSO and GL discussed changing HOG valve position to allow more flow from LWS1 HOG line to lower radiation levels to the levels prior to incident. Valve position was adjusted. Radiation level in TA-B103 lowers to the pre-event levels. HOG pipe at Basement utility vault (BUV) entrance radiation levels increased from 0.4 mrem/h to 50 mrem/h. Stack counts increased from around 13,000 counts/s (cps) to around 23,000 cps.

Relevant Facts Obtained during the Critique (expansion of description)

- The LWS1 piping is connected to the HOG System where work was performed.
- There is a nitrogen Blanket over each of the drain tanks.
- PRV-1279 in figure 1 – drain tank #1
- Feb 23, 2025 - there was an increase in pressure of drain tanks 1 and 4; however, only drain tank 1's level alerted the on-shift technicians.
- The pressure being regulated is the nitrogen blanket on each drain tank.
- Immediate action taken by the OST was to isolate the nitrogen in the tank to get the pressure back into specification.
- RAD is still investigating the cause of the pressure increase, it is unknown currently.
- Drain Tank was vented to zero psi prior to the troubleshooting maintenance activity.
- See figure 1 for radiation level with the pressure.
- Tank 1030 is the drain tank 1 where the event occurred.
- Stack emissions issue was identified in September 2024, coming out of PPU outage; Stack monitor readings were 30,000 cps.
- Buried delay piping is a part of the HOG system design. It was known during the initial system design that the original HOG delay piping length was not adequate to support operations at 1.3 GeV and 2 MW.
- In order to experiment with lowering the radiation levels, the system needed to lower the flow to allow more time to decay.
- On September 11, 2024, the team used a 4-inch butterfly valve to throttle the flow for a proof of concept. The butterfly valve was initially throttled until an approved design change in November of 2024.
- The design change installed a back-pressure control valve (needle valve) to control the flow. At that point, the butterfly valve was fully closed. Pressures for the nitrogen in the tanks was monitored with no issues.
- This new design reduced the dose rate detected on the PCE Room HOG Line radiation monitor (PPS_TA:RadMon_PCE_HogLine:Rad) from 85mrem/h to <5mrem/h, and stack monitor readings from 30,000 cps to 23,000 cps.
- The needle valve provided finer resolution of flow control in lieu of using the coarser butterfly valve.
- Additional decrease in radiation levels and stack monitor readings occurred after the ion change column in loop 4 was replaced.
- In order to remove the PRV due to the installation the upper isolation ball valve had to be disassembled to allow the PRV to be screwed out.
- Troubleshooting of the PRV was completed under Work Order #1682624 – grade 4 work package, no work plan required.
- There was no radiological work associated with the work order; LWS1 and its drain had always been a radiological free water system.
- Per the TL, other water loops are expected to be radiological but not LWS1.
- C-11 was confirmed as the primary nuclide for stack emissions in 2024 which includes the HOG system.
- TA-B103 is exhausted by air handler #9 which distributes air throughout the basement of 8700.
- During the event response, the RCTs completed a sweep of the basement and communicated the need for everyone to exit the area. Six other people found near the area; all were frisked before leaving the building.
- RCTs posted signs on the doors to the basement and stood by entrances to keep people from entering the basement area

- As RCTS were doing the surveys post event, the numbers began decreasing quickly.
- A sign was posted on TA-B103 door, stating "Do Not Enter".
- After internal discussion and planning with RAD, Target Operations adjusted the HOG backpressure system to reduce backpressure to the BUV and TA-B103 HOG systems with the goal of reducing a suspected leak. The backpressure was reduced from about 2 PSIG to less than 1 PSIG. Radiation levels returned to pre-event levels in TA-B103; this did cause the radiation levels at the stack to increase back to pre-design levels.

Further Investigation Required?	
Yes ☒ No ☐	If YES, provide additional information regarding what actions are recommended and who is responsible below: An Engineering Design process evaluation and Root Cause Analysis will be completed for this event.

Other Discussions

Information Collected during the Factual Accuracy Review (not explicitly stated in critique discussion):

There is not an alarm level associated with the actions taken. The RSO expressed concerns with re-entrainment of radioactive material into the building under certain atmospheric conditions that causes measurement issues in the building. Not a concern to personnel safety. 30,000 was decided as a goal limit to try to stay below as power is increased to 2 MW.

