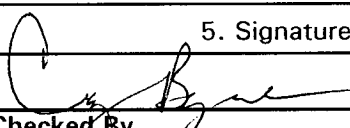
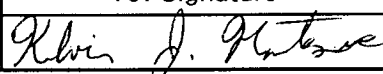
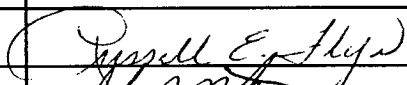
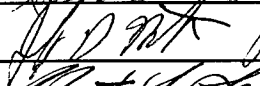

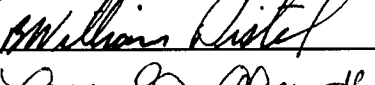
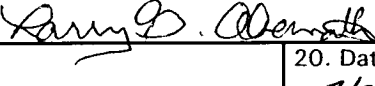
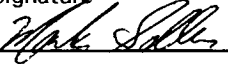


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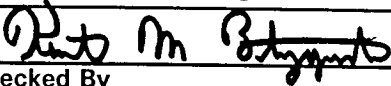
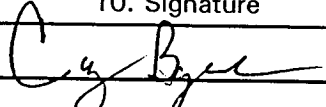
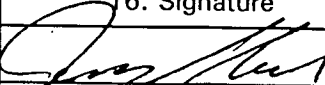
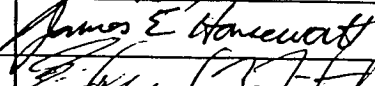
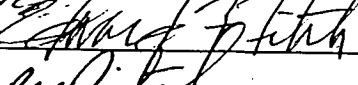
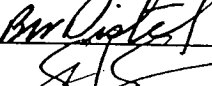
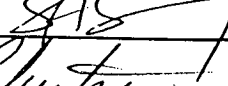
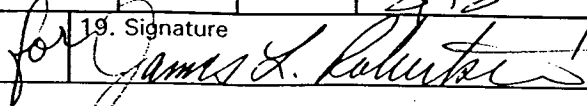
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1. DIE Title Determination of Importance Evaluation for the Surface Exploratory Studies Facility					Document Control Use Only	
2. Document Identifier (DI) Number (include revision number) BAB000000-01717-2200-00106 REV 03/ICN 02						
3. Description of Interim Change (include list of pages involved in this ICN) <p>Added three sentences to Section 10.6 discussing the limited use of hypochlorite bleach for sanitation purposes on the North Portal Pad (NPP). Clarified Section 13.2.1.1 to state "Drainage away from SBT boreholes located on the NPP takes precedence over the 2 percent pad slope requirement within 30 ft. of a borehole, unless adequate protection from surface water infiltration is provided." Updated reference section titles and references to current style guide. Replaced procedure YAP-2.8Q with AP-2.17Q, replaced CRWMS M&O 1998K (letter) with YMP 1999a (Field Work Package), and replaced DOE 1996a (Reference Information Base) with Flint 1998. Added two acronyms to Attachment I (List of Acronyms). Updated Attachment II (TFM List) to reflect current format, new materials, and consistency with other existing DIEs. Updated Attachment V to reflect the most current porosity and saturation values for the Calico Hills rock layer. Note: Format changes are not identified with sidebars.</p> <p>Affected pages: 6, 8, 9, 16, 17, 18, 19, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 39, 40, 41, 42, 43, 44, 47, 48, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 72, 74, 76, 77, 78, 79, 80, 81, 82, 83, I-2, I-4, I-5, Attachment II (entire attachments), III-2, III-4, III-5, IV-2, Attachment V, VII, VIII, and X (entire attachments).</p>						
Prepared By						
4. Print Name Casey J. Byrne		5. Signature 			6. Date 07/25/2000	
Checked By						
7. Print Name Kelvin J. Montague		8. NC	9. CR X	10. Signature 		11. Date 7/25/2000
Reviewed By						
12. Organization	13. Print Name	14. NC	15. CR	16. Signature	17. Date	
TFD Surface Design	RUSSELL E. FLYE	X			7-25-00	
Natural Barriers	Jeff Matties	X			7-25-00	
Site Facilities Office	ROBERT E. LAW		—		7/25/00	
TCO	BWilliam Distel	✓			7/25/00	
OQA	Larry G. Abernethy		✓		7/25/00	
18. Manager's Name Mark D. Sellers		19. Signature 			20. Date 7/25/00	
21. Remarks This Interim Change Notice (ICN) updates and clarifies Determination of Importance Evaluation (DIE) BAB000000-01717-2200-00106 REV 03/ICN 01, which addresses field activities associated with the Surface Exploratory Studies Facility (ESF). This ICN, previous ICNs, and the DIE noted above are required to be used as input in field work package, design drawing, and design specification documents that implement Surface ESF activities addressed herein. This ICN is distributed as a controlled document in accordance with procedure AP-6.1Q.						

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1. DIE Title Determination of Importance Evaluation for the Surface Exploratory Studies Facility				Document Control Use Only	
2. Document Identifier (DI) Number (include revision number) BAB000000-01717-2200-00106 REV 03/ICN 01					
3. Description of Interim Change (include list of pages involved in this ICN) Clarified section 13.2.1.1 and Requirement 1 to note that visual observations of pads were an acceptable method to ensure that pad slopes are maintained after initial pad construction or modifications to the a pad for buildings and other facilities (e.g., Surface-Based Testing boreholes). Affected pages: 59 and 72.					
Prepared By					
4. Print Name Kent M. Fitzgerald		5. Signature 			6. Date 8/18/99
Checked By					
7. Print Name Casey J. Byrne		8. NC <input checked="" type="checkbox"/>	9. CR <input type="checkbox"/>	10. Signature 	11. Date 8/20/99
Reviewed By					
12. Organization	13. Print Name	14. NC	15. CR	16. Signature	17. Date
TFD Surface Design	James S. Leak	<input checked="" type="checkbox"/>	<input type="checkbox"/>		8/19/99
Natural Barriers	James Housworth	<input checked="" type="checkbox"/>	<input type="checkbox"/>		8/19/99
Site Facilities Office	Edward F. Fitch	<input checked="" type="checkbox"/>	<input type="checkbox"/>		8/19/99
TCO	BWilliam Distel	<input checked="" type="checkbox"/>	<input type="checkbox"/>		8/19/99
OQA	Steve SWENNING	<input checked="" type="checkbox"/>	<input type="checkbox"/>		8/20/99
18. SA Manager's Name Dealis W. Gwyn		19. Signature 			20. Date 8/23/99
21. Remarks This Interim Change Notice (ICN) updates and clarifies Determination of Importance Evaluation (DIE) BAB000000-01717-2200-00106 REV 03, which addresses field activities associated with the Surface Exploratory Studies Facility (ESF). This ICN and the DIE noted above are required to be used as input in field work package, design drawing, and design specification documents that implement Surface ESF activities addressed herein. This ICN is distributed as a controlled document in accordance with procedure AP-6.1Q.					

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1. DIE Title Determination of Importance Evaluation for the Surface Exploratory Studies Facility	
2. Document Identifier (DI) Number (include revision number) BAB000000-01717-2200-00106 Rev 03	3. DIE Category (Check one) <input type="checkbox"/> I <input type="checkbox"/> II <input checked="" type="checkbox"/> III

Signatures on this document represents signers' acknowledgement that the applicable procedure has been read, understood and complied with.

Prepared By					
4. Sections	5. Print Name	6. Signature	7. Date		
8.1 and 10	William B. Distel	<i>W B Distel</i>	3/18/99		
8.2, 9, 11, Atts III - X	James E. Houseworth	<i>James E Houseworth</i>	3/18/99		
Remaining Sects & Atts	Daniel M. Jenkins	<i>DM Jenkins</i>	03.18.99		
Checked By					
8. Sections	9. Print Name	10. NC	11. CR	12. Signature	13. Date
8.1 and 10	Alan J. Mitchell	X		<i>Alan J Mitchell</i>	3/18/99
8.2, 9, 11, Att III - X	Yanyong Xiang		X	<i>Y Xiang</i>	3/18/99
Remaining Sects & Atts	Kent M. Fitzgerald		X	<i>Kent M Fitzgerald</i>	3/19/99
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OQA	Stephen F. Schuermann	X	X	<i>Steve Schuermann</i>	3/19/99
Document Control	Justin Grantham		X	<i>Justin Grantham</i>	3/19/99
20. SA Manager's Name 21. Signature 22. Date					
Dealis W. Gwyn		<i>Dealis W Gwyn</i>		03/19/99	
23. Remarks Revision 03 of this Category III Determination of Importance Evaluation (DIE) evaluates activities associated with the Surface Exploratory Studies Facility. This DIE establishes Quality Assurance (QA) controls to prevent or minimize, to the extent practical, the potential impact of the activities, described herein, on site characterization data, the waste isolation capabilities of a potential repository and the Yucca Mountain site, and/or other Q-List items that have been constructed or installed at the Yucca Mountain site. This DIE is required to be used as input in the field work package, design drawing, and design specification documents that implement the activities evaluated herein.					
This DIE is distributed as a controlled document in accordance with procedure AP-6.1Q.					

