Stack. (2) S

MAR 26 2001

ENGINEERING DATA TRANSMITTAL

Page 1 of 1

1. EDT 625146

2. To: (Receiving Organization)	3. From: (Originating Organization)	4. Related EDT No.:
Distribution	Nuclear Safety & Licensing	N/A
5. Proj./Prog./Dept./Div.:	6. Design Authority/Design Agent/Cog. Engr.:	7. Purchase Order No.:
River Protection Project	R.D. Smith	N/A
		9. Equip./Component No.: N/A
		10. System/Bldg./Facility: Tank Farms
		12. Major Assm. Dwg. No.: N/A
		13. Permit/Permit Application No.: N/A
		14. Required Response Date: January 18, 2000

8. Originator Remarks:
The attached document reflects the results of the control decision process for the revised analysis for Rotary Mode Core Sampling.

11. Receiver Remarks: None.

11A. Design Baseline Document? ☐ Yes ☒ No

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	RPP-7552	N/A	0	Rotary Mode Core Sampling Control Decision Record	N/A	1	1	1

16. KEY

Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)
E, S, C, D OR N/A (See WHC-CM-3-5, Sec. 2.7)	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION
(See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN
		Design Authority			
		Design Agent			
1	1	Cog. Eng. RD Smith	RDSmith	3/21/01	
1	1	Cog. Mgr. RJ Cash	RJ Cash	3/23/01	
		QA			
		Safety			
		Env.			

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN
1	1	JS Schofield	John Schofield	3/24/01	

18. RD Smith — Signature of EDT Originator — 3/21/01 Date

19. RJ Cash — Authorized Representative for Receiving Organization — 3/23/01 Date

20. RJ Cash — Design Authority/ Cognizant Manager — 3/23/01 Date

21. DOE APPROVAL (if required)
Ctrl No. NR
☐ Approved
☐ Approved w/comments
☐ Disapproved w/comments

DISTRIBUTION SHEET

To	From	Page 1 of 1
Distribution	NS&L/CH2M HILL Hanford Group Inc.	Date
Project Title/Work Order		EDT No. 625146
RPP-7552, "Rotary Mode Core Sampling Control Decision Record"		ECN No. N/A

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
JS Schofield	S7-12	X			
TG Goetz	R1-49	X			
RD Smith	R1-49	X			
MV Shultz	B4-47	X			
KR Sandgren	R1-49	X			
TR Farris	S7-12	X			
LJ Kripps	R1-49	X			
WC Cowley	R1-49	X			
RJ Cash	R1-49	X			
JE Meacham	R1-49	X			
Central Files (Original + 1 Copy)	A3-88	X			

DISTRIBUTION

Onsite

1	U.S. Department of Energy Richland Operations Office	
	DOE Public Reading Room	H2-53
1	Pacific Northwest National Laboratory	
	Hanford Technical Library	P8-55
2	Lockheed Martin Services, Inc.	
	Central Files	B1-07
	Document Processing Center	A3-94

Rotary Mode Core Sampling Control Decision Record

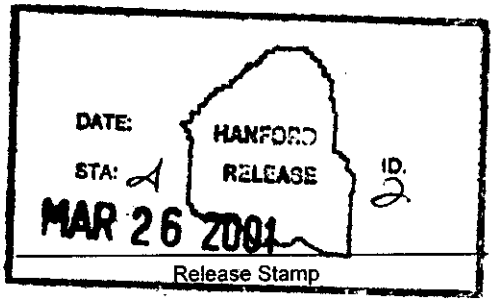
R.D. Smith
CH2M HILL Hanford Group Inc.
Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-99RL14047

EDT/ECN: 625146 UC: 510
Cost Center: 403 Charge Code: 102249
B&R Code: N/A Total Pages: 67

Key Words: Control Decision Record, Rotary Mode Core Sampling, RMCS, Safety SSCs, Flammable Gas, Technical Safety Requirements, TSRs, Hazards

Abstract: The document summarizes the results of a control decision meeting that was conducted to establish the revised controls for Rotary Mode Core Sampling.

3/26/01
Release Approval Date



Approved For Public Release

RPP-7552
Revision 0

Rotary Mode Core Sampling Control Decision Record

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

CH2MHILL
Hanford Group, Inc.
Richland, Washington

Contractor for the U.S. Department of Energy
Office of River Protection under Contract DE-AC27-99RL14047

RPP-7552
Revision 0

Rotary Mode Core Sampling Control Decision Record

Prepared by:
R. D. Smith

Date Published
March 2001

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

CH2MHILL
Hanford Group, Inc.

P. O. Box 1500
Richland, Washington

Contractor for the U.S. Department of Energy
Office of River Protection under Contract DE-AC27-99RL14047

Rotary Mode Core Sampling Control Decision Record

R.D. Smith

March 2001

This page intentionally left blank.

CONTENTS

APPENDICES

TABLES

TERMS

AB	Authorization Basis
AC	Administrative Control
BIO	HNF-SD-WM-BIO-001, *Tank Waste Remediation System Basis for Interim Operation*
CAM	continuous air monitor
DID	defense-in-depth
FSAR	HNF-SD-WM-SAR-067, *Tank Farms Final Safety Analysis Report*
HEPA	high-efficiency particulate air (filter)
LCO	Limiting Condition for Operation
RMCS	rotary mode core sampling
SSC	structure, system, and component

1.0 INTRODUCTION

A control decision meeting was held on December 19, 2000, to analyze the rotary mode core sampling (RMCS) controls. The agenda for the control decision meeting is included in Appendix A, and the attendee list is included in Appendix B.

The purpose of this control decision meeting was to reconcile the Los Alamos National Laboratories safety assessment control allocation for RMCS with the rest of the Tank Farms Authorization Basis (AB). In-mid 1998, calculation note HNF-3228, Rev. 0, *Recalculation of Accident Consequences to Account for Rotary Mode Core Sampling*, was generated to incorporate RMCS into HNF-SD-WM-BIO-001, *Tank Waste Remediation System Basis for Interim Operation* (BIO), which was the current AB at that time. The Addendum 5 addition to the BIO was based on calculation note HNF-3228 and issued for approval in August 1998. Approval of Addendum 5 has been delayed. Since Addendum 5 was generated, the BIO has been superceded by HNF-SD-WM-SAR-067, *Tank Farms Final Safety Analysis Report* (FSAR); numerous changes have been made to the accident analyses; and considerable data have been gathered on aerosol experience during RMCS. These changes necessitated an update to HNF-3228, Rev. 0, to provide a current evaluation of the impact of RMCS activities on the accident analyses in the FSAR before RMCS is incorporated into the FSAR.

The scope of this control decision is for RMCS activities only. The AB documents used for this control decision were Revision 2 of the FSAR and Revision 2 of HNF-SD-WM-TSR-006, *Tank Farms Technical Safety Requirements*, as well as supporting calculation notes HNF-3228, Rev. 1, HNF-4240, Rev. 1, *Organic Solvent Topical Report*, and HNF-3588, Rev. 1, *Organic Complexant Topical Report.*

The control decision meeting was conducted in accordance with the established and approved process and criteria described in the FSAR. A summary of the control decision process and criteria was presented at the start of the control decision meeting and is included in Appendix C. Control decisions were based on Addendum 5 of the BIO, on the best available information from the hazard and accident analyses, and on the technical expertise and experience of the meeting participants. Decisions were made by consensus.

Section 2.0 of this report provides an overview of the control decision meeting presentations made on December 19, 2000. The presentations mainly described the existing hazards identified in Addendum 5 of the BIO.

Section 3.0 of this report summarizes the control decision discussion at the December 19, 2000, meeting. The discussion summary identifies the controls that were considered and the reasons why specific controls were (or were not) selected.

Section 4.0 of this report provides a listing of the references that are cited in the preceding sections.

This page intentionally left blank.

2.0 OVERVIEW OF CONTROL DECISION MEETING PRESENTATIONS

Calculation notes, existing controls, and potential controls were reviewed during the control decision meeting that was held on December 19, 2000. The agenda for the proceeding is included in Appendix A.

After an introduction and a description of the calculation notes that support this control decision, the hazards associated with RMCS from Addendum 5 of the BIO were presented to the group. In order to limit the addition of duplicate data to the FSAR hazard database, the RMCS hazardous conditions were grouped together and a minimum set of unique hazardous conditions was presented. Nine new hazardous conditions were included in the set of unique hazardous conditions. The information presented is included in Appendix D. Additionally, the environmental and defense-in-depth (DID) controls from Addendum 5 of the BIO were presented to the group. The information presented is included in Appendix E.

