

PHAR: Support for Target Systems Design

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March 27, 2024

ORNL is managed by UT-Battelle, LLC for the US Department of Energy

Outline

- PHAR Revision Process
- PHAR Approach

PHAR Evolution History

- April 2019 - PHAR Rev 0 issued to support CD-1 approval
- January 2021- Policy for Selection of Safety Related Credited Controls issued to support PHAR development
- July 2021- PHAR Rev 1 was issued to provide a basis with which to work with the design team and to support them in designing safety into the facility
- January 2023 - PHAR Rev 2 issued to continue the process of working with the design team and to support them designing safety into the facility
- April 2024 - PHAR Rev 3 planned issue and currently in review

PHAR Organization

- Front matter provides an overview of the project and provides a description of the approach to identifying postulated event scenarios, identifying all potential causes for the event, methods of detection, all possible preventers and mitigators, and the design team's current selection of credited controls
 - PHAR Tables in Appendix A through S are organized along WBS lines to support the design team focus on safety
 - The listing of all possible preventors and mitigators provides clear documentation of defense in depth for each postulated scenario
 - Credited controls are only identified for scenarios that qualitatively may have consequences that would trip criteria in the Policy for Selection of Safety Related Credited Controls
 - Critical notes, as well as planned analyses, assumptions, and risks/opportunities are included as warranted

STS PHAR Facility Breakdown

Appendix	Designator	System
A	AIC	Accelerator Interface Components
B	AS	Accelerator Systems
C	BG	Building General
D	CMS/MRA	Cryogenic Moderator System/Moderator Reflector Assembly
E	CW	Cooling Water
F	GW	Gas Waste Processing
G	HB	High Bay
H	HPV	Hot Process Vaults
I	HV	Secondary and Primary Confinement Systems
J	IS	Instrument Systems and Bunker
K	LCS	Leak Collection Systems
L	PW	Process Waste
M	RH	Remote Handling
N	RW	Contact and Remote Handling and Decontamination Area
O	SP	Storage Pad
P	SS	Service Cell
Q	TB	Truck Bay
R	TS	Target, Drive, and Support Systems/Buildings
S	VS	Vessel Systems

PHAR Credited and Critical Controls Documentation

- Engineered Controls (ECs) (Table 4.5)
 - Target Protection System (TPS)
 - Personnel Protection System (PPS) (for RTST, Target, and Instruments)
 - Other Engineered Controls
 - Oxygen Monitoring and Alarm for helium and nitrogen spill events needs to be evaluated based on the facility configuration
 - Target Building Confinement Ventilation System (Passive boundary to HEPA filters)
 - Area Radiation Monitors and Alarms and Access Control
- Design Features (DFs) (Table 4.6)
- Administrative Controls (ACs) (Table 4.7)
- Critical Assumptions and Initial Conditions (Table 4.8)
 - Includes ACs, DFs, ICs, ECs

Event Number			
Designator Event Category-Event Number			
Event Description:			
Assumptions and Initial Conditions: 1. Assumptions made in the evaluation (IC) 2. Initial condition for the event. (IC)		Causes: 1. All possible causes for the event	
		Initiating Event Frequency A, U, EU, or BEU	
Unmitigated Impact on Systems: Damage to other systems or operations		Unmitigated Consequences	
		Radiological Public: N/A WG1: N/A WG2: N/A	Chemical Public: N/A WG1: N/A WG2: N/A
		ODH Public: N/A WG1: N/A WG2: N/A	
Safety Function: Clear statement of high level safety function without identifying a specific control.			
Method of Detection: List every possible means of detecting the event			
Preventive Features – Attributes:			Credited:
Engineered Controls that “prevent” the initiating event (EC)			X
Design Features that “prevent” the initiating event (DF)			
Administrative Controls that “prevent” the initiating event (AC)			
Mitigative Features – Attributes: List of all ECs, DFs, and ACs that mitigate the event scenario			Credited:
Planned analysis, assumption validations, and Risk/Opportunities: This is the “actions” section.		Mitigated Consequences:	
		Radiological Public: N/A WG1: N/A WG2: N/A	Chemical Public: N/A WG1: N/A WG2: N/A
		ODH Public: N/A WG1: N/A WG2: N/A	
Notes: Any general note that supports the event evaluation or would help in future evaluations.			Mitigated Frequency A, U, EC, BEU, Prevented

Event Type Designations

- E-1 Fire
- E-2 Explosion
- E-3 Loss of Confinement/Containment
- E-4 Direct Radiation or Chemical Exposure
- E-5 Cryogenic or ODH Events
- E-6 External Events
- E-7 Natural Phenomena Events

Questions?

An aerial architectural rendering of a large campus or industrial site. The scene features several large, interconnected buildings with flat roofs, some with skylights. A prominent road or path winds through the site, connecting various structures. There are numerous trees, some with autumn foliage, and green lawn areas. The overall impression is of a well-planned, modern facility.

ESH&Q is ready to continue supporting the project as it evolves towards project completion and operation

Backup Slides

Event Frequency Ranges

Event frequency level	Estimated annual likelihood of occurrence	Description
Anticipated (A)	$10^{-1} > p > 10^{-2}$	Incidents that may occur several times during the lifetime of the facility. (Incidents that commonly occur)
Unlikely (U)	$10^{-2} > p > 10^{-4}$	Events that are not anticipated to occur during the lifetime of the facility.
Extremely Unlikely (EU)	$10^{-4} > p > 10^{-6}$	Events that will probably not occur during the life cycle of the facility.
Beyond Extremely Unlikely (BEU)	$10^{-6} > p$	All other events

Radiological Consequences by receptor: High, Moderate, Low, Negligible

Consequence level	Off-site receptor	On-site receptor
High (H)	≥ 25 rem	≥ 100 rem
Moderate (M)	$5 \leq C < 25$ rem	$25 \leq C < 100$ rem
Low (L)	$0.5 \leq C < 5$ rem	$5 \leq C \leq 25$ rem
Negligible (N)	< 0.5 rem	< 5 rem

Chemical Consequences by receptor: High, Moderate, Low, Negligible

Consequence level	Off-site receptor	On-site receptor
High (H)	$> \text{PAC } 2$	$> \text{PAC } 3$
Moderate (M)	$\text{PAC } 1 < C \leq \text{PAC } 2$	$\text{PAC } 2 < C \leq \text{PAC } 3$
Low (L)	$< \text{PAC } 1$	$\text{PAC } 1 < C \leq \text{PAC } 2$
Negligible (N)	$\ll \text{PAC } 1$	$\leq \text{PAC } 1$

Consequences: High, Moderate, Low, Negligible

- **ODH Consequence Guidance**

- (Evaluation Levels vs Oxygen Concentration by Volume)

Consequence Level	Worker Receptor
High (H)	$< 12.5\%$
Moderate (M)	$12.5\% \leq C < 15\%$
Low (L)	$15\% \leq C < 19\%$
Negligible (N)	$\approx 19.5\% - 21\%$

Oxygen Deficient Atmospheres

19.5 %	Minimum acceptable oxygen level.
15 - 19 %	Decreased ability to work strenuously. Impaired coordination. Early symptoms.
12 - 14 %	Respiration increases. Poor judgment.
10 - 12 %	Respiration increases. Lips turn blue.
8 - 10 %	Mental failure. Fainting; nausea; unconsciousness; vomiting.
6 - 8 %	8 minutes - fatal, 6 minutes - 50% fatal. 4 - 5 minutes - possible recovery.
4 - 6 %	Coma in 40 seconds. Death. <small>Source: OSHA</small>