Determination of Importance Evaluation Revision Record

DIE Title Determination of Importance Evaluation for the Surface Exploratory Studies Facility		
DI Number (include revision number) BAB000000-01717-2200-00106 Rev 03		
Rev No.	Date	Description of Revision
00	03/14/96	Original Issue.
01	05/17/96	Revised Sections 6, 11, 13, and Attachment VIII of the analysis to include specific blasting activities required for application of pre-shearing blasting techniques for excavation of the boxcut/headwall of the South Portal and Pad. Added descriptions (Sections 1 and 6) and evaluations (Sections 10, 11, 13, and Attachment XIII) for environmental reclamation, meteorological monitoring, and radiological monitoring activities. Added descriptions of (Sections 1 and 6), reviewed, and evaluated, as appropriate, (Sections 10, 11, and 13) the site grounding and lightning protection systems for the South Portal and Pad. Changed verbiage from inspections to checks/surveillances throughout the document. Revised QA Requirements 5, 7, 10, and 11 to reflect revisions to the evaluation. Updated and added references to support analysis. Changed Exploratory Studies Facility Design Requirements Document (ESFDR) cites to reflect Revision 2 of the ESFDR. Identified additional Test Interference Evaluation (TIE) and Waste Isolation Evaluation (WIE) documents superseded by this revision. Made minor editorial revisions throughout the document.
02	02/14/97	Revised the evaluation of reclamation materials to consider biodegradability. Prohibited use of the dust suppression compound DUSTAC®. Deleted Attachments IX and X, which were associated with DUSTAC®, and renumbered Attachments XI, XII, and XIII as Attachments IX, X, and XI, respectively. Changed text throughout to eliminate the words that a precise definition within the argot of the QA program (e.g., "surveillance," "inspection," "monitoring"). Updated references as appropriate. Made various minor editorial, grammatical, and/or typographical changes throughout.
03	03/19/99	Incorporated a standardized format for the entire DIE, including major philosophical changes in DIE reference list (Section 14) format and individual reference citation format throughout, to satisfy Ensure Defensible Documents initiative requirements. Incorporated and superseded Interim Change Notice (ICN) 01 to Revision 02 (which added the scope of six geodetic monitoring sites to Sections 6, 8, and 11 and added Sikacrete 212 Premix to the Attachment II approved tracers, fluids, and materials [TFM] list). Added potential power lines for surface-based testing (SBT) sites (Sections 6, 10, 11, and 13), an Exploratory Studies Facility (ESF) Heliport Site (Sections 6, 10, 11, and 13), a TFM description section (Section 6.3), and various approved TFMs (Attachment II) to the scope of this DIE. Moved the description of the Muck Storage Area (previous Section 6.2.9) to the North Portal Pad (NPP) description (Section 6.2.2). Eliminated the scope of the South Portal design borehole, General Support Facilities Complex, and the designed ESF Shop Building throughout. Extensively revised the evaluations and requirements applicable to surface ESF water use, which resulted in deleting Attachment IX and renumbering Attachments X and XI as Attachments IX and X, respectively. Modified evaluation (Section 13 and Attachment II) to exempt biodegradable TFMs used in surface ESF applications from TFM recording and reporting requirements. Added an evaluation of the use of surface ESF telephone lines for data transfer (Sections 10 and 13). Added a comprehensive list of ESFDR citations considered in the context of this DIE to Section 13.1. Updated DIE references and incorporated up-to-date information, as appropriate, throughout. Officially superseded DIE BABBDC000-01717-2200-00029 REV 00, WIE BABBDB000-01717-2200-00099 REV 00, and WIE Letter LV.PA.JEH.6/93-068. Reformatted Attachment II to ensure consistent format with other Category III DIEs. Incorporated various editorial changes throughout. Change bars were not used because changes were too extensive.

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1. PURPOSE

This DIE applies to the surface facilities component of the Yucca Mountain Site Characterization Project (YMP) ESF. The ESF complex—including surface and subsurface accommodations—encompasses an area that is approximately six miles wide and nine miles long (approximately 30,000 acres total) (United States Department of Energy [DOE] 1997, p. 9.04). It is located on federally withdrawn lands, near the southwest border of the Nevada Test Site (NTS) in southern Nevada (DOE 1997, p. 9.04). Site characterization activities are conducted within the subsurface ESF to obtain the information necessary to determine whether the Yucca Mountain Site is suitable as a geologic repository for spent nuclear fuel and high-level radioactive waste. Most ESF surface facilities are located within the Conceptual Controlled Area Boundary (CCAB) (DOE 1997, p. 9.04), with the exception of the southeastern most portions of the H-Road and the Water Supply System. Various SBT activities are also conducted throughout the Yucca Mountain region as a part of the overall site-characterization effort. In general, the DIE for SBT Activities (Civilian Radioactive Waste Management System [CRWMS] Management and Operating Contractor [M&O] 1998a) evaluates activities associated with SBT. Potential test-to-test interference and waste isolation impacts associated with SBT activities are also evaluated in CRWMS M&O (1998a).

The original issue (Revision 00) of this evaluation combined and superseded DIEs, TIEs, WIEs, and Raytheon Services Nevada (RSN) Classification Analyses previously prepared to evaluate various surface ESF activities (Table 1-1). The Revision 00 evaluation included activities associated with the use of temporary items in support of surface ESF accommodations. Revision 01 incorporated descriptions and evaluations for a revised general surface blasting analysis, a site-specific blasting calculation for a pre-splitting blasting technique (which was required for excavation of the boxcut/headwall of the South Portal and Pad), site grounding and lightning protection systems for the South Portal and Pad, and environmental monitoring and reclamation activities. Revision 02 modified the evaluation of reclamation materials to consider biodegradability; prohibited the use of the dust suppression compound, DUSTAC[®], within the CCAB pending additional evaluation (which was required due to a change in the chemical composition of DUSTAC[®]); deleted two attachments associated with DUSTAC[®] (i.e., Attachments IX and X), and renumbered Attachments XI, XII, and XIII as Attachments IX, X, and XI, respectively; changed the text as appropriate to eliminate certain words having precise definitions within the argot of the QA Program (e.g., “surveillance,” “inspection,” “monitoring”); updated references as appropriate; and made various minor editorial, grammatical, and/or typographical changes throughout.

Revision 03 of this DIE incorporated extensive changes. Most of the changes in Revision 03 were driven by the CRWMS M&O Ensure Defensible Documents initiative and the (NLP-2-0) requirement to update DIEs with the most up-to-date information. With respect to the Ensure Defensible Documents initiative, a new standardized-document format was incorporated, which is consistent with other CRWMS M&O documents. The reformatting effort included major philosophical changes in the previous DIE reference list format (Section 14) and in reference-citation formats used throughout the text. Most of the references cited in Section 14 had been revised since Revision 02 of this DIE was approved, which resulted in extensive

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changes to the Section 14 list. A substantial amount of up-to-date information from the new/revised references was also integrated into the text throughout.

Revision 03 also incorporated a number of other changes. The evaluation was updated to eliminate the scope of temporary items and activities that have not been and are not expected to be constructed/initiated—including the South Portal design borehole, General Support Facilities Complex, and the designed ESF shop building. Revision 03 also incorporated and superseded ICN 01 to Revision 02 of this DIE (which added six geodetic monitoring sites to the evaluation scope of Configuration Item Identifier [CII] BABC00000 [Auxiliary Sites] and added Sikacrete 212 Premix to the Attachment II approved TFM list). Activity descriptions and evaluations, as appropriate, were also added to the evaluation scope by Revision 03. Scope additions included a potential, dedicated-power line for several SBT sites, an ESF Heliport Site, a TFM description section (Section 6.3), and various approved TFMs, which were incorporated into Attachment II. The activity description for the Muck Storage Area CII (previous Section 6.2.9) was integrated into Section 6.2.2. Revision 03 extensively modified the evaluation and requirements applicable to surface ESF water use based on recent performance assessment analyses and as-constructed information for various surface ESF systems. The revised water use evaluation also deleted Attachment IX and required Attachments X and XI to be renumbered as Attachments IX and X, respectively. Revision 03 specifically exempted biodegradable TFMs used in support of surface ESF activities/accommodations from the recording and reporting requirements of the YMP TFM procedure (AP-2.17Q). The Category II DIE for Disposal of Super-Chlorinated Water (BABBD000-01717-2200-00029 Rev 00), WIE Tracers, Fluids, and Materials Usage for Construction of the Waterline for the North Ramp (BABBD000-01717-2200-00099 Rev 00), and WIE Letter Exploratory Studies Facility Concrete Batch Plant (LV.PA.JEH.6/93-068) were added to Table 1-1 and were superseded by Revision 03.¹ A comprehensive list of ESFDR (YMP 1997a) citations considered herein were added to Section 13.1. Attachment II was completely reformatted to ensure consistency with other Category III DIEs. Various editorial changes/corrections were also made throughout the document, as appropriate.

Construction and/or use of ESF items evaluated herein include: ESF Starter Tunnel Steel Arch Section; NPP (including pad Extension and Optional Muck Storage Areas); South Portal Pad (SPP) (including boxcut/headwall, site grounding system and lightning protection); Compressed Air System; Surface and Standby Power Systems (including additional auxiliary generators/support equipment); Surface Wastewater System; Surface Sanitation System; Water Supply and Distribution Systems; Switchgear Building; Change House; Stormwater Drainage System; Rock and Topsoil Storage Areas; Surface Conveyor System; Surface Communication; Subdock Storage and Lay Down Areas; ESF Weather and other Monitoring Stations; Fran Ridge Borrow Pit No. 1; Access Roads, including H-Road; and various constructor-supplied accommodations. Detailed descriptions of these ESF activities are provided in Section 6.

¹ The technical content of the Category II DIE for Disposal of Super-Chlorinated Water was incorporated into Revision 02 of this DIE. However, the DIE was inadvertently omitted from Table 1-1 and was not officially superseded by Revision 02. Therefore, Revision 03 of this DIE officially supersedes DIE BABBD000-01717-2200-00029 Rev 00.

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The objectives of this DIE are to determine whether activities (as associated with the location, construction, operation [use], maintenance, and reclamation of surface ESF accommodations) could potentially impact:

1. YMP testing, or
2. waste isolation capabilities of a repository at the Yucca Mountain site.

Any controls necessary to limit such potential impacts are identified herein. To the extent that activities evaluated by this DIE are conducted in support of ESF or SBT site characterization testing activities, the assigned Principle Investigator(s) (PIs) are responsible for the validity and veracity of individual tests, including data collection. These test-specific considerations are addressed in the supporting evaluation(s) for the applicable Field Work Package(s) (FWPs).