Positive Attributes

- Isotope quick identification helped with the response
- RCTs provided quick response

Potential Causal Factors (Brainstorm + Failed SCOR + HPI)

- TBD

Applicable SCOR Principles

Positive		At Risk	
1. Everyone is personally responsible for ensuring safe operations.	☒	1. Everyone is personally responsible for ensuring safe operations.	☐
2. Leaders value the safety legacy they create in their discipline	☒	2. Leaders value the safety legacy they create in their discipline	☐
3. Staff raise safety concerns because trust permeates the organization	☐	3. Staff raise safety concerns because trust permeates the organization	☐
4. Cutting-edge science requires cutting-edge safety	☐	4. Cutting-edge science requires cutting-edge safety	☐
5. A questioning attitude is cultivated	☐	5. A questioning attitude is cultivated	☒
6. Learning never stops	☒	6. Learning never stops	☐
7. Hazards are identified and evaluated for every task, every time	☐	7. Hazards are identified and evaluated for every task, every time	☒
8. A healthy respect is maintained for what can go wrong	☐	8. A healthy respect is maintained for what can go wrong	☒

Critique Report

Initial Causal Analysis and Actions

Common Error Precursors A & B

A. Task Demands		B. Individual Capabilities	
1. Time Pressure (in a hurry)	☐	1. Unfamiliarity with task / First time	☐
2. High workload (large memory)	☐	2. Lack of knowledge (faulty mental model)	☒
3. Simultaneous, multiple actions	☐	3. New techniques not used before	☐
4. Repetitive actions / Monotony	☐	4. Imprecise communication habits	☒
5. Irreversible actions[a]	☒	5. Lack of proficiency / Inexperience	☐
6. Interpretation requirements	☐	6. Indistinct problem-solving skills	☐
7. Unclear goals, roles, or responsibilities	☐	7. Unsafe attitudes	☐
8. Lack of or unclear standards	☐	8. Illness or fatigue; general poor health or injury	☐

Common Error Precursors C & D

C. Work Environment		D. Human Nature	
1. Distractions / Interruptions	☐	1. Stress	☐
2. Changes / Departure from routine	☐	2. Habit patterns	☐
3. Confusing displays or controls	☐	3. Assumptions	☒
4. Work-arounds / OOS[b] instrumentation	☐	4. Complacency / Overconfidence	☐
5. Hidden system / equipment response	☐	5. Mind-set (intentions)	☐
6. Unexpected equipment conditions	☒	6. Inaccurate risk perception	☒
7. Lack of alternative indication	☐	7. Mental shortcuts or biases	☐
8. Personality conflict	☐	8. Limited short-term memory	☐

[a] - Irreversible actions are not necessarily precursors to error, but are often overlooked, leading to preventable events. It is included in this list because of its importance.