It should be noted that the control decision team agreed that the hazards and controls presented at the meeting associated with Addendum 5 of the BIO adequately represent the RMCS activity.

This page intentionally left blank.

3.0 CONTROL DECISION DISCUSSION SUMMARY

Based on the FSAR controls, proposed Addendum 5 controls, and calculation notes presented to the group (see Section 2.0), control decisions were made.

3.1 CONTROLS SPECIFIED IN ADDENDUM 5

The RMCS structures, system, and components (SSCs), Administrative Controls (ACs), and Limiting Conditions for Operation (LCO) specified in Addendum 5 of the BIO for each representative accident are shown below.

Safety Systems, Structures, and Components:

- Ventilation Stack Continuous Air Monitor (CAM) Interlock
- Nitrogen Purge Gas Instrumentation System
- Downward Force Instrumentation System
- Rotations-Per-Minute Instrumentation System
- Penetration Rate Instrumentation System
- Shutdown Interlock System

Technical Safety Requirements:

- Flammable Gas Deflagration
  - AC 5.10 – Ignition Controls
  - AC 5.11 – Flammable Gas Monitoring Controls
  - AC 5.14 – Emergency Preparedness
- High-Efficiency Particulate Air (HEPA) Filter Failure from Exposure to High Temperature or Pressure
  - AC 5.10 – Ignition Controls
  - AC 5.11 – Flammable Gas Monitoring Controls
  - AC 5.14 – Emergency Preparedness
  - AC 5.18 – HEPA Filter Controls
  - LCO 3.1.4 – Ventilation Stack CAM Interlock Systems
  - LCO 3.4.1 – RMCS Drill Engine Shutdown Systems
- Tank Failure Due to Excessive Loads
  - AC 5.16 – Dome Loading Controls (New Truck 12-Foot Height)
- Organic Solvent Fire
  - AC 5.27 – RMCS Operation Controls
  - LCO 3.4.1 – RMCS Drill Engine Shutdown Systems

- In-Tank Fuel Fire/Deflagration

  - AC 5.10 – Ignition Controls
  - AC 5.11 – Flammable Gas Monitoring Controls
  - AC 5.14 – Emergency Preparedness
  - AC 5.16 – Dome Loading Controls

- Organic Salt-Nitrate Reaction

  - AC 5.10 – Ignition Controls
  - AC 5.11 – Flammable Gas Monitoring Controls
  - AC 5.16 – Dome Loading Controls
  - AC 5.27 – RMCS Operation Controls
  - LCO 3.4.1 – RMCS Drill Engine Shutdown Systems

Defense-In-Depth:

- See Appendix E.

Environmental:

- Hydraulic bottom detector shall be operable and activated for the last sample.

3.2 CONTROL DECISION RESULTS

The disposition of each of the listed controls is provided here.

Safety-Significant Systems, Structures, and Components:

- The consensus of the control decision team was that no Safety-Significant SSCs are required.

- The ventilation stack CAM SSC is not required based on calculation note HNF-3228, Rev. 1. See discussion below for HEPA Filter Failure from Exposure to High Temperature or Pressure.

- The Nitrogen Purge Gas Instrumentation System, Downward Force Instrumentation System, Rotations-Per-Minute Instrumentation System, Penetration Rate Instrumentation System, and Shutdown Interlock System are not required based on calculation notes HNF-3228, Rev. 1, HNF-4240, Rev. 1, and HNF-3588, Rev. 1. See discussions below for the Organic Salt-Nitrate Reaction and the Organic Solvent Fire accidents.

Technical Safety Requirements:

- Flammable Gas Deflagration – Two new hazardous conditions were added: (1) operation of the drill results in high temperatures at the drill bit caused by excessive rotational speed, and (2) spark from a drill bit causes a flammable gas deflagration. The consensus of the control decision team was that the standard sets of flammable gas deflagration

controls are adequate. The hazard database tables should be updated to be consistent with the rest of the flammable gas deflagration accident scenarios. Additionally, a hazardous condition should be included in the hazards database to capture the flammable gas temperature limit of 780 °F in AC 5.10, Ignition Controls, which is credited for not overheating the RMCS drill bit. This is needed because the previously bounding temperature limit and hazardous condition was removed for organics. The following is the standard set of controls that were discussed and agreed upon:

- AC 5.10 – Ignition Controls
- AC 5.11 – Flammable Gas Monitoring Controls
- AC 5.14 – Emergency Preparedness
- AC 5.18 – HEPA Filter Controls
- AC 5.19 – Measure and Test Equipment.

- HEPA Filter Failure from Exposure to High Temperature or Pressure – One new hazardous condition was added: external fire causes HEPA filter failure in RMCS exhauster followed by unfiltered release. The consensus of the control decision team was that only two controls are needed to mitigate or prevent the HEPA filter failure from exposure to high temperature or pressure accidents. This decision was based on calculation note HNF-3228, Rev. 1, which provides the rationale that the consequences (S1) do not exceed guidelines. One of the controls that is needed is AC 5.18, HEPA Filter Controls, because the accident analysis in HNF-3228 assumes that the HEPA filter loading is 200 mrem/h, which is an assumption protected by this control. The control decision team also recommended that AC 5.24, Safety Management Programs, be added to the tank pressurization accident to help ensure that improper materials are not added to the tanks during core sampling. Currently only water, nitrogen, and lithium bromide solution are added to the tanks. The following is the standard set of controls that were discussed and agreed upon:

  - AC 5.18 – HEPA Filter Controls
  - AC 5.24 – Safety Management Program.

- Tank Failure Due to Excessive Loads – The consensus of the control decision team was that the existing control for AC 5.16, Dome Loading Controls, is adequate. The control decision team unanimously agreed that there is no reason to have a more conservative lift height (12 ft instead of 20 ft) on the RMCS truck because it exceeds the analyzed lift weight parameters. The control decision team agreed that it would be impossible to drop the RMCS truck and have a single-point impact that would accept the full load of the dropped truck. The technical justification and analysis for this accident can be found in HNF-3228, Rev. 1, Section 4.0.

- Organic Solvent Fire – One new hazardous condition was added: an overheated drill bit ignites an organic solvent fire. The consensus of the control decision team was that no controls are required to mitigate or prevent the Organic Solvent Fire accident. This decision was based on calculation note HNF-3228, Rev. 1, which provides the rationale that the consequences (S1) do not exceed guidelines. Therefore the existing proposed

controls from Addendum 5 of the BIO (AC 5.27, RMCS Operation Controls, and LCO 3.4.1, RMCS Drill Engine Shutdown Systems) are no longer needed.

- In-Tank Fuel Fire/Deflagration – The consensus of the control decision team was that the existing controls are adequate to mitigate and prevent this accident and that no new controls are needed. The control decision team agreed that the hazard associated with a vehicle leak initiating a waste fire should be captured under the Organic-Salt Nitrate Reaction accident. It was determined by the control decision team that AC 5.18, HEPA Filter Controls, should be allocated for this accident since it is an assumption of the accident analysis. The controls retained for the RMCS hazardous conditions assigned to this analyzed accident are as follows:

  - AC 5.10 – Ignition Controls
  - AC 5.11 – Flammable Gas Monitoring Controls
  - AC 5.14 – Emergency Preparedness
  - AC 5.16 – Dome Loading Controls
  - AC 5.18 – HEPA Filter Controls.

- Organic Salt-Nitrate Reaction – The consensus of the control decision team was that no controls are required to mitigate or prevent the Organic Salt-Nitrate Reaction accident. This decision was based on calculation note HNF-3228, Rev. 1, which provides the rationale that the frequency (F0) for this accident is beyond extremely unlikely. The control decision board agreed that the hazardous condition for an overheated drill bit needs to be captured in the Flammable Gas Deflagration accident and that AC 5.27, RMCS Operation Controls, and LCO 3.4.1, RMCS Drill Engine Shutdown Systems, are no longer required. The controls retained for the RMCS hazardous conditions assigned to this analyzed accident are as follows:

  - AC 5.10 – Ignition Controls
  - AC 5.11 – Flammable Gas Monitoring Controls
  - AC 5.16 – Dome Loading Controls.