The conclusions and requirements of this DIE are determined to conservatively bound the conclusion and requirements of previously approved evaluations (i.e., DIEs, TIEs, WIEs, and RSN Classification Analyses) for the surface ESF activities evaluated herein. This determination is based on conservative engineering judgement and on concurrence with this DIE by the originating organizations of the previously approved surface ESF evaluations. Hence, this DIE superseded the DIEs, WIEs, TIEs, and RSN Classification Analyses listed in Table 1-1.

Table 1-1. Superseded DIEs, WIEs, TIEs, and RSN Classification Analyses

Type of Document	Title	Document Identifier	Date
DIE	DIE for ESF Stormwater System	B00000000-AA-09-00002 Rev 03	07/13/93
DIE	DIE for ESF Starter Tunnel Steel Arch Section	B00000000-AA-09-00003 Rev 02	03/22/93
DIE	DIE for ESF Rock Storage Area	B00000000-AA-09-00004 Rev 01	03/22/93
DIE	DIE for ESF Switchgear Building/Temporary Office Facility	B00000000-AA-09-00006 Rev 00	06/14/93
DIE	DIE for ESF Muck Storage Area and Conveyor/Muck Storage Area Access Road	BAB000000-01717-2200-00010 Rev 01	12/07/94
DIE	DIE for ESF H-Road Improvements - Widening, Grading, and Paving	BABA00000-01717-2200-00017 Rev 00	12/21/93
DIE	DIE for ESF North Portal Pad	BABB00000-01717-2200-00001 Rev 05	12/05/94
DIE	DIE for ESF Auxiliary Generators and Associated Support Systems/Facilities	BABB00000-01717-2200-00003 Rev 00	04/25/95
DIE	DIE for ESF Booster Pump Power Supply Line	BABB00000-01717-2200-00004 Rev 00	04/28/95
DIE	DIE for Application of Subsurface Wastewater to the North Portal Pad and Extension	BABB00000-01717-2200-00005 Rev 00	05/16/95
DIE	ESF Subsurface Lightning Protection Pole Installation	BABB00000-01717-2200-00006 Rev 00	06/02/95

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Table 1-1. Superseded DIES, WIEs, TIEs, and RSN Classification Analyses (Continued)

Type of Document	Title	Document Identifier	Date
DIE	DIE for the Optional Muck Storage Area and North Portal Pad North Parking Lot	BABB00000-01717-2200-00007 Rev 00	09/08/95
DIE	DIE for the North Portal Pad TFM Exemptions	BABB00000-01717-2200-00008 Rev 00	09/22/95
DIE	DIE for ESF Change House Facility and Shop Building	BABBA0000-01717-2200-00007 Rev 00	12/21/93
DIE	DIE for ESF Subsurface Wastewater (Surface Portion) and Sanitary Sewer Collection & Treatment Systems	BABBD0000-01717-2200-00009 Rev 02	03/03/95
DIE	DIE for ESF Surface Compressed Air System	BABBD0000-01717-2200-00022 Rev 01	08/31/95
DIE	DIE for ESF Water Distribution System	BABBD0000-01717-2200-00001 Rev 00	09/30/93
DIE	DIE for Disposal of Super-Chlorinated Water	BABBD0000-01717-2200-00029 Rev 00	10/31/95
DIE	DIE for the Surface Communication System	BABBD0000-01717-2200-00001 Rev 00	07/14/95
DIE	DIE for ESF Water Supply System	BABCD0000-01717-2200-00001 Rev 00	09/17/93
DIE	DIE for the Topsoil Storage Area	BABCE0000-01717-2200-00001 Rev 01	01/31/96
DIE	DIE for the Conveyor System	BABFC0000-01717-2200-00001 Rev 00	07/14/95
RSN Classification Analysis	Access Roads	RSN # CA-ESF-1A-007 Rev 01	11/10/92
RSN Classification Analysis	Topsoil Storage Area	RSN # CA-ESF-1A-008 Rev 02	12/09/92
TIE	Test Interference Evaluation for the North Portal Sewer System ESF Construction Support	B00000000-01717-2200-00034 Rev 00	08/19/93
TIE	Test Interference Evaluation for the Proposed North Portal Sanitary Sewer System, Treatment System and Leach Field at the Exploratory Studies Facility	B00000000-01717-2200-00034 Rev 01	02/08/95
TIE	Test Interference Evaluation for Proposed North Portal Sanitary Sewer System, Treatment System and Leach Field at the Exploratory Studies Facility	B00000000-01717-2200-00034 Rev 02	03/02/95
TIE	Evaluation of Potential Impacts of Global Usage of Dust Suppression Fluids on Site Characterization as Requested by H. Kalia 3/23/93 (Letter)	B00000000-01717-2200-00054 Rev 00	08/11/93
TIE	Test Interference Evaluation for the Widening, Grading, and Paving of the ESF H-Road and the Grading and Paving of the North Portal Pad	B00000000-01717-2200-00057 Rev 00	08/27/93

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Table 1-1. Superseded DIES, WIEs, TIEs, and RSN Classification Analyses (Continued)

Type of Document	Title	Document Identifier	Date
TIE	Test Interference Evaluation for the Widening, Grading, and Paving of the Exploratory Studies Facility (ESF) H-Road and the Grading and Paving of the North Portal Pad	B00000000-01717-2200-00057 Rev 01	10/28/93
TIE	Test Interference Evaluation for Proposed Water Supply and Distribution System for the North Portal Pad	B00000000-01717-2200-00058 Rev 02 (including letter LV.SC.STN.9/93-240)	09/03/93
TIE	Test Interference Evaluation Specific to the Planned Construction of the Subsurface Wastewater Pond for the Exploratory Studies Facility	BAB000000-01717-2200-00081 Rev 00	10/07/93
TIE	Test Interference Evaluation for the Planned Construction of the Subsurface Wastewater Pond (WWP) for the Exploratory Studies Facility (ESF)	BAB000000-01717-2200-00081 Rev 01	03/02/95
TIE	Test Interference Evaluation for the North Portal Exploratory Studies Facility Compressed Air System	BAB000000-01717-2200-00082 Rev 01	10/28/93
TIE	Test Interference Evaluation for North Portal Exploratory Studies Facility Compressed Air System, M&O Design Package 1C	BAB000000-01717-2200-00082 Rev 02	03/18/94
TIE	Test Interference Evaluation for Construction and Operation of the Shop Building and Change House Facility at the North Portal	BAB000000-01717-2200-00086 Rev 00	11/09/93
TIE	Test Interference Evaluation for the Procurement of Materials for the Surface and Subsurface Conveyor Belt System	BAB000000-01717-2200-00090 Rev 00	11/11/93
TIE	Test Interference Evaluation for the North Portal ESF Standby Generators System, Design Package 1C	BABBDA000-01717-2200-00001 Rev 00 (including summary)	03/11/94
TIE	Test Interference Evaluation for North Portal Temporary 69 kV Power Supply System, Site Grounding System, and Lightning Protection System	BABBDA000-01717-2200-00087 Rev 01	10/27/93
TIE	Test Interference Evaluation for Exploratory Studies Facility Muck Storage Area, Design Package 1D	BABCC0000-01717-2200-00002 Rev 00	09/07/94
TIE	Test Interference Evaluation for Exploratory Studies Facility Muck Storage Area, Design Package 1D	BABCC0000-01717-2200-00002 Rev 01	09/30/94
TIE	Test Interference Evaluation Specific to the Planned Construction and Operation of the Explosive Storage Area (ESA), ESF Design Package 1B	BABCG0000-01717-2200-00085 Rev 00	10/21/93

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Table 1-1. Superseded DIES, WIEs, TIEs, and RSN Classification Analyses (Continued)

Type of Document	Title	Document Identifier	Date
TIE	Test Interference Evaluation Specific to the Planned Construction and Operation of the Explosive Storage Area (ESA), ESF Design Package 1B	BABCG0000-01717-2200-00085 Rev 01	11/04/93
TIE	Test Interference Evaluation for Extension of the North Portal Pad, Standby Generator Fuel Storage System, Equipment Pads and Foundations, Additional Site Lighting, Fencing, & Oil/water Condensate Collection System	BABEAA000-01717-2200-00002 Rev 01	10/18/94
TIE	Test Interference Evaluation for Tunnel Boring Machine (TBM) Erection on the North Ramp Pad	BABEAA000-01717-2200-00097 Rev 00	11/22/94
TIE	Test Interference Evaluation for the Procurement of Materials for the Reinforced Cast-In-Place Concrete for the ESF North Ramp Starter Tunnel and Launch Area	BABEAD000-01717-2200-00001 Rev 00	12/10/93
TIE Letter	Test Interference Evaluation for Construction and Operation of the Subsurface Power Center at the North Portal	BAB000000-01717-2200-00083 Rev 00 (including LV.SC.STN.10/93-280)	10/11/93
TIE Letter	Test Interference Evaluation /Test Planning Package 92-01, Soil and Rock Properties of Potential Locations of Surface and Subsurface Access Facilities, Phase II Test Pits	LV.SC.7/92.JDA-053	08/14/92
TIE Letter	TIE for South Ramp Geologic Borehole UE-25 SRG-1	LV.SC.ACR.11/92-111 (including LV.SC.ACR.12/92-154 Addendum dated 12/4/92)	11/9/92
TIE Letter	Test Interference Evaluation for Soil and Rock Properties Phase III, Proposed Fran Ridge Borrow Pit #1	LV.SC.ACR.11/92-125	11/13/92
TIE Letter	Review of Test and Construction Controls for Proposed Water Supply and Distribution System	LV.SC.ACR.6/93-141 (letter and evaluation)	06/02/93
TIE Letter	Amendment of the Test Interference Evaluations for Proposed C-Well Complex Testing and the Proposed Water Supply and Distribution System for North Portal Pad	LV.SC.ACR.6/93-160 (letter and evaluation)	06/18/93
TIE Letter	Test Interference Evaluation for the Topsoil and Associated Rock Storage Sites - ESF Construction Plan, Phase 1A	LV.SC.BWD.11/92-143 (Includes Evaluation LV.SC.BWD.11/92-142)	11/18/92