[b] – OOS = Out of service

Additional Discussions

- None

Immediate Corrective Actions/Compensatory Actions

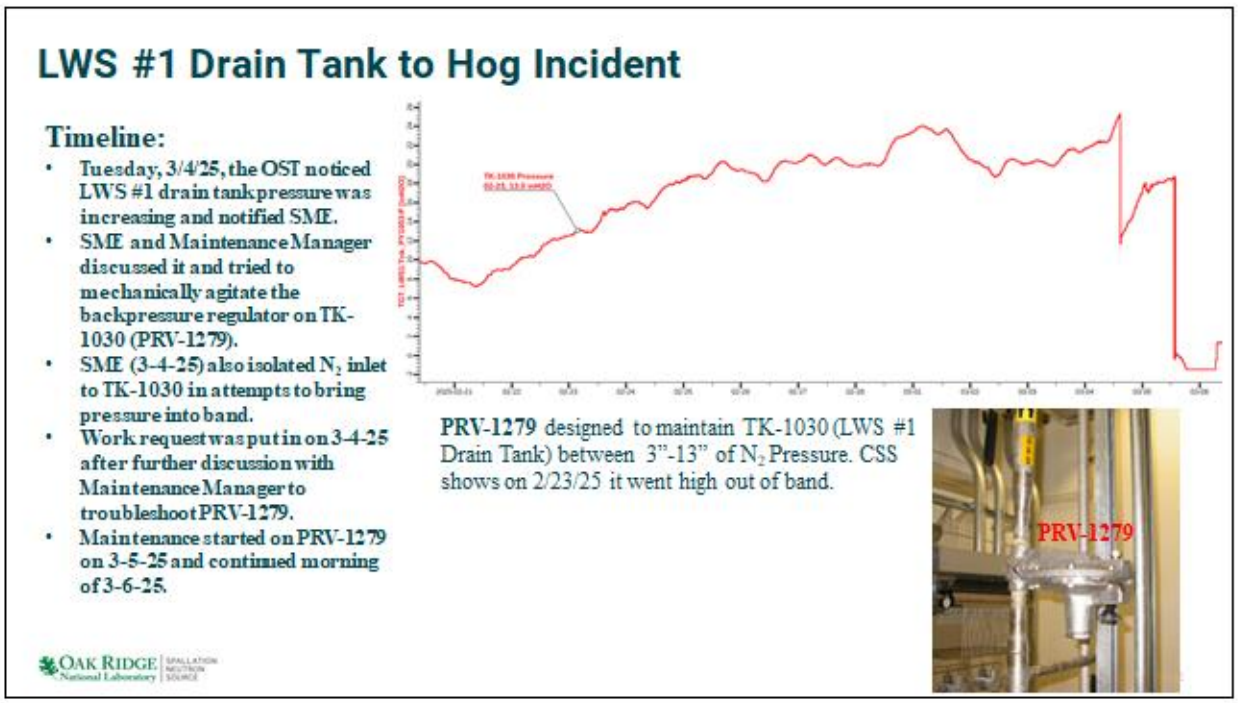
Immediate	Compensatory
• RCTs responded quickly and provided support	• Evaluate the 9A.3 Design Change process to determine if there needs to be better communication when a design change is completed. • Consider installing flanges on each of the water system to allow for easier maintenance of the pressure relief devices. • Continue to investigate the cause of the pressure increase in 2 of the 4 drain tanks.

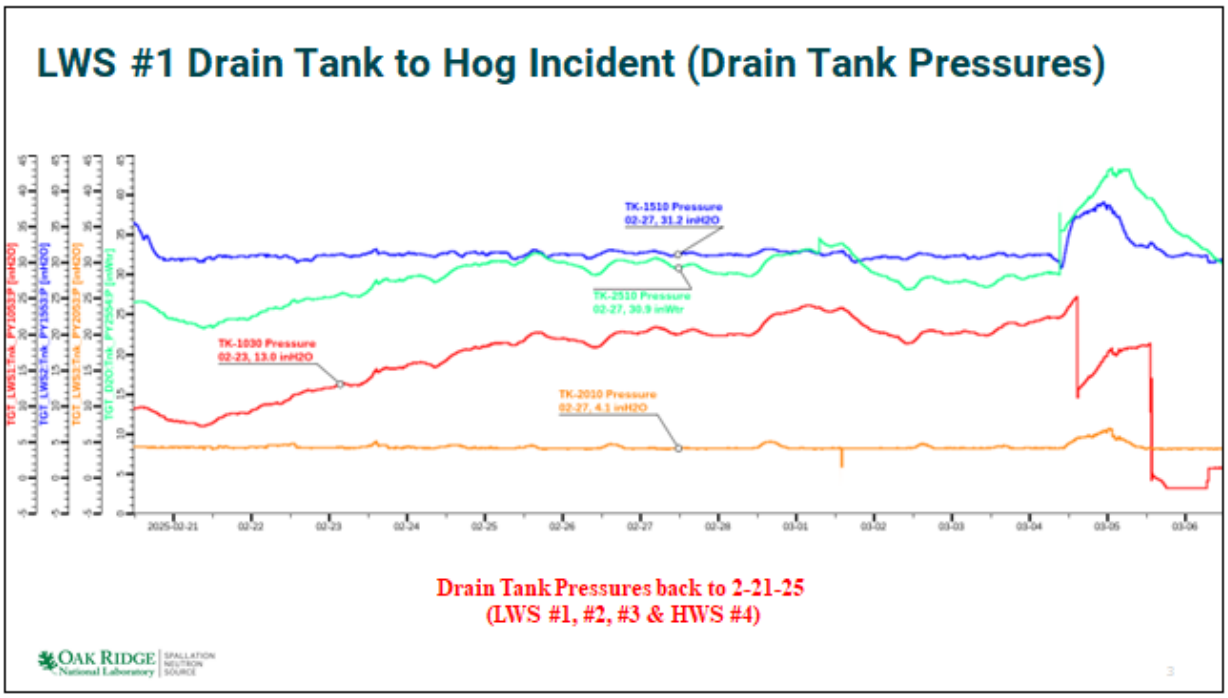
Critique Report

Potential Lessons Learned	
• TBD	
Reference Materials (e.g., work authorization docs, procedures, RWPs, access logs, etc.	
Reference #	Reference Title
Figure 1	Presentation on the event from the critique
SNS-21876-7	ORNL Radiological Work Permit
WO 1682624	Work Order
RWP SNS-18200	ORNL Radiological Work Permit