Defense-In-Depth:

- RMCS DID Controls for HEPA Failure Accidents – The consensus of the control decision team was that all seven of the HEPA filter DID controls (Table 3.4.2.2-5 of Appendix E) should be retained. The determining factor in the control decision team's decision to retain all of these controls was that all of these controls are currently standard practices in the tank farms and RMCS currently has the capability to implement these controls. It was identified that Controls 1 through 3 all map to FSAR DID controls in Table T3.3.2.4.2-7. Controls 4, 5, and 7 all map to FSAR DID controls in Table T3.3.2.4.3-3. Control 6 maps to the Ignition Control Program as part of AC 5.10.

- RMCS DID Controls Related to Tank Failure Accidents for RMCS Operations – The consensus of the control decision team was that most of the tank failure DID controls (Table 3.4.2.13-3 of Appendix E) should be retained. It was identified that Control 1 maps to FSAR DID controls in Table T3.4.2.1-5 and encompasses the intent of

Controls 2 and 3. Control 5 should be added to Table T3.4.2.1-5; Control 4 is not needed to support the current FSAR safety analysis; and Control 5 is covered by the environmental control to use the hydraulic bottom detector for the last sample.

- RMCS DID Controls for Flammable Gas Deflagrations – The consensus of the control decision team was that none of the flammable gas DID controls (Table 3.4.2.14-2 of Appendix E) need to be retained. This decision was based on the consensus that RMCS has no unique perceivable impact on flammable gas in the tank farms and is covered by the existing controls.

- RMCS DID Controls for Organic Solvent Fires – The consensus of the control decision team was that none of the organic solvent DID controls (Table 3.4.2.15-4 of Appendix E) need to be retained. It was identified that Control 1 is not relevant to this accident and Control 2 is covered by environmental controls.

- RMCS DID Controls for Organic Salt-Nitrate Reactions – The consensus of the control decision team was that none of the organic salt-nitrate controls (Table 3.4.2.17-4 of Appendix E) need to be retained. It was identified that Control 1 is not relevant to this accident and Control 2 is covered by environmental controls.

Environmental:

- The consensus of the control decision team was that the existing control to have the hydraulic bottom detector operable and activated for the last sample is adequate for protecting against penetrating the bottom of the tank.

Table 1. Summary of Controls Selected for Rotary Mode Core Sampling.

Structures, Systems, and Components			
Structures, Systems, and Components	**Classification**	**Safety Function**	**Comments**
None identified.	--	--	--
Technical Safety Requirements			
Control	**Safety Function**	**Comments**	
AC 5.10 – Ignition Controls	Provides ignition controls to minimize the risk of fire or deflagrations.	None	
AC 5.11 – Flammable Gas Monitoring Controls	Ensures that flammable gas levels do not reach 100% of the lower flammability limit.	None	
AC 5.14 – Emergency Preparedness	Ensures that proper management systems are used to manage radiological and toxicological releases from accidents.	None	
AC 5.16 – Dome Loading Controls	Ensures that suspended loads are not dropped in tank pits and tank structures are not compromised from excessive loads.	None	
AC 5.19 – Measure and Test Equipment	Provides a support control for the process instrumentation and measuring and test equipment used to verify process parameters to comply with TSRs.	None	
AC 5.24 – Safety Management Program	Minimizes the risks to the public, onsite workers, and facility workers during normal, abnormal, and emergency conditions.	None	

Table 1. Summary of Controls Selected for Rotary Mode Core Sampling.

Defense-in-Depth Controls		
Control	**Safety Function**	**Comments**
HEPA filter replacement typically performed at 1.0 E-03 Sv/h (100 mrem/h)	Limit inventory available for release and limit dose rate to workers in the vicinity of the filters.	Applies to the RMCS portable exhauster during RMCS operations.
HEPA filter high differential pressure interlock	Indicate plugging of HEPA filters.	Applies to the RMCS portable exhauster during RMCS operations.
Aerosol testing of HEPA filters	Ensure the operability of the filters on the ventilation system.	Applies to the RMCS portable exhauster during RMCS operations.
Fire prevention practices	Fire prevention	Program contains a number of provisions that would prevent fires in a pit from causes other than ruptured fuel tanks.
Vehicle positioning spotters	Spotters provide additional level of control in positioning cranes/vehicles.	Reduces the proability of analyzed accident.
Vegetation control program	Prevent range fires from impacting tank farm facilities.	None
Hydrostatic load monitoring	Protects against tank failure due to excessive hydrostatic loads.	None
Core sampling truck ramp stops and hydraulic jacks	Decreases the potential for a truck falling into a pit.	None

4.0 REFERENCES

HNF-SD-WM-BIO-001, 1997, *Tank Waste Remediation System Basis for Interim Operation*, Rev. 0, Lockheed Martin Hanford Corporation, Richland, Washington.

HNF-SD-WM-SAR-067, 2000, *Tank Farms Final Safety Analysis Report*, as amended, CH2M HILL Hanford Group, Inc., Richland, Washington.

HNF-SD-WM-TSR-006, 2000, *Tank Farms Technical Safety Requirements*, as amended, CH2M HILL Hanford Group, Inc., Richland, Washington.

HNF-3228, *Recalculation of Accident Consequences to Account for Rotary Mode Core Sampling*, Rev. 1, CH2M HILL Hanford Group, Inc., Richland, Washington.

HNF-4240, *Organic Solvent Topical Report*, Rev. 1, CH2M HILL Hanford Group, Inc., Richland, Washington.

HNF-3588, *Organic Complexant Topical Report*, Rev. 1, CH2M HILL Hanford Group, Inc., Richland, Washington.

This page intentionally left blank.

APPENDIX A

CONTROL DECISION MEETING AGENDA

This page intentionally left blank.

APPENDIX A

CONTROL DECISION MEETING AGENDA

Purpose – To include all of RMCS into Revision 2 of the FSAR, TSRs, and Hazard Analysis consistent with the rest of the AB for the tank farms.

Introduction – Calculation Note HNF-3228, Revision 0 was generated in mid 1998 to incorporate RMCS into the current AB at that time (HNF-SD-WM-BIO-001). An addendum 5 was generated to the BIO based upon calculation note HNF-3228 and issued for approval in August of 1998. Approval of this Addendum has been delayed. Since this time the BIO has been superceded by the FSAR, there have been numerous changes to the accident analysis, and considerable data has been gathered on aerosol experience during RMCS. These changes have necessitated an update to HNF-3228 Revision 0 to provide a current evaluation of the RMCS impact on the FSAR accident analysis prior to incorporation of RMCS into the FSAR.

Scope – The scope of this control decision is for RMCS activities only. The AB that shall be used for this control decision shall be Revision 2 of the FSAR and TSRs as well as supporting calculation notes HNF-3228 Revision 1, Recalculation of Accident Consequences to Account for Rotary Mode Core Sampling, RPP-6965, Revision 0 DRAFT, Toxicological Source Term for Tank Farm Safety Analysis, and HNF-3588 Revision 2, Organic Complexant Topical Report

Process – Follow the normal process (Draft procedure HNF-IP-0842, Volume IV, Section 5.15, Revision 0 Draft [will be provided as handout]) except since a hazard analysis was already performed the team will access the existing hazards and re-allocate controls based upon the latest AB and supporting calculation notes and information.