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Table 1-1. Superseded DIES, WIEs, TIEs, and RSN Classification Analyses (Continued)

Type of Document	Title	Document Identifier	Date
TIE Letter	Test Interference Evaluation of Tracers, Fluids, and Materials for Exploratory Studies Facility (ESF) Phase 1A Construction - North Portal Area	LV.SC.BWD.12/92-172 (includes Evaluation LV.SC.BWD.12/92-171)	12/21/92
TIE Letter	Test Interference Review for Proposed Concrete Batch Plant and Associated Aggregate Pad	LV.SC.BWD.6/93-150	06/11/93
TIE Letter	Switchgear Building Construction on the North Portal Pad	LV.SC.BWD.6/93-156 (Letter and Evaluation)	06/14/93
TIE Letter	Clarification of Existing Test Interference Suggested Controls and Constraints for ESF North Portal Water Supply System	LV.SC.BWD.6/93-176 (letter evaluation)	06/29/93
TIE Letter	Clarification of Test Interference Evaluation "Review of Test and Construction Controls for the Water Supply and Distribution System, Amendment, LV.SC.ACR.6/93-167, dated 6/21/93"	LV.SC.BWD.7/93-178 (letter evaluation)	07/09/93
TIE Letter	Test Interference Evaluation for Proposed Water Supply and Distribution System, Amendment 1	LV.SC.STN.6/93-167 (letter and evaluation)	06/21/93
WIE	Waste Isolation Evaluation for Tracers, Fluids, and Materials for the ESF North Portal Pad 69 - 12.47 kV Electrical Power, Site Grounding and Lightning Systems	B00000000-01717-2200-00036 Rev 02	11/04/93
WIE	Waste Isolation Impact Evaluation Subsurface Waste Water System	B00000000-01717-2200-00037 Rev 00	07/26/93
WIE	Waste Isolation Evaluation Package 1A Water Supply System for the Exploratory Studies Facility Supplement #1	B00000000-01717-2200-00038 Rev 00	07/29/93
WIE	Waste Isolation Evaluation Exploratory Studies Facility Package 1B Surface Buildings, Parking, and Compressed Air Facility Supplement # 1	B00000000-01717-2200-00039 Rev 01	09/30/93
WIE	Waste Isolation Evaluation Exploratory Studies Facility Package 1B Explosives Storage Area	B00000000-01717-2200-00044 Rev 02	01/14/94
WIE	Waste Isolation Evaluation for Tracers, Fluids, and Materials for Radiological and Environmental Field Monitoring Program	BAA000000-01717-2200-00091 Rev 00	11/11/93

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Table 1-1. Superseded DIES, WIEs, TIEs, and RSN Classification Analyses (Continued)

Type of Document	Title	Document Identifier	Date
WIE	Waste Isolation Evaluation Package 1A Water Distribution System for the Exploratory Studies Facility	BAB000000-01717-2200-00001 Rev 01	09/17/93
WIE	Waste Isolation Evaluation for Tracers, Fluids, and Materials for Exploratory Studies Facility (ESF) Phase 1A Construction	BAB000000-01717-2200-00062 Rev 03	01/10/94
WIE	Waste Isolation Evaluation Package 1A Water Supply System for the Exploratory Studies Facility	BAB000000-01717-2200-00063 Rev 01	09/10/93
WIE	Waste Isolation Evaluation H-Road Widening and Paving	BABA00000-01717-2200-00075 Rev 00	09/30/93
WIE	Waste Isolation Evaluation for Tracers, Fluids, and Materials for Use in Package 1D North Portal Pad Facilities	BABB00000-01717-2200-00002 Rev 00	08/29/94
WIE	Waste Isolation Evaluation Exploratory Studies Facility Surface Systems for Water Conveyance and Disposal	BABBD0000-01717-2200-00001 Rev 02	02/27/95
WIE	Waste Isolation Evaluation Exploratory Studies Facility Standby Generators and Air Compressors on the North Portal Pad	BABBD0000-01717-2200-00002 Rev 01	02/25/94
WIE	Waste Isolation Evaluation Tracers, Fluids, and Materials Usage for Construction of the Waterline for the North Ramp	BABBD0000-01717-2200-00099 Rev 00	12/02/93
WIE	Waste Isolation Evaluation Muck Storage Pad for the ESF Topopah Spring Loop	BABCC0000-01717-2200-00001 Rev 00	08/29/94
WIE	Waste Isolation Evaluation, ESF North Portal Pad Extension	BABEAA000-01717-2200-00001 Rev 00	03/17/94
WIE Letter	Waste Isolation Evaluation Package 1A Water Supply System for the Exploratory Studies Facility	LV.PA.JEH.6/93-060	06/01/93
WIE Letter	Waste Isolation Evaluation Exploratory Studies Facility Concrete Batch Plant	LV.PA.JEH.6/93-068	06/16/93
WIE Letter	Waste Isolation Evaluation Package 1A Water Distribution System for the Exploratory Studies Facility	LV.PA.JEH.6/93-070	06/17/93
WIE Letter	Waste Isolation Evaluation for Tracers, Fluids, and Materials for FY-1993 Exploratory Studies Facility (ESF) Phase 1A Construction	LV.SY.JLY.12/92-069	12/11/92

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Table 1-1. Superseded DIES, WIEs, TIEs, and RSN Classification Analyses (Continued)

Type of Document	Title	Document Identifier	Date
WIE Letter	Evaluation of Infiltration and Waste Isolation Implications of "to be determined" (TBD) and "to be verified" (TBV) Statements for ESF Work Package 1A	Letter, Laurence S. Costin to J. Russell Dyer, WBS 1.2.1.4.7	07/24/92
WIE Letter	Sandia National Laboratories (SNL) Response to Information Request of October 27, 1992	Letter, Thomas E. Blejwes to R.L. Bullock, WBS 1.2.5.4.7	11/03/92
WIE Letter	Waste Isolation Evaluation Exploratory Studies Facility Package 1B Surface Buildings, Parking, and Compressed Air Facility	LV.PA.JEH.6/93-061 (Letter and Evaluation)	06/01/93
WIE Letter	Waste Isolation Impact Evaluation Fran Ridge Borrow Pit No. 1 for Exploratory Studies Facility (ESF) Phase 1A Construction	LV.SY.JLY.12/92-064	12/21/92
WIE Letter	Waste Isolation Evaluation for Tracers, Fluids, and Materials for FY-1993 Exploratory Studies Facility (ESF) Phase 1A Construction	LV.SY.JLY.12/92-065	12/18/92

2. QUALITY ASSURANCE

This revision was prepared in accordance with CRWMS M&O implementing line procedure Nevada Line Procedure (NLP) NLP-2-0. Activities controlled by (NLP-2-0) are subject to the requirements of the DOE, Office of Civilian Radioactive Waste Management, Quality Assurance Requirements and Description for the Civilian Radioactive Waste Management Program. This DIE is quality-affecting because it establishes the applicability of the QA program to field activities associated with surface ESF accommodations with specific regard to potential impacts on site characterization testing and the waste isolation capabilities of a geologic repository as the Yucca Mountain site, and other permanent Q-List (YMP 1998a) items (which are classified QA-1, QA-2, and QA-5, including natural barriers) that have been constructed or installed at the Yucca Mountain site. This DIE addresses:

1. Activities associated with temporary items
2. Temporary items² or activities that are subject to QA control.

² Temporary items are not assigned specific classifications under M&O Quality Administrative Procedure (QAP) QAP-2-3.

Pursuant to the requirements of Title 10 Code of Federal Regulations Part 60 (10CFR60, Section 15[c][1]), this DIE establishes QA controls for minimizing, to the extent practical, any potential for impacts (as identified herein) to permanent, classified items, including potential impacts associated with the use of temporary items.

3. METHODOLOGY

This revision was performed in accordance with (NLP-2-0). This is a Category III DIE because it addresses field activities that 1) are potentially significant with respect to their affect on Q-List (YMP 1998a) items and/or site characterization data and 2) do not have an applicable Category III DIE or analogous precedent. The DIE is prepared by:

1. Reviewing the best available design information related to construction, operation (use), maintenance, and reclamation activities associated with surface ESF accommodations
2. Evaluating the potential of these items and activities to affect Q-List (YMP 1998a) items and site characterization testing
3. Establishing QA controls as required to minimize, to the extent practical, potential impacts on Q-List (YMP 1998a) items (including natural barriers) and site characterization testing.

The best available design information related to surface ESF construction, operation (use), maintenance, and reclamation activities includes but is not limited to: preliminary/approved CRWMS M&O design analyses, specifications, and drawings; constructor procedures; constructor submittals; Title III Evaluation Reports; FWPs; CRWMS M&O Test Coordination Office (TCO) criteria letters; and applicable Lotus Notes. In cases where inputs from these documents provide critical characteristics that could potentially impact the conclusions and derived requirements of this evaluation, specific reference citations are provided in the text.

After the approval of this DIE revision, subsequent iterations of field implementing documents (e.g., FWPs, design specifications, and design drawings) will be reviewed by the Safety Assurance Department. These reviews are conducted to:

1. Ensure that the original basis for this evaluation (i.e., best available design information) adequately bounds the final scope of surface ESF activities to be conducted
2. Verify that any applicable DIE requirements have been properly integrated into the implementing documents.