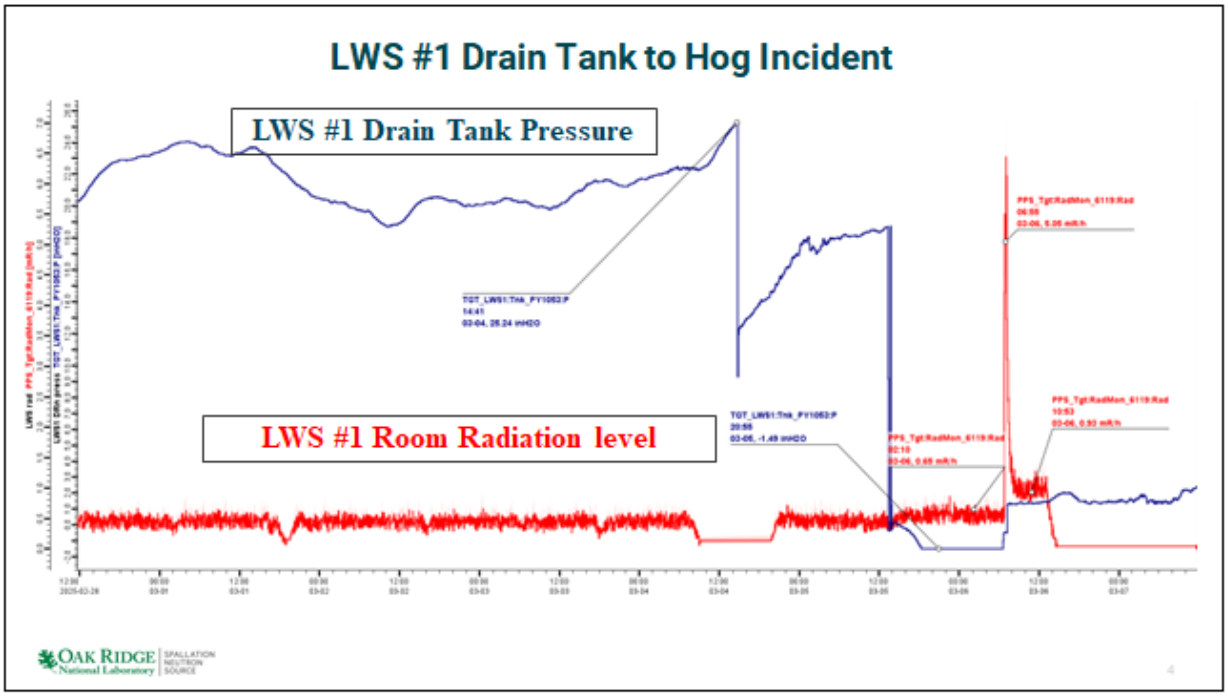
Figure 1 – LWS#1 Drain Tank to HOG Incident presentation