Hazard Analysis

1. Hazard Analysis Overview
2. Hazardous Conditions Addressed by LANL SA
3. Hazardous Conditions Addressed by proposed Addendum 5 and BIO
4. Hazardous Conditions Not Addressed by the Existing Authorization Basis and Controls

Representative Flammable Gas Accident Analysis Results

1. Existing Authorization Basis Representative Accidents
   A. LANL
   B. BIO
   C. CALC Notes

Control Decisions

1. Flammable Gas Deflagration – Induced gas release from steady state gas accumulations and GREs.
   A. Existing Controls
      1. AC 5.10 - Ignition Controls
      2. AC 5.11 - Flammable Gas Monitoring Controls

B. Possible Controls

C. Selected controls (Safety SSCs, TSRs, defense-in-depth)

D. Review represented hazardous conditions to determine whether selected controls acceptably prevent or mitigate the hazardous condition, and if not, select additional controls

2. HEPA Filter Failure – Exposed to high pressure or temperature.

   A. Existing Controls
      1. LCO 3.1.4 - Ventilation Stack CAM Interlock
      2. AC 5.10 - Ignition Controls
      3. AC 5.14 - Emergency Prepardness
      4. AC 5.18 - HEPA Filter Controls

   B. Possible Controls

   C. Selected controls (Safety SSCs, TSRs, defense-in-depth)

   D. Review of represented hazardous conditions to determine whether selected controls acceptably prevent or mitigate the hazardous condition, and if not, select additional controls

3. Tank Failure – Due to excessive loads.

   A. Existing Controls
      1. AC 5.16 - Dome Loading

   B. Possible Controls

   C. Selected controls (Safety SSCs, TSRs, defense-in-depth)

   D. Review of represented hazardous conditions to determine whether selected controls acceptably prevent or mitigate the hazardous condition, and if not select additional controls

4. Organic Solvent Fire

   A. Existing Controls
      1. LCO 3.4.1 - RMCS Drill Engine Shutdown Systems
         a. Purge Gas
         b. Downforce
         c. Rotations-Per-Minute
         d. Penetration Rate
         e. Shutdown Interlock
      2. AC 5.27 - RMCS Operation Controls (Restricted Tanks)

   B. Possible Controls

   C. Selected controls (Safety SSCs, TSRs, defense-in-depth)

   D. Review of represented hazardous conditions to determine whether selected controls acceptably prevent or mitigate the hazardous condition, and if not, select additional controls

5. In-Tank Fuel Fire/Deflagration
   A. Existing Controls
      1. AC 5.10 - Ignition Controls
      2. AC 5.11 - Flammable Gas Monitoring Controls
      3. AC 5.14 - Emergency Preparedness
      4. AC 5.16 - Dome Loading (New Limit on Truck Height)
   B. Possible Controls
   C. Selected controls (Safety SSCs, TSRs, defense-in-depth)
   D. Review of represented hazardous conditions to determine whether selected controls acceptably prevent or mitigate the hazardous condition, and if not, select additional controls

6. Organic Salt-Nitrate
   A. Existing Controls
      1. LCO 3.4.1 - RMCS Drill Engine Shutdown Systems
         a. Purge Gas
         b. Downforce
         c. Rotations-Per-Minute
         d. Penetration Rate
         e. Shutdown Interlock
      2. AC 5.10 - Ignition Controls
      3. AC 5.27 - RMCS Operation Controls (Restricted Tanks, Drill Bit Verification)
   B. Possible Controls
   C. Selected controls (Safety SSCs, TSRs, defense-in-depth)
   D. Review of represented hazardous conditions to determine whether selected controls acceptably prevent or mitigate the hazardous condition, and if not, select additional controls

This page intentionally left blank.

APPENDIX B

CONTROL DECISION MEETING ATTENDEE LIST

This page intentionally left blank.

APPENDIX B

CONTROL DECISION MEETING ATTENDEE LIST

RMCS CONTROL DECISION MEETING ATTENDANCE

Name	Knowledge Area(s) Represented (see below)	Organization	Telephone Number
Ryan Smith	1, 7, 9, 10	NS&L	372-1383
Kevin Sandgren	1, 7, 9, 10	NS&L	372-0374
Tom Goetz	1, 2, 6, 7, 9, 10	NS&L	373-4818
LARRY KRIPPS	1, 2, 3, 6, 7, 9, 10	NS&L	376-1061
John Schofield	2, 4, 5	CPO	3-2245
[illegible]	[illegible]	CPO	373-4393
MILTON V SHULTZ	3, 6, 7, 9, 10	EFS - NS&L	376-2215

Knowledge Areas:

1 Licensing
2 Safety Analysis
3 Hazard Analysis
4 Engineering
5 Operations
6 Accident Analysis
7 Nuclear Safety
8 Design Authority
9 Technical Safety Requirements
10 Safety Structures, Systems, and Components
11 Emergency Preparedness
12 Radiological Control
13 Regulatory Compliance
14 Environmental Protection
15 Quality Assurance
16 Other - specify
17 Industrial Safety
18 Project Management
19 Industrial Hygiene
20 Maintenance Engineering
21 Reliability Engineering
22 Process Engineering
23 Equipment Engineering

This page intentionally left blank.

APPENDIX C

CONTROL DECISION MEETING PROCESS AND CRITERIA

This page intentionally left blank.

APPENDIX C

CONTROL DECISION MEETING PROCESS AND CRITERIA

PURPOSE, SCOPE, AND PROCESS FOR THE CONTROL DECISION MEETING FOR ROTARY MODE CORE SAMPLING HAZARDS

Note: Controls include safety-class and safety-significant structures, systems, and components (SSCs); technical safety requirements (TSRs); and other controls that provide defense-in-depth or environmental protection.

Purpose:

The purpose of the control decision meeting is to review existing controls and potentially select new or revised controls to prevent or mitigate RMCS hazards. The control decisions and their basis will support the Authorization Basis amendment to reconcile SAD-035 with the current AB.

Scope:

The scope of the control decision meeting covers potential hazards for RMCS.

Process:

The control decision process and the criteria for control decisions are described in the FSAR along with the methodology for the hazard and accident analyses whose results are used to identify controls. Control decision criteria are summarized in Exhibit I.

Control decisions will be based on the best available information from the hazard and accident analyses and on the technical expertise and experience of the meeting participants. Decisions will be made by consensus.

Required participants in the RMCS hazard control decision meeting are representatives from operations, engineering, and Nuclear Safety and Licensing. Control decision meeting participants may also include representatives from process engineering, safety services, emergency management, nuclear regulatory compliance, quality assurance, radiological control, environmental, and engineering. Personnel responsible for developing the information or performing the analysis supporting control decisions will be present at the control decision meetings.

The control decision meeting discussions will be documented, including the control decisions (see Exhibit II). The control decisions and their bases will be incorporated into the FSAR and TSRs through an Authorization Basis amendment to reconcile SAD-035 with the current AB. Contractor (i.e., Tier I) and DOE review and approval of the Authorization Basis amendment will be required.

Exhibit I

SUMMARY OF CONTROL DECISION CRITERIA

Note: FSAR Section 3.3.1.5, "Controls Identification," contains a complete discussion of control decision criteria.

Control decision criteria are based on the following documents:

- DOE 5480.23, Nuclear Safety Analysis
- DOE 5480.22, Technical Safety Requirements
- DOE-STD-3009-94, Preparation Guide for U. S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports
- WHC-CM-4-46, Nonreactor Facility Safety Analysis Manual, Section 6, "Technical Safety Requirements," Rev. 1, and Section 9,"Safety Classification of Structures, Systems, and Components," Rev. 2.

Risk Evaluation Guidelines:

Radiological Risk Guidelines

Frequency Category	**Frequency Range (yr-1)**	**Effective Dose Equivalent (rem)**	
		Onsite	**Offsite**
Anticipated	>10-2 to ≤10+0	0.5	0.1
Unlikely	>10-4 to ≤10-2	5	0.5
Extremely Unlikely	>10-6 to ≤10-4	10	4

Toxicological Risk Guidelines

Frequency Category	**Frequency Range (yr-1)**	**Primary Concentration Guidelines**	
		Onsite	**Offsite**
Anticipated	>10-2 to ≤10+0	≤ERP-1	≤PEL-TWA
Unlikely	>10-4 to ≤10-2	≤ERP-2	≤ERP-1
Extremely Unlikely	>10-6 to ≤10-4	≤ERP-3	≤ERP-2

ERPG = Emergency Response Planning Guideline.
PEL-TWA= Permissible Exposure Limit-Time-Weighted Average.

Additional criteria to guide control decisions are the following:

- Control preferences are as follows:
  - Controls that prevent the accident versus those that mitigate its consequences;
  - Passive engineered versus active engineered controls;
  - Engineered controls versus administrative controls
- Controls providing significant defense-in-depth are classified as safety SSCs or are elevated to a TSR control
- TSR controls are not developed for postulated accidents resulting in only environmental consequences
- SSCs are not classified safety-class or safety-significant solely for preventing or mitigating postulated accidents resulting in environmental consequences.

Other criteria that are important considerations in control decisions are listed below:

- Control reliability, availability, and maintainability
- Control effects on facility workers (e.g., increased radiation doses or toxicological exposures, ALARA issues)
- Control optimization and integration
- Control cost/benefit
- Control human factors impacts
- Controls impacts on RPP mission.