4. ASSUMPTIONS

- 4.1 It is assumed throughout this evaluation that general construction excavation (including blasting) associated with surface ESF accommodations will not be conducted more than 33 feet (ft) below the natural ground surface, as shown on design drawings and sketches

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(based on review of best available design information – Section 3). This assumption does not apply to construction excavation or blasting at the South Portal and Pad.

- 4.2 It is assumed throughout this evaluation that conventional construction equipment such as bulldozers, front-end loaders, trucks, dry screens, rock crushers, mobile conveyors/radial stackers, backhoes, graders, etc., will be used (best available design information – Section 3).
- 4.3 It is assumed throughout this evaluation, that during the NPP extension, the construction extension materials (i.e., excavated muck and aggregate fill) contained approximately 10 percent moisture content required for compaction purposes (RSN 1993).
- 4.4 It is assumed throughout this evaluation that chip-and-seal surface treatment will be used and that asphaltic concrete could be used as paving materials for surface ESF accommodations (CRWMS M&O 1998b).
- 4.5 It is assumed throughout this evaluation, based on requirements in the applicable subsurface DIE(s), that muck excavated by the TBM, other mechanical excavation method, and/or drill-and-blast methods does not contain intentional discharges of TFMs other than water. Any muck contaminated by accidental TFM discharges other than water is assumed throughout this evaluation to have been identified, separated, and removed during excavation. It is further assumed throughout this evaluation that no muck containing such TFM discharges was used to construct the NPP extension nor stored in the Optional Muck Storage Areas (CRWMS M&O 1995a; 1998c; 1999a).
- 4.6 In establishing the scope for this DIE, it is assumed that construction and other activities associated with surface ESF operation, maintenance, utilities installation, and support for ongoing subsurface ESF construction/operations activities will be accomplished in accordance with the ESF design specifications and drawings, which implement applicable requirements of the ESFDR (YMP 1997a).
- 4.7 It is assumed throughout this evaluation that (in the event of the loss of commercial power) the Standby Generator (Power) System will not be relied upon for ensuring an uninterruptible power supply (UPS) for test equipment (Section 10.5).
- 4.8 The TFMs to be used in surface ESF accommodations will be those for which data [e.g., Material Safety Data Sheets (MSDSs)] have been provided and reviewed (Attachment II). TFMs that have not yet been reviewed will be evaluated in accordance with the project TFM procedure (AP-2.17Q). It is assumed throughout this DIE that the MSDS-recommended procedures will be followed for use, storage, handling, ventilation, spills, leaks, and personnel safety. Temporary items/materials used for the construction, operation (use), maintenance, and reclamation of surface ESF accommodations and equipment, which are not permanently emplaced/committed to the ESF environment (based on the detailed Title III as-built documentation), are exempted from the TFM program reporting requirements of AP-2.17Q. Similarly, Section 13.2 of this DIE specifically exempts certain items/materials from TFM program reporting requirements because their use is evaluated herein to have negligible potential to impact either site

characterization data and/or site waste isolation characteristics. This assumption establishes the scope for the DIE with respect to TFMs and is based on the ESFDR (YMP 1997a) and Office of Civilian Radioactive Waste Management (OCRWM) Administrative Procedure (AP) AP-2.17Q.

- 4.9 Other assumptions used throughout this evaluation are made and documented in existing analyses (CRWMS M&O 1994a; 1995a; 1998a; 1999a).

5. COMPUTER CALCULATIONS

No analytical computer programs have been used directly in the preparation of this document. However, computer programs have been used in some of the referenced documents that form the basis of some of the results presented in this document. Detailed discussions of these computer calculations, including their treatment under the QA program, are given in the referenced documents.

6. DESCRIPTION OF ITEMS/ACTIVITIES

6.1 INTRODUCTION

The scope of this evaluation includes surface ESF accommodations, as defined by the CIIIs (CRWMS M&O 1996a) in Table 6-1 below, and includes activities associated with siting, construction, operation (use), maintenance, and reclamation of these Configuration Items (CIs). The following descriptions of the CIs identified below establish the general bounding conditions for this DIE. Activities that are not bounded by the following descriptions will require a separate Safety Assurance Department evaluation, as mandated by (NLP-2-0). [Note that, where specific DIE inputs are critical to the evaluation of a particular CI, the individual source documents (e.g., CRWMS M&O 1998d; YMP 1992a; 1992b) are cited in the text, along with the associated input information.]

Table 6-1. Configuration Items Associated with the Surface Portion of the ESF (CII BAB000000)

Item Description	CIIIs	DIE Section(s)
Access Roads	BABA00000	6.2.2, 6.2.3.1, 6.2.3.4, 6.2.3.6, 6.2.7, 6.2.9, 6.2.10
Main Sites [NPP (including pad extension) and SPP (including boxcut/headwall)]	BABB00000	6.2.2
Switchgear Building	BABBAA000	6.2.4
Parking Areas	BABBAB000	6.2.2, 6.2.10
Change House	BABBAF000	6.2.5
Site Drainage	BABBB0000	6.2.6
Site Preparation (including reclamation)	BABBC0000	6.2-6.10
Surface Utilities	BABBD0000	6.2.3

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Table 6-1. Configuration Items Associated with the Surface Portion of the ESF (CII BAB000000)
(Continued)

Item Description	CIIs	DIE Section(s)
Surface Power (including North and South Portal site grounding and lightning protection systems and permanent power for specified SBT sites)	BABBDA000	6.2.3.1
Surface Water	BABBDB000	6.2.3.6
Surface Sanitation	BABBDC000	6.2.3.5
Surface Communication	BABBDD000	6.2.3.2
Surface Wastewater (subsurface generated)	BABBDE000	6.2.3.4
Surface Compressed Air	BABBDF000	6.2.3.3
Auxiliary Sites (Subdock Storage and Lay Down Areas, ESF Weather Station, Other Meteorological Stations, Radiological Monitoring Stations, Geodetic Monitoring Stations, Fran Ridge Borrow Pit No. 1, and ESF Heliport Site)	BABC00000	6.2.10
Auxiliary-Site Preparation (including reclamation)	BABCA0000	6.2.3.1, 6.2.3.4-6.2.3.6, 6.2.7, 6.2.9, 6.2.10
Auxiliary-Site Drainage	BABCB0000	6.2.3.1, 6.2.3.4-6.2.3.6, 6.2.7, 6.2.9, 6.2.10
Muck Storage ³	BABCC0000	6.2.2
Substation with Standby Generator	BABCD0000	6.2.3.1
Topsoil Storage Area	BABCE0000	6.2.7
Water Boost Pump Station	BABCF0000	6.2.3.6
Water Storage Tank	BABCH0000	6.2.3.6
Rock Storage Area	BABCI0000	6.2.7
ESF Starter Tunnel Steel Arch Section (Part of Portals CI)	BABEAA000	6.2.1
Surface Conveyor	BABFCA000	6.2.8
Subsurface Conveyor (Surface portion)	BABFCB000	6.2.8

NOTE 1: All CIs identified above are considered temporary.

Auxiliary-Site Development CIs and other ESF Facilities CIs not specifically evaluated in this DIE may require additional evaluation. Auxiliary Sites that have been evaluated within the scope of this DIE include: Subdock Storage and Lay Down Areas, ESF Weather Station, Other Meteorological Stations, Radiological Monitoring Stations, Geodetic Monitoring Stations, Fran

³ The ESF Muck Storage Area was designed as the primary storage location for tunnel muck. However, it was not used for this purpose. As such, the scope of the evaluation herein has changed with respect to the ESF Muck Storage Area, and a more general Muck Storage CII activity description has been integrated with the NPP activity description.

Ridge Borrow Pit No. 1, and the ESF Heliport Site. These Auxiliary Sites have not been assigned specific CII, but they have been evaluated under CII BABBC00000. Site reclamation and auxiliary-site reclamation activities have not been assigned specific CII, but they have been evaluated under CII BABBC0000 (Site Preparation) and CII BABCA0000 (Auxiliary-Site Preparation). The Optional Muck Storage Areas⁴ are located adjacent to the NPP and are evaluated under CII BABB00000 with the NPP (Montalvo 1995). Various constructor-supplied warehouses, shops,⁵ offices, etc. are evaluated under each appropriate CII for which these accommodations have been supplied.

Design/construction/operation/maintenance of the surface portion of the Subsurface Conveyor System (CII BABFCB000), which extends from the North Portal headwall to the transfer tower on the NPP, is evaluated as a surface ESF accommodation as a result of its physical location. The ESF Starter Tunnel Steel Arch Section (CII BABEAA000) is also evaluated as part of the surface facilities because of its surface location. The (NLP-2-0) requirement to discuss temporary/permanent items is addressed in greater detail in Section 13.1.

6.2 DESCRIPTION OF ITEMS AND ACTIVITIES

6.2.1 ESF Starter Tunnel Steel Arch Section (BABEAA000)

The ESF Starter Tunnel at the North Portal is located at the southwest corner of the NPP. The steel arch section of the ESF Starter Tunnel was to consist of a portal wall, a multi-plate steel arch with reinforced concrete wall footing and concrete floor, and a concrete headwall and wingwalls. The construction (except for the establishment/maintenance of the floor slope) and installation of the steel arch section has been deferred and the design placed on "Hold" (Hold Description HM 93-16.0000-22) until additional design options can be evaluated (YMP 1994a). Additional DIE evaluation will be required before the "Hold" being released or for the generation of a new design (YMP 1994a). QA requirements from the superseded DIE for the ESF Starter Tunnel Steel Arch Section have been incorporated into this DIE—i.e., the maintenance of the 2 percent slope of the NPP, including the concrete floor in the ESF Starter Tunnel (Section 6.2.2)—and the DIE for the subsurface ESF (CRWMS M&O 1999a)—i.e., tunnel slope requirements. The concrete floor is sloped 2.0 percent downward toward the east, away from the mouth of the drill and blast section of the tunnel, with which the headwall provides an interface. The NPP, for which the outer portal wall provides an interface, is similarly sloped. This slope is provided to ensure that surface stormwater flows away from the ESF Starter Tunnel. The ESF Starter Tunnel at the North Portal and the ESF Starter Tunnel Steel Arch Section area are protected from stormwater intrusion through the construction of two stormwater drainage channels as part of the NPP development (Section 6.2.2 and 6.2.6). One channel runs from north to south and is located to the west of the pad; the other runs from east to west and is located to the south of the pad (CRWMS M&O 1998d).