1

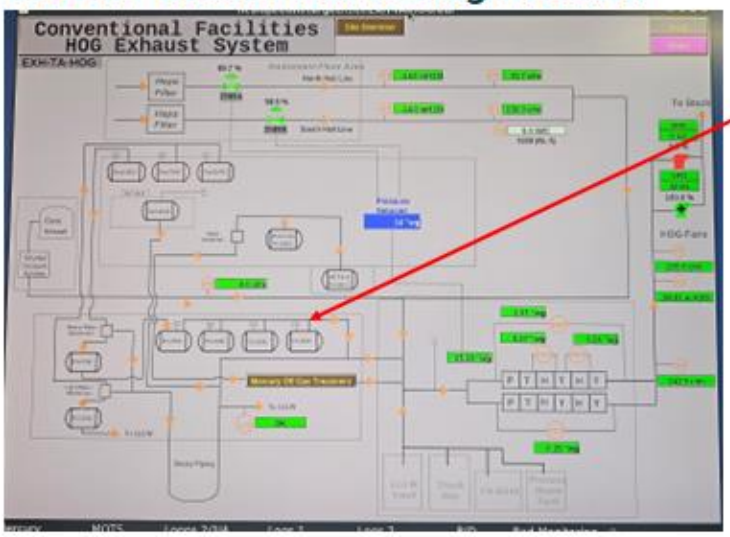



LWS #1 Drain Tank to Hog Incident (Drain Tank Pressures)
TK-1510 Pressure
02-27, 31.2 inH2O
TK-2510 Pressure
02-27, 30.9 inWr
TK-1030 Pressure
02-23, 13.0 inH2O
TK-2010 Pressure
02-27, 4.1 inH2O
Drain Tank Pressures back to 2-21-25
(LWS #1, #2, #3 & HWS #4)
OAK RIDGE National Laboratory
SPALLATION NEUTRON SOURCE

3


LWS #1 Drain Tank to Hog Incident
LWS #1 Drain Tank Pressure
LWS #1 Room Radiation level
OAK RIDGE National Laboratory
SPALLATION NEUTRON SOURCE

LWS #1 Drain Tank to Hog Incident



LWS #1 to HOG valve bolts loosened

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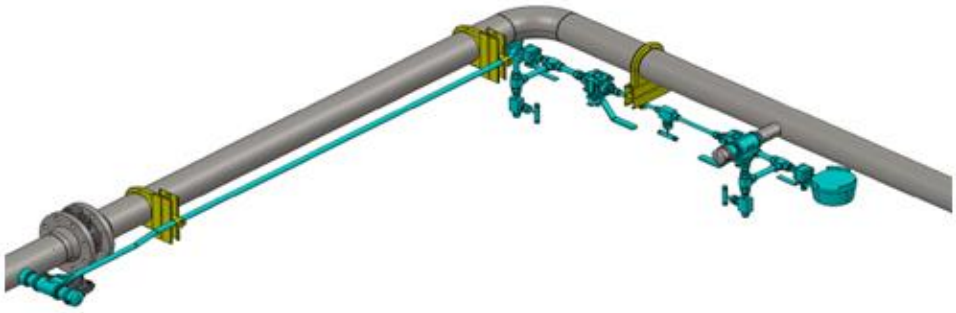
5

HOG Design modification to increase back pressure



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HOG Design modification to increase back pressure

HOG upstream Pressure

HOG Down Stream Pressure

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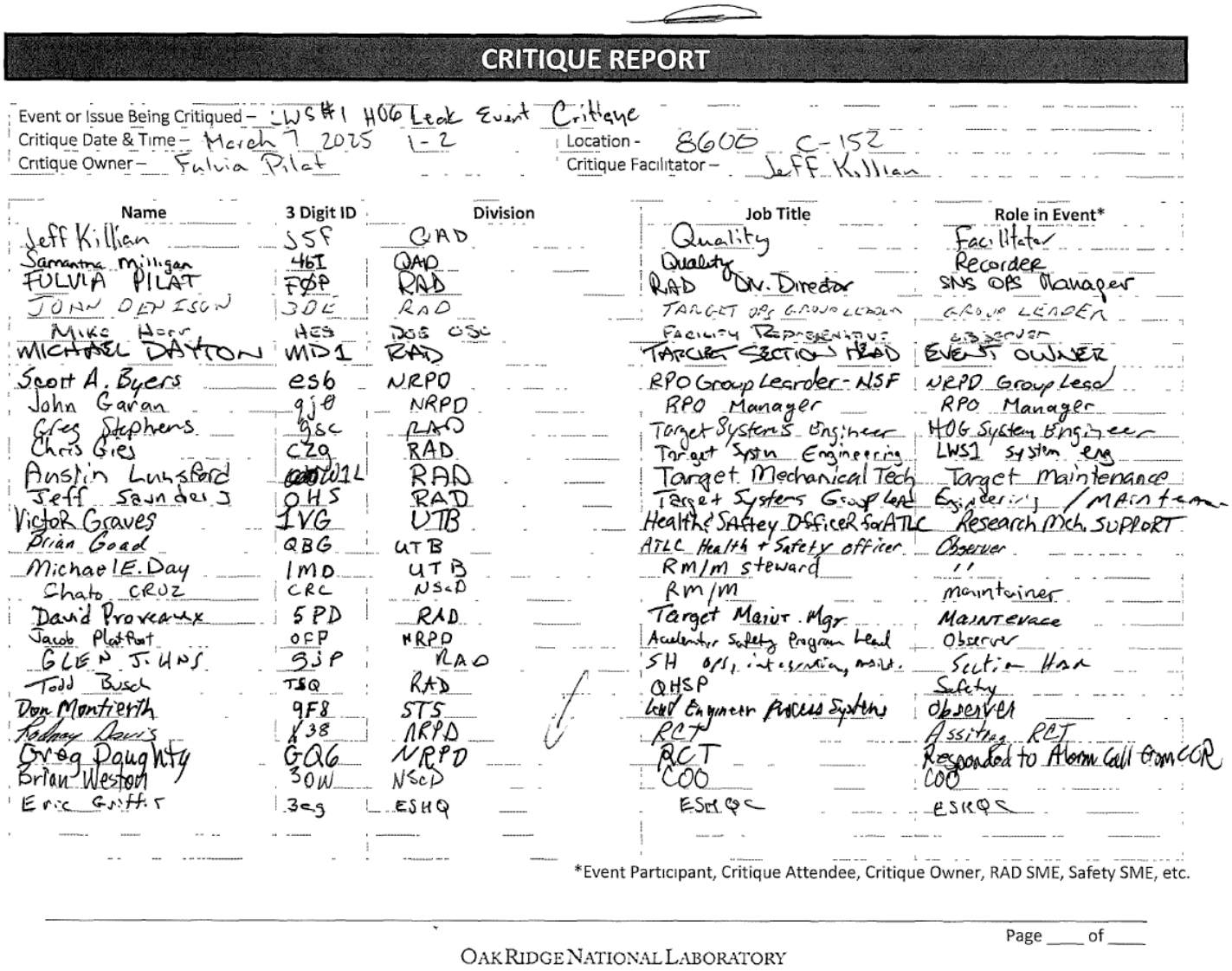
Critique Attendance