Exhibit II

CONTROL DECISION RECORD

Hazard/Accident Title:

Structures, Systems, and Components (SSCs)

Structures, Systems, and Components	Classification		Safety Function	Comments
	SC	SS		

SC = Safety Class.
SS = Safety Significant.

Technical Safety Requirements (TSRs)

Control	Safety Function	Comments

Defense-in-Depth Controls

Control	Safety Function	Comments

APPENDIX D

HAZARD DATABASE HANDOUT

This page intentionally left blank.

APPENDIX D

HAZARD DATABASE HANDOUT

Table B-1 Safety SSCs and TSRs for Potential S3 and S2 Consequences

Node	Hazardous Condition	Causes	Prev SSC	Prev TSR	Mit SSC	Mit TSR	Control Memo	Env Cons	Freq	Cons
HEPA Filter Failure-Exposure to High Temperature										
RMCS New 1	Release of radioactive or hazardous material from RMCS exhauster caused by HEPA filter failure and unfiltered release	External fire causes HEPA filter failure in RMCS exhauster followed by unfiltered release	None required	AC 5.10, Ignition Controls	SC: RMCS exhauster CAM interlock	LCO 3.1.4, Ventilation Stack CAM Interlock Systems AC 5.14, Emergency Preparedness AC 5.18, HEPA Filter Controls	Controls based on BIO Addendum 5 accident analysis	E2	F2	S2
Mixing of Incompatible Material-Tank Pressurization										
RMCS Global.4	Release of radioactive aerosol caused by chemical reaction with tank waste and subsequent exothermic reaction	Introduction of incompatible materials into tank	None required	None required	None required	None required	Controls not required based on RMCS hazard actually being a flammable gas hazard (See controls for Flammable Gas Deflagrations)	E2	F3	S2
Tank Failure Due to Excessive Loads										

Table B-1 Safety SSCs and TSRs for Potential S3 and S2 Consequences

Node	Hazardous Condition	Causes	Prev SSC	Prev TSR	Mit SSC	Mit TSR	Control Memo	Env Cons	Freq	Cons
RMCS 37.1	Release of radioactive and/or toxic material due to dome collapse	Tank static load exceeded leading to dome collapse	None required	AC 5.16, Dome Loading	None required	None required	Controls are based on existing BIO accident analysis (Tank Failure Due to Excessive Loads)	E2	F2	S2
RMCS 37.13	Release of radioactive and/or toxic material due to dome collapse	Drilling truck drives off ramps into open pit, initiates dome collapse	None required	AC 5.16, Dome Loading: New limit on truck height	None required	None required	Controls based on existing BIO analysis and BIO Addendum 5 analysis (Tank Failure Due to Excessive Loads)	E2	F2	S2
RMCS 1.1	Release of radioactive and/or toxic material due to dome collapse	Tank dome overloaded	None required	AC 5.16, Dome Loading	None required	None required	Controls are based on existing BIO accident analysis (Tank Failure Due to Excessive Loads)	E2	F2	S2
RMCS 2.4	Release of radioactive and/or toxic material due to dome collapse	Truck driven off ramps into open pit leading to dome collapse	None required	AC 5.16 Dome Loading: New limit on truck height	None required	None required	Controls based on existing BIO analysis and BIO Addendum 5 analysis (Tank Failure Due to Excessive Loads)	E2	F2	S2
RMCS 37.2	Release of radioactive and/or toxic material due to dome collapse	Load dropped on top of tank during lift leading to dome collapse	None required	AC 5.16, Dome Loading	None required	None required	Controls are based on existing BIO accident analysis (Tank Failure Due to Excessive Loads)	E2	F2	S2

Table B-1 Safety SSCs and TSRs for Potential S3 and S2 Consequences

Node	Hazardous Condition	Causes	Prev SSC	Prev TSR	Mit SSC	Mit TSR	Control Memo	Env Cons	Freq	Cons
RMCS External. 23	Release of radioactive and/or toxic material due to dome collapse	Extreme winds during drilling operations results in drill truck upset due to jack or ramp failure	None required	AC 5.16, Dome Loading: New limit on truck height	None required	None required	Controls based on existing BIO analysis and BIO Addendum 5 analysis (Tank Failure Due to Excessive Loads)	E3	F0	S2 S3?
RMCS 32.3	Release of radioactive and/or toxic material due to dome collapse	Operator error; truck pulled off jacks by jib hoist, falls, impacts dome which then collapses	None required	AC 5.16, Dome Loading: New limit on truck height	None required	None required	Controls based on existing BIO analysis and BIO Addendum 5 analysis (Tank Failure Due to Excessive Loads)	E2	F2	S2
RMCS 1.2	Release of radioactive and/or toxic material due to dome collapse	Load dropped on top of tank during lift	None required	AC 5.16, Dome Loading	None required	None required	Controls are based on existing BIO accident analysis (Tank Failure Due to Excessive Loads)	E2	F0	S2
RMCS 2.5	Release of radioactive and/or toxic material caused by containment breach	Truck driven off ramps into open pit leading to containment breach	None required	AC 5.16 Dome Loading: New limit on truck height	None required	None required	Controls based on existing BIO analysis and BIO Addendum 5 analysis (Tank Failure Due to Excessive Loads)	E2	F2	S2

Table B-1 Safety SSCs and TSRs for Potential S3 and S2 Consequences

Node	Hazardous Condition	Causes	Prev SSC	Prev TSR	Mit SSC	Mit TSR	Control Memo	Env Cons	Freq	Cons
RMCS 14.1	Release of radioactive and/or toxic material due to dome collapse	Excess vacuum by exhauster due to plugged inlets	None required	None required	None required	None required	Controls not required based on existing BIO analysis (Tank Failure Due to Excessive Loads)	E2	F2	S2
RMCS 14.4	Release of radioactive *and/or toxic* material due to dome collapse	High exhaust flow creates *excess* vacuum	None required	None required	None required	None required	Controls not required based on existing BIO analysis (Tank Failure Due to Excessive Loads)	E2	F2	S2
Flammable Gas Deflagrations										
RMCS 37.22	Release of radioactive and/or toxic material due to dome fire	Hardware dropped into open riser causes a spark and ignition of gas in dome space	None required	AC 5.10, Ignition Controls AC 5.11, Flammable Gas Monitoring Controls	None required	None required	Controls are based on existing BIO accident analysis (Flammable Gas Deflagrations)	E2	F3	S3
RMCS 16.11	Release of radioactive and/or toxic material due to dome fire	Spark in vapor space from broken drill string from bit striking item in waste	None required	AC 5.10, Ignition Controls AC 5.11, Flammable Gas Monitoring Controls	None required	None required	Controls are based on existing BIO accident analysis and BIO Addendum 5 accident analysis (Flammable Gas Deflagrations)	E2	F3	S3

Table B-1 Safety SSCs and TSRs for Potential S3 and S2 Consequences

Node	Hazardous Condition	Causes	Prev SSC	Prev TSR	Mit SSC	Mit TSR	Control Memo	Env Cons	Freq	Cons
RMCS 16.5	Release of radioactive and/or toxic material due to dome fire	Drill bit catches fast in waste, drill string breaks, exposed wiring provides spark source and ignites dome space flammable gas	None required	AC 5.10, Ignition Controls AC 5.11, Flammable Gas Monitoring Controls	None required	None required	Controls are based on existing BIO accident analysis and BIO Addendum 5 accident analysis (Flammable Gas Deflagrations)	E2	F3	S3
RMCS External. 7	Release of radioactive and/or toxic material due to dome fire	Activity in interconnected tank causes fire that propagates to sampled tank leading to dome space fire	None required	AC 5.10, Ignition Controls	None required	AC 5.14, Emergency Preparedness	Controls are based on existing BIO accident analysis (Flammable Gas Deflagrations)	E2	F3	S3
RMCS 1.7	Release of radioactive and/or toxic material due to dome fire	Dome fire from spark from vehicle striking riser, vehicle gas tank breached, spark ignites fire	None required	AC 5.10, Ignition Controls	None required	AC 5.14, Emergency Preparedness	Controls are based on existing BIO accident analysis (Flammable Gas Deflagrations, In-Tank Fuel Fire/Deflagration)	E2	F3	S3