⁴ ESF tunneling muck has been stored in the NPP Extension and Optional Muck Storage Areas.

⁵ The designed ESF shop building (CII BABBAD000) was not constructed. Various temporary, constructor-supplied shops were constructed as an alternative. These constructor-supplied shops will continue to be used to support on going ESF activities (Leak 1999a), in lieu of constructing the designed shop building. As such, the evaluation scope under this CII has been eliminated.

6.2.2 Main Sites [NPP and SPP (BABB00000)] and Muck Storage (BABCC0000)

6.2.2.1 NPP and Muck Storage

The NPP consists of approximately 14 acres of developed land positioned approximately one mile east of the eastern edge of the conceptual repository lower waste emplacement (WE) block boundary, as defined in the potential ESF/Geologic Repository Operations Area (GROA) interface (CRWMS M&O 1996b). The pad was modified and expanded to approximately 18 to 20 acres to accommodate temporary accommodations necessary for TBM support and continuation of subsurface construction activities (CRWMS M&O 1998d). The NPP was extended on the east side of the current pad using approximately 120,000 cubic yards of muck, which is was generated by the mechanical and drill-and-blast excavation of the North Ramp and testing alcoves (best available design information – Section 3). An additional pad for muck storage only is located east of and adjacent to the NPP extension. This pad, Optional Muck Storage Area #1,⁶ encompasses approximately 9 acres and is not designed to support any type of facility development (including vehicle parking or storage operation) other than the placement of a radial stacker. It has a total storage capacity of approximately 525,000 cubic yards of additional muck. The Optional Muck Storage Area #1 will be graded with a slope that facilitates drainage of the NPP through sheet flow drainage (CRWMS M&O 1998c; 1998d).

Optional Muck Storage Area #2 is located approximately 500 ft south of the pad, encompasses approximately 18.5 acres, and is designed for a total of approximately 1.1 million cubic yards of muck (CRWMS M&O 1998c). Muck currently stored in Optional Muck Storage Area #2 was generated during the excavation of the Enhanced Characterization of the Repository Block (ECRB) Cross Drift (CRWMS M&O 1998c). Optional Muck Storage Area #2 was also not designed to support facility development (except for the placement of a radial stacker). Per CRWMS M&O (1998d), this pad is attached to the NPP by a narrow strip, which crosses the NPP interceptor drainage channel. Culverts were installed in this area of the NPP drainage channel to ensure that drainage was not compromised (CRWMS M&O 1998d). Optional Muck Storage Area #2 was designed with its own interceptor drainage channels (ditches) to divert water flow around the muck pile and into natural drainage patterns (CRWMS M&O 1998d). The top of the pad will be graded with a slope away from the North Portal, which facilitates sheet flow drainage (CRWMS M&O 1998c). Throughout this evaluation, the Optional Muck Storage Areas are considered as a part of the NPP, which brings total NPP potential acreage to approximately 47 acres (Montalvo 1995; 1996 CRWMS M&O 1998c; 1998d).

The NPP is generally sloped 2 percent downward away from the ESF Starter Tunnel at the North Portal. The NPP slope, being away from the North Portal, along with the stormwater diversion system, ensure that surface stormwater or fire fighting water flows away from the North Ramp (CRWMS M&O 1998d).

Temporary construction support accommodations on the pad were provided to support TBM operations and ongoing subsurface construction activities. Additional construction/operational

⁶ The names for the various muck storage areas vary among various sources. The names used in this DIE pertain to the storage locations as described above.

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storage areas/facilities (approximately 300 foot by 600 foot area), which are east of the NPP Access Road and across from the Optional Muck Storage Area #1, have also been used (CRWMS M&O 1998d). Throughout this evaluation, the additional temporary construction support shop and storage facilities located off the main pad are also considered as part of the NPP. A rail system was added to the pad to support TBM operations. Other designed accommodations associated with the NPP that are bounded by this evaluation include: subsurface power switchgear enclosure, standby generators (including the associated fuel storage system, equipment pads and foundations), compressed air system (including related equipment pads and foundations with oil/water containment), tracer injection system (including a pad and foundation), Switchgear Building and Change House (CRWMS M&O 1998d and best available design information – Section 3).

The following constructor-supplied temporary items are also included as part of the NPP: TBM support and ongoing construction support accommodations (including associated concrete slabs, shops, maintenance and office facilities, storage areas, Sprung/Rubb fabric structures [for storage], medical facility, equipment/vehicle parking, construction water, tracer injection system,⁷ grout processing facility, and steam cleaning area); transport rail on the pad; rail car muck dump; on-pad portions of the stormwater drainage system; pad extension; Optional Muck Storage Areas; pad paving; standby power generator and fuel storage system (plus equipment pads and foundations); compressed air system (including equipment pads and foundations with oil/water containment); site lighting; and fencing (CRWMS M&O 1998d and best available design information – Section 3). These constructor-supplied accommodations will be formally incorporated into the ESF baseline by the Architect/Engineer (A/E), in lieu of constructing various accommodations that were originally designed features of the ESF (Leak 1999a). Access to the NPP is provided by means of an access road from H-Road (CRWMS M&O 1998b; 1998d). Associated activities for these items and accommodations include construction, operation (use), maintenance, and reclamation.

The designed ESF Muck Storage Area was to be a triangular-shaped parcel of land located approximately 2,000 ft southeast of the NPP. The design laid out approximately 32 acres located approximately 400 ft north and 600 ft east of H-Road and the NPP access road, respectively. A portion of the ESF Muck Storage Area was cleared and partially graded (topsoil removed). This area of the pad has only been used for parking and equipment storage. Associated activities for these items and facilities include construction, operation (use), maintenance, and reclamation.

6.2.2.2 SPP

Per CRWMS M&O (1996c; 1996d), the SPP consists of approximately 2.25 acres of undeveloped land. It is located approximately 1.2 miles southeast of the eastern edge of the conceptual repository lower WE block, as defined in the potential ESF/GROA interface boundary (CRWMS M&O 1996b). The pad is approximately 300-ft wide and 350-ft long (CRWMS M&O 1996b). It accommodates temporary facilities for TBM holeout and disassembly and other ongoing subsurface construction activities (CRWMS M&O 1996c; 1996d;

⁷ Responses to subsurface ESF spills and leakage, as associated with the tracer injection system, are evaluated by CRWMS (1999a).

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and best available design information – Section 3). A rail line has been added to the pad to support TBM disassembly. The SPP design does not currently contain provisions for NTS surface-supplied water, sewer, or electric power (except as supplied from subsurface utilities). Otherwise, only temporary self-contained construction utilities are planned for the SPP. Drainage from the pad is accomplished by a combination of sheet flow (away from the South Portal) and a pad stormwater drainage system (CRWMS M&O 1996c; 1996d). The SPP is designed to support only temporary construction/disassembly activities.

The SPP is designed⁸ to be generally sloped 2 percent downward away from the South Portal, which is located in the center of the west end of the SPP. The 2 percent slope continues for approximately 300 ft into a boxcut and an additional approximately 33 ft into the South Portal. The SPP slope, being away from the South Portal, along with the stormwater system ensure that surface stormwater or fire fighting water flows away from the South Ramp (CRWMS M&O 1996c; 1996d; and best available design information – Section 3). A stormwater diversion channel, originally shown above the South Portal, was eliminated from the SPP design (CRWMS M&O 1996c; 1996d) based on additional design analyses for mitigation of stormwater drainage requirements created by the Probable Maximum Flood (PMF).

The South Portal Boxcut was excavated by drill-and-blast, using a pre-shearing blasting technique. This technique produces nominally smooth solid portal walls and bench cuts while minimizing over-breakage of the surrounding rock formation (CRWMS M&O 1996c; 1996d; and best available design information – Section 3). Access to SPP is provided by means of an access road from H-Road (CRWMS M&O 1998b). Associated activities for these items and accommodations include construction, operation (use), maintenance, and reclamation.

6.2.3 Surface Utilities (BABBD0000)

6.2.3.1 Surface Power (BABBD000 and BABCD0000)

The ESF surface power system consists of a temporary 69 kilovolt (kV) power supply system (including substation, which steps the voltage down to the distribution system of 12.47kV), power line access road, site grounding systems, lightning protection systems, and standby generator systems (CRWMS M&O 1997a and best available design information – Section 3). The system supports uses voltages of 4160 volts, 480 volts, 208 volts, and 120 volts (CRWMS M&O 1997a). The ESF surface-power-distribution system may also incorporate two 12.47kV power lines dedicated for SBT sites and the Busted Butte facility (Leak 1999b and best available design information – Section 3).