CRITIQUE REPORT

Event or Issue Being Critiqued – LWS#1 H06 Leak Event Critique
Critique Date & Time – March 7 2025 1-2 Location - 8600 C-152
Critique Owner – Fulvia Pilat Critique Facilitator – Jeff Killian

Name	3 Digit ID	Division	Job Title	Role in Event*
Jeff Killian	JSF	QAD	Quality	Facilitator
Samantha Milligan	46I	QAD	Quality	Recorder
FULVIA PILAT	FOP	RAD	RAD Dv. Director	SNS OPS Manager
JOHN OLENSON	JOE	RAD	TARGET OPS GROUP LEADER	GROUP LEADER
Mike Herr	HES	DOE OSC	Facility Representative	OBSERVER
MICHAEL DAYTON	MD1	RAD	TARGET SECTION HEAD	EVENT OWNER
Scott A. Byers	es6	NRPO	RPO Group Learder - NSF	NRPO Group Lead
John Garan	qj8	NRPD	RPO Manager	RPO Manager
Greg Stephens	gsc	RAD	Target Systems Engineer	H06 System Engineer
Chris Gies	CZ9	RAD	Target Sytm Engineering	LWS1 system eng
Austin Lunsford	[illegible]	RAD	Target Mechanical Tech	Target Maintenance
Jeff Saunders	OHS	RAD	Target Systems Group Lead	Engineering / Maintenance
Victor Graves	IVG	UTB	Health Safety Officer for ATLC	Research Mch. SUPPORT
Brian Goad	QBG	UTB	ATLC Health + Safety officer	Observer
Michael E. Day	IMD	UTB	Rm/m steward	"
Chato CRUZ	CRC	NSCD	Rm/m	maintainer
David Proveaux	5PD	RAD	Target Maint. Mgr	Maintenance
Jacob Platfoot	OFP	NRPD	Accelerator Safety Program Lead	Observer
GLEN JOHNS	3JP	RAD	SH ops, integration, maint.	Section Head
Todd Busch	TSQ	RAD	QHSP	Safety
Don Monteith	9F8	STS	Lead Engineer Process Systems	Observer
Rodney Davis	[illegible]38	NRPD	RCT	Assisting RCT
Greg Doughty	GQ6	NRPD	RCT	Responded to Alarm Call from CCR
Brian Weston	30W	NSCD	COO	COO
Eric Griffith	3eg	ESHQ	ESHQS	ESHQS

*Event Participant, Critique Attendee, Critique Owner, RAD SME, Safety SME, etc.

Page ____ of ____

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