Table B-1 Safety SSCs and TSRs for Potential S3 and S2 Consequences

Node	Hazardous Condition	Causes	Prev SSC	Prev TSR	Mit SSC	Mit TSR	Control Memo	Env Cons	Freq	Cons
RMCS 4.4	Release of radioactive and/or toxic material due to dome fire	Reactive material dropped into open riser, chemical reaction generates flammable gas followed by ignition of dome space gases	None required	None required	None required	None required	Controls based on existing BIO accident analysis and BIO Addendum 5 accident analysis (Flammable Gas Deflagrations)		F3	S3
RMCS 6.1	Release of radioactive and/or toxic material due to dome fire	Drill string drops due to operator error (hoist not attached), or foot clamp failure. Spark generated and gas ignites	None required	AC 5.11, Flammable Gas Monitoring Controls	None required	None required	Controls based on existing BIO accident analysis and BIO Addendum 5 accident analysis (Flammable Gas Deflagrations)	E2	F3	S3
RMCS External. 28	Release of radioactive and/or toxic material due to dome fire	Insertion of non conductive material into dome space results in static discharge and subsequent dome fire	None required	AC 5.10, Ignition Controls	None required	None required	Controls are based on existing BIO accident analysis (Flammable Gas Deflagrations)	E2	F3	S3

Table B-1 Safety SSCs and TSRs for Potential S3 and S2 Consequences

Node	*Hazardous* Condition	*Causes*	*Prev SSC*	*Prev TSR*	*Mit SSC*	*Mit TSR*	*Control Memo*	*Env* Cons	*Freq*	*Cons*
RMCS 6.4	Release of radioactive and/or toxic material due to dome fire	Drill string strikes metal object during installation causing dome space ignition	None required	AC 5.10, Ignition Controls AC 5.11, Flammable Gas Monitoring Controls	None required	None required	Controls based on existing BIO accident analysis and BIO Addendum 5 accident analysis (Flammable Gas Deflagrations)	E2	F3	S3
RMCS 32.2	Release of radioactive and/or toxic material due to dome fire	Operator error or foot clamp failure and drill string drops to waste surface, causes spark, and ignites vapor space	None required	AC 5.11, Flammable Gas Monitoring Controls	None required	None required	Controls based on existing BIO accident analysis and BIO Addendum 5 accident analysis (Flammable Gas Deflagrations)	E2	F3	S3
RMCS 11.3	Release of radioactive and/or toxic material due to dome fire	Hardware dropped into open riser causes a spark and ignition of dome gas	None required	AC 5.10, Ignition Controls AC 5.11, Flammable Gas Monitoring Controls	None required	None required	Controls are based on existing BIO accident analysis (Flammable Gas Deflagrations)	E2	F3	S3

Table B-1 Safety SSCs and TSRs for Potential S3 and S2 Consequences

Node	Hazardous Condition	Causes	Prev SSC	Prev TSR	Mit SSC	Mit TSR	Control Memo	Env Cons	Freq	Cons
RMCS 4.8	Release of radioactive and/or toxic material due to above ground fire	Reactive material dropped into open riser, chemical reaction generates flammable gas followed by ignition of above ground gas	None required	None required	None required	None required	Controls based on existing BIO accident analysis and BIO Addendum 5 accident analysis (Flammable Gas Deflagrations)	E2	F3	S3
RMCS 37.24	Release of radioactive and/or toxic material due to dome fire	Reactive material dropped into open riser, chemical reaction generates flammable gas followed by ignition of dome space gas	None required	None required	None required	None required	Controls based on existing BIO accident analysis and BIO Addendum 5 accident analysis (Flammable Gas Deflagrations)	E2	F3	S3
RMCS 4.7	Release of radioactive and/or toxic material due to dome fire	Hardware dropped into open riser causes spark and ignition of dome space gas	None required	AC 5.10, Ignition Controls AC 5.11, Flammable Gas Monitoring Controls	None required	None required	Controls are based on existing BIO accident analysis (Flammable Gas Deflagrations)	E2	F3	S3
Organic Solvent Fire										

Table B-1 Safety SSCs and TSRs for Potential S3 and S2 Consequences

Node	Hazardous Condition	Causes	Prev SSC	Prev TSR	Mit SSC	Mit TSR	Control Memo	Env Cons	Freq	Cons
RMCS New 2	Release of radioactive aerosols to atmosphere caused by organic solvent fire	Overheated drill bit ignites organic solvent fire	SS: Purge gas, downforce, rpm, and penetration rate instrumentation and shutdown interlock	LCO: RMCS Drill Engine Shutdown Systems	None required	None required	Control based on BIO Addendum 5 accident analysis (Organic Solvent Fire)	E2	F2	S2 S3?
In-Tank Fuel Fire/Deflagration										
RMCS 37.8	*Release of* radioactive and/or toxic material due to dome fire	*Vehicle* impacts riser, tears gas tank, leaks flaming fuel into tank and initiates waste fire	*None required*	AC 5.10, Ignition Controls	None required	AC 5.14, Emergency Preparedness	Controls are based on existing BIO accident analysis which bounds core sampling trucks (In-Tank Fuel Fire/Deflagration	E2	F2	S3 S2?
RMCS 2.7	Release of radioactive and/or toxic material due to dome fire and dome collapse	Truck driven off ramps into pit causing dome collapse followed by waste fire	None required	AC 5.10, Ignition Controls AC 5.16 Dome Loading: New limit on truck *height*	None required	AC 5.14, Emergency Preparedness	Controls are based on existing BIO accident analysis (In-Tank Fuel Fire/Deflagration) and BIO Addendum 5 accident analysis (Tank Failure Due to Excessive Loads)	E2	F2	S3
RMCS 2.3	Release of radioactive and/or toxic material due to dome fire	Dome fire from vehicle striking riser, vehicle gas tank breached, spark ignites fire	None required	AC 5.10, Ignition Controls	None required	AC 5.14, Emergency Preparedness	Controls are based on existing BIO accident analysis which bounds core sampling trucks (In-Tank Fuel Fire/Deflagration		F2	S3

Table B-1 Safety SSCs and TSRs for Potential S3 and S2 Consequences

Node	Hazardous Condition	Causes	Prev SSC	Prev TSR	Mit SSC	Mit TSR	Control Memo	Env Cons	Freq	Cons
RMCS External. 2	Release of radioactive and/or toxic material due to waste fire	Fuel spill near pump pit with drain open allows ignited fuel into tank causing waste fire	None required	AC 5.10, Ignition Controls	None required	AC 5.14, Emergency Preparedness	Controls are based on existing BIO accident analysis which bounds core sampling trucks (In-Tank Fuel Fire/Deflagration	E2	F2	S3
Organic Salt-Nitrate Reactions										
RMCS 15.1	Release of radioactive and/or toxic material due to waste fire	Bit overheats due to low purge gas flow	SC: Purge gas instrumentation and shutdown interlock	LCO: RMCS Drill Engine Shutdown Systems	None required	None required	Control based on BIO Addendum 5 accident analysis (Organic Salt-Nitrate Reactions)	E2	F2	S3 S2?
RMCS 37.16	Release of radioactive and/or toxic material due to dome collapse and waste fire	Drilling truck drives off ramps into open pit, initiates dome collapse followed by waste fire.	None required	AC 5.10, Ignition Controls AC 5.16 Dome Loading: New limit on truck height	None required	None required	Controls are based on existing BIO accident analysis (In-Tank Fuel Fire/Deflagration) and BIO Addendum 5 accident analysis (Tank Failure Due to Excessive Loads)	E2	F1	S3 S2?
RMCS 16.8	Release of radioactive and/or toxic material due to waste fire	Bit overheating due to improperly defined operating envelope	None required	General RMCS AC: Restricted tanks that cannot be sampled Verification of correct drill bit	None required	None required	Control based on BIO Addendum 5 accident analysis (Organic Salt-Nitrate Reactions)	E2	F2	S3