Per CRWMS M&O (1997a), the 69kV power supply system consists of a substation, switchgear, cables and electrical ductbanks, transformers, junction boxes, a subsurface power switchgear enclosure, and an instrumentation system. The NPP grounding system consists of the surface and subsurface grounding grids; grounding copper conductors; rods; and other components of the grounding system that are attached to transformers, switchgear, power substations, the power

⁸ Originally, the designs for the SPP and South Ramp were to be supplemented by data from an engineering borehole, which was to be drilled at the South Portal location. However, this borehole was not drilled. Therefore, the previous discussion and evaluation of this borehole has been eliminated from Revision 3 of the document.

distribution system, lighting, and receptacles. The SPP grounding system consists of a subsurface grounding grid, grounding copper conductors, rods, and other components of the grounding system that are attached to the South Portal Lightning Protection System. The same design was used for the SPP grounding and lightning systems as was used at the NPP (best available design information – Section 3). The power line access road lies between H-Road and the NPP and supports construction and maintenance of the 69kV power lines. The North Portal and South Portal Lightning Protection Systems consist of lightning protection air terminals, copper-clad grounding rods, bronze cable holders, clamps and connectors, and copper down conductors (cable). Two Lightning Prevention Umbrellas are provided (at the North and South Portals) to protect subsurface ESF personnel and equipment.

The standby-generator system functions as a redundant electrical power source for the commercial primary power supply (CRWMS M&O 1997a and best available information – Section 3). Associated equipment includes transformer(s), breakers, diesel-fuel-storage tank, piping, cabling, conduit, concrete surface pad, duct banks, and grounding materials (best available design information – Section 3). Associated activities for these systems include construction, operation (use), maintenance, and reclamation.

Leak (1999b) also describes the potential addition of two 12.47kV power lines to provide direct service for ongoing SBT borehole testing sites and the Busted Butte Unsaturated Zone (UZ) Transport Test facility. These power lines are to be fed by and connected to the existing power distribution system. The first power line will run north from the northwest corner of the NPP past Exile Hill. It will then turn to the west toward the access road for SBT boreholes UE-25 UZN #4 and UE-25 UZN #5. Upon reaching the access road, it will then turn and parallel the roadway to the location of these boreholes. The power line will then follow a general westward path toward the location of SBT boreholes USW NRG-7 and USW NRG-7a, where it will terminate. The second power line will originate at the small substation near well UE-25 J-12, follow the Busted Butte access road, and terminate at the Busted Butte UZ Transport Test facility. The equipment associated with these power lines is to be consistent with the equipment currently used in the power supply system. Similarly, the activities associated with these power lines would include construction, operation (use), maintenance, and reclamation.

6.2.3.2 Surface Communication (BABDD000)

The communication system consists of those systems, subsystems, and components necessary to provide both telephone and radio communication for surface and subsurface areas of the ESF. The telephone and radio communication systems are integrated into the NTS system. The communication system will be designed to permit phased installation and modular replacement of components. Site characterization data may be transmitted over the ESF telephone lines. All electrical power wiring in both the surface and subsurface telephone systems will be kept physically separated from data and communication service to prevent induced interference. The communication center and associated equipment design indicates that this equipment is to be installed in the Switchgear Building at the NPP (CRWMS M&O 1998e). Associated activities for this system include construction, operation (use), maintenance, and reclamation.

6.2.3.3 Surface Compressed Air (BABBD000)

The compressed air system located on the NPP will provide and distribute compressed air to surface and subsurface ESF construction, operations, and site characterization testing activities. (The use of the subsurface compressed air system is evaluated in the applicable subsurface DIE; however, the operation and maintenance of any components located on the surface are evaluated in this DIE.) Compressed air is provided to the North Portal at approximately 125 pounds (lbs) per square inch and up to approximately 2,376 standard cubic feet per minute (CRWMS M&O 1999c). The compressed air system includes two in-service units and at least one standby unit. Each compressor is electrically driven and totally self-contained. Components in this system may include: the concrete compressor pads, tracer injection unit, receivers, filters, separators, piping, valves, condensate drainage and collection system, and other appurtenances. The condensate drainage and collection system is made up of piping and tanks, all located above ground level (CRWMS M&O 1999c). Associated activities for this system include construction, operation (use), maintenance, and reclamation.

6.2.3.4 Surface Wastewater (BABBD000)

The surface wastewater system transports wastewater generated by subsurface mining operations to a surface location where it can be stored and processed for disposal. Per CRWMS M&O (1998f), the as-installed system is comprised of piping—i.e., a portion of the designed piping, which is not functional—and a wastewater collection tank,⁹ which is connected directly to the subsurface portion of this system. The buried piping was intended to interface with the subsurface portion of the system at the North Portal (Station 0+00). It is buried approximately 3 to 5 ft below the pad level. The installed segment of the 8-inch polyvinyl chloride (PVC) pipe runs from the North Portal in a southeasterly direction to a buried termination point in the eastern slope of the Muck Storage Area adjacent to the NPP. The subsurface portion of this system pumps wastewater, generated during tunnel construction, operation, and maintenance activities, into the surface wastewater collection tank. This water is then treated (as necessary to comply with federal and/or state environmental regulations), filtered, and used for surface ESF construction and dust suppression purposes. Associated activities for these surface ESF temporary items and accommodations include construction, operation (use), maintenance, and reclamation.

6.2.3.5 Surface Sanitation (BABBD000)

The Surface Sanitation System is made up of two major subsystems: a collection system (consisting of piping and manholes), and a treatment system (consisting of a septic tank, dosing tank, distribution boxes, and a below ground open leach field). The collection system is located at the NPP. The building serviced by the collection system that is closest to the North Portal is the Change House Facility, approximately 225 ft southeast of the North Portal. The collection

⁹ Per CRWMS M&O (1998f), the designed Surface Wastewater System was not constructed. The design for this system included piping from the North Portal to a Wastewater Pond east of the NPP. Since the designed system was not, and is not likely to be constructed, the previous descriptions, evaluations, and QA control requirements applicable to the designed system have been removed/modified and replaced, as appropriate, with as-installed Surface Wastewater System information throughout this DIE.

system uses PVC piping designed to collect sanitary wastewater from each building on the NPP. The 8-inch PVC (main line) piping is part of the buried utilities on the pad and is located a minimum of 4 ft below the surface of the pad. The PVC line is sloped to provide sufficient velocity to maintain solids in suspension. Manholes are provided as part of the collection system approximately every 400 ft to allow access to the piping for maintenance. Each manhole is constructed of concrete approximately 48 inches in diameter with a watertight seal between the manhole and the PVC sewer piping (for leakage prevention) (CRWMS M&O 1998g and best available design information – Section 3).

The treatment system is a below-ground septic tank and below-ground open leach field constructed on the northeast side of the ESF Muck Storage Area. The septic tank and leach field are approximately 3,000 ft (linear) from the NPP's eastern boundary (CRWMS M&O 1998g). The treatment system is designed to accommodate the sewage from approximately 400 people (maximum occupancy) based on a use rate of 35 gallons (gal) per capita per day (CRWMS M&O 1998g). The septic tank is designed to contain 18,000 gal and is constructed of pre-cast or cast-in-place concrete. The centerline of the septic tank is located at the approximate Nevada State Central Zone Coordinate (NSCZC) (expressed in ft) N763218, E573077, which is approximately 30 ft (linear) westward from the dosing tank and 60 ft (linear) from the distribution boxes (CRWMS M&O 1998g). The dosing tank and dosing siphon, which are directly eastward from the septic tank, will have the capacity to distribute sewage equally to all parts of the leach field at 3 to 4 hour intervals. The dosing tank feeds a set of distribution boxes, which in turn distribute the sewage to the leach field. The leach field is constructed of 4-inch diameter, perforated and corrugated, PVC piping which disperses effluent into approximately 6-ft deep trenches containing clean aggregate (CRWMS M&O 1998g). Associated activities for these items and facilities include construction, operation (use), maintenance, and reclamation.

6.2.3.6 Surface Water (BABBD000, BABCF0000, and BABCH0000)

The surface water system consists of the water supply and distribution systems.

The Water Supply System (North Portal) connects the J-13 well and pump facility with the Booster Pump Station and the Booster Pump Station with the North Portal Water Tanks. The system provides raw water from the J-13 well and pump through an 8-inch PVC line. The line runs uphill in a northerly direction, along the west side of an existing access road and parallel to a 6-inch fiberglass water line, for approximately 1,700 ft. The 8-inch line then continues in a northerly direction parallel to the existing 6-inch line for approximately 700 ft, until it intersects the west side of the existing H-Road right-of-way. The 8-inch line continues parallel with H-Road (minimum of 40 ft from centerline) for approximately 16,700 ft until it reaches the east side of the Booster Pump Station (CRWMS M&O 1998h).

The Booster Pump Station is comprised of two 20,000-gal water storage tanks, four water pumps, a vehicle water dispensing facility, and associated electrical and mechanical equipment (CRWMS M&O 1998h). It is located in a fenced area approximately 100 ft southwest of the intersection of H-Road and the NPP access road. Electrical power is supplied to the Booster Pump Station by overhead electrical power lines emanating from the weather station located approximately 1300 ft north of the Booster Pump Station (CRWMS M&O 1997a). Each booster pump water storage tank is approximately 16 ft in diameter and 18-ft high (CRWMS M&O

1998h). An 8-inch raw water line leaves the west side of the Booster Pump Station and continues westward, again paralleling the H-Road for approximately 900 ft, then turns northerly. From this point, the PVC line is located beneath the centerline of the North Portal water storage tank access road, which is designed with a crown to avoid ponding of water. The line and access road continue northward for approximately 1,600 ft until they reach the North Portal water storage tanks (Section 3). The PVC water line is covered its entire length with a minimum 3-ft backfill (CRWMS M&O 1998h; YMP 1994b).

The North Portal water storage tank accommodation consists of a pad; associated disinfection (i.e., chlorination) and sensing/control equipment; and two large, aboveground-water-storage tanks. A one-time treatment of the potable water system with up to 50,000 gal of super-chlorinated water [(at about 500 parts per million (ppm))] was required before initial operation of the Water Distribution System. A 200,000-gal (nominal) capacity tank is designated to hold 150,000 gal for fire suppression and 50,000 gal for construction purposes. The disinfection (i.e., chlorination) equipment (CRWMS M&O 1998h) located next to the potable water tank provides potable water, which is stored in a separate 50,000-gal (nominal) capacity tank (CRWMS M&O 1998h). The elevation of the tank pad is approximately 3,860 ft (Table 8-1). The four water storage tanks (i.e., 2 booster pump and 2 hilltop) are constructed on concrete ring foundations lined with an impermeable liner which holds oil impregnated sand (corrosion prevention measure to protect tank bottoms). The liner is designed to minimize contact between any hydrocarbon materials contained in the sand and the underlying rock (CRWMS M&O 1998h).