Table B-1 Safety SSCs and TSRs for Potential S3 and S2 Consequences

Node	Hazardous Condition	Causes	Prev SSC	Prev TSR	Mit SSC	Mit TSR	Control Memo	Env Cons	Freq	Cons
RMCS 16.6	Release of radioactive and/or toxic material due to waste fire	Excessive down force and *torque* combination overheats waste and initiates fire	SC: Purge gas, downforce, *rpm and* penetration rate instrumentation and shutdown interlock	LCO: RMCS Drill Engine Shutdown Systems	None required	None required	Control based on BIO Addendum 5 accident analysis (Organic Salt-Nitrate Reactions)	E2	F2	S3
RMCS 15.4b	Release of radioactive and/or toxic material due to waste fire	Vendor supplies flammable gas for purge gas supply	None required	None required	None required	None required	Procurement of nitrogen from commercial vendors provides a high degree of assurance that the correct gas is delivered because: 1) the government regulates the distribution of industrial gases; 2) the organization that governs the industry (the Compressed Gas Association) requires that each type of industrial gas have a unique mating connection and also requires the entire gas distribution network to use the same mating connections for a particular gas; 3) the industry does not provide adapters to connect different types of connectors. No controls required based on low accident frequency	E2	F2	S3

Table B-1 Safety SSCs and TSRs for Potential S3 and S2 Consequences

Node	Hazardous Condition	Causes	Prev SSC	Prev TSR	Mit SSC	Mit TSR	Control Memo	Env Cons	Freq	Cons
RMCS External. 5	Release of radioactive and/or toxic material due to waste fire	Wrong truck is used (e.g. push mode truck on a rotary mode operation) resulting in waste fire due to operating outside operational parameters	None required	None required	None required	None required	No controls necessary because locks on the drill rig clutch prevent rotation	E2	F2	S3
RMCS 16.9	Release of radioactive and/or toxic material due to waste fire	Overheating or spark due to high torque load on bit that breaks bit	SC: Purge gas, downforce, rpm and penetration rate instrumentation and shutdown interlock	LCO: RMCS Drill Engine Shutdown Systems	None required	None required	Control based on BIO Addendum 5 accident analysis (Organic Salt-Nitrate Reactions)	E2	F2	S3
RMCS 16.1	Release of radioactive and/or toxic material due to waste fire	High drill bit RPM causes high bit temp and initiates waste fire	SC: RPM instrumentation and shutdown interlock	LCO: RMCS Drill Engine Shutdown Systems	None required	None required	Control based on BIO Addendum 5 accident analysis (Organic Salt-Nitrate Reactions)	E2	F2	S3
RMCS 16.2	Release of radioactive and/or toxic material due to waste fire	Reverse bit rotation causes high bit temp and initiates waste fire	None required	None required	None required	None required	Controls not required. Engineering barrier (metal plate) physically prohibits use of reverse	E2	F2	S3

Table B-1 Safety SSCs and TSRs for Potential S3 and S2 Consequences

Node	Hazardous Condition	Causes	Prev SSC	Prev TSR	Mit SSC	Mit TSR	Control Memo	Env Cons	Freq	Cons
RMCS 16.4	Release of radioactive and/or toxic material due to waste fire	Wrong bit or no bit installed leads to high bit temp and initiates waste fire	None required	General RMCS AC: Verification of correct drill bit	None required	None required	Control based on BIO Addendum 5 accident analysis (Organic Salt-Nitrate Reactions)	E2	F2	S3
RMCS External. 4	Release of radioactive and/or toxic material due to waste fire	Drilling in wrong tank with non qualified equipment or high heat tank leading to waste fire	None required	General RMCS AC: Restricted tanks that cannot be sampled. (tanks with waste temperature > 90°C Verification of correct drill bit	None required	None required	Control based on BIO Addendum 5 accident analysis (Organic Salt-Nitrate Reactions)	E2	F2	S3
RMCS 16.10	Release of radioactive and/or toxic material due to waste fire	Bit overheating from using wrong bit	None required	General RMCS AC: Verification of correct drill bit	None required	None required	Control based on BIO Addendum 5 accident analysis (Organic Salt-Nitrate Reactions)	E2	F2	S3
RMCS 16.16	Release of radioactive and/or toxic material due to waste fire	Bit strikes item in waste and spark ignites gas phase in waste. Fire propagates to waste	None required	General RMCS AC: Verification of correct drill bit	None required	None required	Control based on BIO Addendum 5 accident analysis (Organic Salt-Nitrate Reactions, Flammable Gas Deflagrations)		F3	S3

Table B-1 Safety SSCs and TSRs for Potential S3 and S2 Consequences

Node	Hazardous Condition	Causes	Prev SSC	Prev TSR	Mit SSC	Mit TSR	Control Memo	Env Cons	Freq	Cons
RMCS 37.26	Release of radioactive and/or toxic material due to waste fire	Reactive material dropped into open riser, chemical reaction results in waste ignition	None required	AC 5.10, Ignition Controls	None required	None required	Controls based on existing BIO accident analysis and BIO Addendum 5 accident analysis (Organic Salt-Nitrate Reactions, Flammable Gas Deflagrations)	E2	F2	S3
RMCS 16.7	Release of radioactive and/or toxic material due to waste fire	Loss of purge gas flow causes bit to overheat and initiates waste fire	SC: Purge gas instrumentation and shutdown interlock	LCO: RMCS Drill Engine Shutdown Systems	None required	None required	Control based on BIO Addendum 5 accident analysis (Organic Salt-Nitrate Reactions)	E2	F2	S3
RMCS 5.1	Release of radioactive and/or toxic material due to waste fire	Frisbee seal damage combined with operator error causes drill string drop to strike waste surface, reaction results in waste burn	None required	AC 5.11, Flammable Gas Monitoring Controls	None required	None required	Controls based on existing BIO accident analysis and BIO Addendum 5 accident analysis (Flammable Gas Deflagrations)	E2	F2	S3
RMCS Mode Change. 1	Release of radioactive and/or toxic material due to waste fire	Wrong bit used going from push to rotary mode results in high temp and fire	None required	General RMCS AC: Verification of correct drill bit	None required	None required	Controls based on existing BIO accident analysis and BIO Addendum 5 accident analysis (Organic Salt-Nitrate Reactions)	E2	F2	S3

Table B-1 Safety SSCs and TSRs for Potential S3 and S2 Consequences

Node	Hazardous Condition	Causes	Prev SSC	Prev TSR	Mit SSC	Mit TSR	Control Memo	Env Cons	Freq	Cons
RMCS 11.6	Release of radioactive and/or toxic material due to waste fire	Reactive material dropped into open riser, chemical reaction results in waste ignition	None required	None required	None required	None required	Controls based on existing BIO accident analysis and BIO *Addendum 5* accident analysis (Organic Salt-Nitrate Reactions, Flammable Gas Deflagrations)	E2	F2	S3
RMCS 4.6	Release of radioactive and/or toxic material due to waste fire	Reactive material dropped into open riser, chemical reaction results in waste ignition	None required	None required	None required	None required	Controls based on existing BIO accident analysis and BIO Addendum 5 accident analysis (Organic Salt-Nitrate Reactions, Flammable Gas Deflagrations)	E2	F2	S3
RMCS 15.3	Release of radioactive and/or toxic material due to waste fire	High purge gas temperature due to failed heater controller	None required	None required	None required	None required	No controls necessary based on low accident frequency	E2	F2	S3
RMCH 15.4	Release of radioactive and/or toxic material due to waste fire	Purge gas heater fails and allows propane into drill string	None required	None required	None required	None required	No controls necessary based on low accident frequency	E2	F2	S3

[redacted]

Node	Hazardous Condition	Causes	Prev SSC	Prev TSR	Mit SSC	Mit TSR	Control Memo	Env Cons	Freq	Cons
Safety SSCs and TSRs for Accidents with only Environmental Consequences										
RMCS 6.3	Release of *radioactive* and/or toxic material to environment due to subterranean spill	Tank bottom *breach* due to uncertainties in tank depth measurement or addition of too many dirll sections	SC: Downforce instrumentation and shutdown interlock	LCO: RMCS Drill Engine Shutdown Systems	None Required	None Required	SC and LCO are applicable to RMCS only Environmental controls are use of the Hydraulic Bottom Detector for the last sample (RMCS and PMCS) and limiting the down force for PMCS such that it will not exceed 5300 pounds	E3		
RMCS 30.3	Release of radioactive and/or toxic materials to environment due to drilling through bottom of tank	Drill bit engages tank floor and drills through	SC: Downforce intrumentation and shutdown intelock	LCO: RMCS Drill Engine Shutdown Systems	None Required	None Required	SC and LCO are applicable to RMCS only Environmental controls are use of the Hydraulic Bottom Detector for the last sample (RMCS and PMCS) and limiting the down force for PMCS such that it will not exceed 5300 pounds	E3		
RMCS 30.5	Release of radioactive and/or toxic materials to environment due to high down force that punctures bottom of tank	Hydraulic down force pushes bit through steel liner	SC: Downforce instrumentation and shutdown interlock	LCO: RMCS Drill Engine Shutdown Systems	None Required	None Required	SC and LCO are applicable to RMCS only Environmental controls are use of the Hydraulic Bottom Detector for the last sample (RMCS and PMCS) and limiting the down force for PMCS such that it will not exceed 5300 pounds	E3		

APPENDIX E

ENVIRONMENTAL AND DEFENSE-IN-DEPTH CONTROLS HANDOUT

This page intentionally left blank.

APPENDIX E

ENVIRONMENTAL AND DEFENSE-IN-DEPTH CONTROLS HANDOUT

HNF-SD-WM-BIO-001 REV 0
ADDENDUM 5

Table 3-4 Environmental Controls.

RMCS operations controls	Hydraulic bottom detector shall be operable and activated for the last sample
PMCS operations controls	Hydraulic bottom detector shall be operable and activated for the last sample[a]
	Core sampling trucks shall not be modified to more pressure than 250 lb/in^2 or more downward force than 5,300 lbf[a]

[a]Defined in Wagoner 1997b.

Table 3.4.2.2-5. RMCS Defense-in-Depth Controls for HEPA Failure Accidents

Control	Function	Comments
HEPA filter loading - filters are replaced at loading of approximately 1 mSv/h (100 mrem/h)	Limit inventory available for release and limit dose rate to workers in the vicinity of the filters	None
Shutdown of exhauster with > 5.9 inches of water differential pressure across HEPA filter	Automatic shutdown of exhauster prevents excessive loading on HEPA filters	Exhauster will shut down and send signal to shutdown interlock to shut down drill rig
Aerosol testing of filters whenever exhauster is moved to new tank or riser	Ensures filtering efficiency of HEPA filter	Workers trained in testing the filters
Fire protection program	Fire prevention	Program contains a number of provisions that would prevent fires from causes other than ruptured fuel tanks
Vehicle positioning spotters	Spotters provide additional level of control in positioning cranes/vehicles	Reduces probability of analyzed accident
Tank Farm fences	Provide line of demarcation within which Ignition Control Program key elements related to vehicle fuel systems must be met	Fence gates are typically closed and locked
Vegetation control program	Prevent range fires from impacting Tank Farm facilities	None

Table 3.4.2.13-3 Defense-in-Depth Controls Related to Tank Failure Accidents for RMCS Operations

Control	Function	Comments
Exhauster induced tank pressure shutdown interlock is operable	Provides automatic shutdown to maintain tank pressure less than atmospheric pressure and greater than or equal to a -3 inches of water	Exhauster design limits vacuum to -14 inches of water. Drill rig engine and exhauster shut down on low tank pressure
Shutdown exhauster after 5 minutes with flow ≥250 scfm	Prevents excess vacuum in the dome	Only flow > 100 scfm is required to compensate for nitrogen purge flow
Shutdown exhauster when flow ≤150 scfm	Prevents potential for tank overpressurization caused by purge gas	Maximum nitrogen purge flow is 100 scfm
Exhauster shutdown indication system elements shall be calibrated every 6 months	Ensures accuracy of exhauster-induced shutdown signals to drill rig engine	Includes exhauster-induced shutdown signals on tank pressure and exhauster flow
Truck ramp and jacks	Requires safe use of the ramp supporting the sampling truck, including use of stops at end of ramp, and the truck's hydraulic jacks	None
Terminate sampling 3 inches from tank bottom (applicable to both RMCS and PMCS)	Prevents inadvertent drilling or pushing into the tank bottom	Drill string length is calculated such that sampling is terminated 3 inches from tank bottom

Note that these are the Defense-in-Depth controls that are unique to RMCS/PMCS activities. Other Defense-in-Depth controls described in BIO Table 5.3.2.13-3, "Defense-in-Depth Controls for Load Drops," are also applicable to RMCS/PMCS operations.

Table 3.4.2.14-2 RMCS Defense-in-Depth Controls for Flammable Gas Deflagrations

Control	Function	Comments
Exhauster operation one hour before and during RMCS operations in passively ventilated SSTs. (RMCS portable exhauster is not required when sampling actively ventilated SSTs)	Disperses and reduces any flammable gas concentrations prior to commencing RMCS operations and minimizes accumulation of aerosols, particulates, and flammable gases during RMCS operations	Flammable gas concentrations in the tank vapor head space are verified to be less than 25% of the LFL prior to commencing exhauster operation per AC 5.11. Exhauster automatic interlock will shutdown drill rig engine on positive tank pressure
Exhauster shutdown indication system elements shall be calibrated every 6 months	Ensures accuracy of exhauster-induced shutdown signals to drill rig engine	Includes high tank pressure shutdown, which occurs when negative tank pressure is not being maintained
Drill string restraint	Drill string shall be positively restrained to prevent dropping and the potential for sparking	Drill string is restrained by two independent mechanisms any time it is not connected to the quill rod, shielded receiver, or held by a crane
The hydrostatic head instrumentation systems for the drill string and shielded receiver shall be operating while the shielded receiver is attached	Prevents inadvertent waste and flammable gas accumulation in the drill string during retrieval of core samplers	None
The drill string shall be purged when the grapple is in motion	Prevents waste penetration and associated hydrogen generation in the drill string	None

Table 3.4.2.14-2 RMCS Defense-in-Depth Controls for Flammable Gas Deflagrations

Control	Function	Comments
Hydrostatic head systems for the drill string and shielded receiver shall be tested for leakage every 6 months	Provide detection of leaks that might occur in a location downstream of the flow measurement point.	Leaks from hydrostatic head systems are verified to be within the uncertainty range of the instrumentation or less than 2% of the required flow
Drill string shall only be removed above waste surface with the last sampler, a dummy sampler or other core barrel gas seal in place	Minimizes potential for flammable gas release from drill string during removal	None
Frisbee/drill string interface shall be lubricated with waste compatible lubricant before drill string insertion	Reduces possibility of seal damage, thereby reducing potential for gas/particulate release	None

Note that these are the Defense-in-Depth controls that are unique to RMCS activities.

Table 3.4.2.15-4 RMCS Defense-in-Depth Controls for Organic Solvent Fires

Control	Function	Comments
Walkdown function shall be operable and used for all samples except the last	Provide a means to independently monitor and control the downward force of the drill string for all samples except the last	Allows limit on downward force to be set (must be less than 750 lbf). When limit is reached hydraulic solenoid valve stops flow of fluid into drill head rams, thereby stopping drill bit penetration
Hydraulic bottom detector shall be used for the last sample	Provide a means to independently monitor and control the downward force of the drill string for the last sample	Used on last sample only. When preset limit on downward force is reached, hydraulic solenoid valve reverses flow of fluid into drill head rams,thereby reversing direction of the drill head

Note that these are the Defense-in-Depth controls that are unique to RMCS activities. Other Defense-in-Depth controls described in BIO Table 5.3.2.15-6 are also applicable to RMCS operations.

Table 3.4.2.17-4 RMCS Defense-in-Depth Controls for Organic Salt-Nitrate Reactions

Control	Function	Comments
Walkdown function shall be operable and used for all samples except the last.	Provide a means to independently monitor and control the downward force of the drill string for all samples except the last.	Allows limit on downward force to be set (must be less than 750 lbf). When limit is reached hydraulic solenoid valve stops flow of fluid into drill head rams, thereby stopping drill bit penetration.
Hydraulic bottom detector shall be used for the last sample	Provide a means to independently monitor and control the downward force of the drill string for the last sample.	Used on last sample only. When preset limit on downward force is reached, hydraulic solenoid valve reverses flow of fluid into drill head rams,thereby reversing direction of the drill head.

Note that these are the Defense-in-Depth controls that are unique to RMCS activities. Other Defense-in-Depth controls described in BIO Table 5.3.2.17-6 are also applicable to RMCS operations.

This page intentionally left blank.

DISTRIBUTION

Onsite

1	U.S. Department of Energy Richland Operations Office	
	DOE Public Reading Room	H2-53
1	Pacific Northwest National Laboratory	
	Hanford Technical Library	P8-55
2	Lockheed Martin Services, Inc.	
	Central Files	B1-07
	Document Processing Center	A3-94

This page intentionally left blank.