The Water Distribution (North Portal)-System connects the North Portal water storage tanks to the NPP surface and ESF subsurface accommodations. The water distribution system provides two separate water lines from the water storage tanks to the NPP; one for potable water (8-inch PVC line) and one for non-potable water (10-inch PVC line). The 8-inch PVC pipe provides potable (chlorinated) water to the surface facilities only and does not have tracers added. The 10-inch pipe provides fire and construction water (untraced and unchlorinated) to the surface facilities on the NPP, as well as to the tracer injection system for subsequent use in subsurface construction and testing activities. Water distribution lines originate from their respective storage tanks and run downhill in an easterly direction for approximately 1,000 ft until they intercept the 69kV power line access road. They then turn in a northeasterly direction until they intercept the NPP (YMP 1994c). Upon reaching the NPP, the main water-distribution lines continue in a generally northeasterly direction across the pad. Branches off the main water-distribution lines run both westerly and easterly to supply individual NPP accommodations. The entire length of the water-distribution lines is covered with a minimum 3-ft backfill (YMP 1994b). The fire and construction water pipe line for subsurface use is connected to a tracer injection system, which is evaluated as part of the applicable subsurface DIE, except for leakage and spills from the system occurring on the surface. Per Leak (1999c), the installed water-supply and water-distribution systems require manual operation of each system to transfer water between two different system elements.

Associated activities for the surface water system include construction, operation (use), maintenance, and reclamation.

6.2.4 Switchgear Building (BABBA000)

The Switchgear Building is located at the south end of the NPP approximately 330 ft east of the North Portal. The facility consists of a single-story, pre-engineered, metal building which is placed on reinforced concrete footings and a slab. The building is approximately 16-ft high (eave height), 60-ft wide, and 140-ft long (8,400 square feet [ft²]) (YMP 1994d). The facility has three electrical service trenches that are located below the finished floor level and range in depth from approximately 3 ft to approximately 6 ft (YMP 1994e). The cable routing trenches provide for routing the power and control from and to various pieces of the power distribution equipment on the NPP and into the subsurface ESF. As designed, electrical power is to be supplied either from the existing Canyon Substation (normal power supply) or the standby diesel generators (used during loss of normal power supply) to the 4160VAC switchgear and 480VAC power distribution equipment located in the Switchgear Building. However, an alternative constructor-supplied power distribution system was installed (CRWMS M&O 1997a), which did not integrate all of the designed features of the Switchgear Building, duct banks, cabling, electrical switchgear, nor a communication center.¹⁰ The Switchgear Building has also been used for administrative/shop space. Associated activities for this facility include construction, operation (use), maintenance, and reclamation.

6.2.5 Change House (BABBAF000)

The Change House is located approximately 125 ft east of the North Portal. The facility consists of a single story, pre-engineered, metal building (which is placed on reinforced concrete footings) and a slab. The building is approximately 24-ft high, 112-ft wide, and 127-ft long (best available design information – Section 3). The Change House consists of a portal control center (for personnel access); first aid area and underground rescue apparatus center; clothes change rooms and showers; and a training facility (CRWMS M&O 1994b). The Change House is designed to provide 24-hour operational service to underground personnel at maximum staffing levels on a three-shift rotation basis (CRWMS M&O 1994c). Associated activities for this facility include construction, operation (use), maintenance, and reclamation.

6.2.6 Site Drainage (Stormwater Drainage [BABBB0000 and BABCB0000])

The stormwater drainage systems provide flood protection and drainage for the NPP, SPP, Access Roads (H-Road, NPP, SPP, Rock and Topsoil Storage Areas, Optional Muck Storage Areas, 69kV power line, ESF Heliport Site, and Conveyor Maintenance), Water Booster Pump Station Pad, Subdock Storage and Lay Down Areas, ESF Weather Station, Fran Ridge Borrow Pit No. 1, Rock and Topsoil Storage Areas, and ESF Heliport Site. Flood protection for the NPP is accomplished by construction of drainage channels, one located west of the pad running north-south, and another located south of the pad running east-west (best available design information – Section 3). Flood protection for the SPP is to be accomplished by maintaining a 2 percent slope across the pad (CRWMS M&O 1996c; YMP 1992c). The drainage channels for the NPP

¹⁰ The original design for the Switchgear Building included provision for it to house the Integrated Data and Control System and the Facility Monitoring and Control System. Neither of these systems was installed in the as-constructed Switchgear Building, and neither is expected to be installed in the future. As such, the description of these features has been removed in Revision 03.

are designed to handle the stormwater runoff caused by the occurrence of the PMF, which is discussed in YMP (1997a).

Flood protection and drainage for H-Road as well as access roads to the NPP, SPP, ESF Muck Storage Area, Conveyor Maintenance, and the Rock and Topsoil Storage Areas are accomplished by routing stormwater flow through a system of culverts, swales, and ditches, designed to handle the stormwater runoff caused by a 100-year event (discussed in YMP [1997a]). Flood protection and drainage for the access road to the North Portal water storage tank facility (including the tank pad area) are not considered because this road and pad are located on the crest of Exile Hill and therefore do not receive any tributary drainage (YMP 1992c).

Flood protection and drainage are accomplished for the Rock Storage Area, Topsoil Storage Area, ESF Muck Storage Area, Subdock Storage and Lay Down Areas, ESF Weather Station, Fran Ridge Borrow Pit No. 1, and Water Booster Pump Station Pad by routing stormwater runoff through a system of culverts, swales and/or ditches around the pads/areas to direct the flow away from the pad/area and into natural drainage paths (YMP 1992c). Ditches around the Rock/Topsoil Storage and ESF Muck Storage Areas are designed to handle runoff from a 100-year flooding event, and those around the Water Booster Pump Station, Subdock Storage and Lay Down Areas, ESF Weather Station, and Fran Ridge Borrow Pit No. 1 are designed to handle a 50-year flooding event. Associated activities for these systems include construction, operation (use), maintenance, and reclamation.

6.2.7 Rock and Topsoil Storage Areas (BABC10000 and BABCE0000)

The Rock Storage Area consists of approximately 1.3 acres of graded pad lined with a 40-mil PVC geomembrane liner. It is located approximately 6,000 ft south of the NPP and approximately 150 ft west of the Topsoil Storage Area (YMP 1992a; 1992b). The Rock Storage Area is used to store rock originating from the ESF Starter Tunnel.

The Topsoil Storage Area is approximately 25 acres in size and is located approximately 6,000 ft south of the NPP and approximately 150 ft east of the Rock Storage Area (YMP 1992a; 1992b). The Topsoil Storage Area is unlined and will be used to store topsoil originating from the NPP, SPP, Rock Storage Area, Booster Pump Station, ESF Muck Storage Area, North Portal Water Tank Storage Facility, various Access Roads, and other facilities that are developed to support site characterization activities. Topsoil Storage Area erosion control includes planned surface irrigation (approximately 300,000 gal of water applied to an area of 161,000 ft² over a 2 to 3 month time frame by means of sprinklers) as part of re-vegetation activities intended to limit erosion of the topsoil (Harris 1996). The re-vegetation effort also involves the use of various TFMs, which are listed in Group 3 of Attachment II of this DIE.

Flood protection and drainage for the Rock and Topsoil Storage Areas are accomplished by routing stormwater flow through a system of culverts, swales, and/or ditches, designed to handle the stormwater runoff caused by a 100-year event.

The Topsoil and Rock Storage Access Road has been developed to provide vehicle access from H-Road to the Topsoil and Rock Storage Areas. This access road uses an existing road, in conjunction with the development of a new access section, and is designed with a crown to avoid

ponding of water (CRWMS M&O 1998b). Associated activities for these areas include construction, operation (use), maintenance, and reclamation.

6.2.8 Surface Conveyor (BABFCA000) and Surface Portion of the Subsurface Conveyor (BABFCB000)

The Surface Conveyor System, as evaluated in this DIE, includes the portion of the Subsurface Conveyor System emanating from the headwall (North Ramp Station 0+00 m) and ending at the transfer-tower discharge chute. Muck generated from subsurface TBM, mechanical excavator, and/or drill-and-blast activities is transported to the Optional Muck Storage Areas by truck (CRWMS M&O 1998c). Surface Conveyor System components located between the headwall and the transfer tower include a maintenance platform, hydraulic power units, a belt splice platform, a constant tension mechanism, and the main pulley drive, which is mounted on the drive tower. With the exception of the radial stacker, which was installed at the transfer tower, the Surface Conveyor System beyond the transfer tower was not constructed (CRWMS M&O 1998c). The elevated portion of the conveyor is enclosed to prevent material from falling on the roadway or NPP. The surface conveyor will also be provided with a full wind cover. Iron magnets will be provided to remove ferrous tramp metal pieces. All transfer points will use full enclosure chutework and a dust suppression water spray system (with similar features as the subsurface spray systems) (CRWMS M&O 1998i).

Portable radial stackers are provided for muck distribution in the Optional Muck Storage Areas. The same dust suppression system (i.e., using water spray and chutework) as for the conveyor will also be used for transfer points on the radial stackers. Radial stacker bearings will be protected by labyrinth seals that prevent grease from leaking out, and idlers that are the "sealed-for-life" type and will not require lubrication (CRWMS M&O 1998i; 1999a). Dust suppression water will be provided to the radial stacker and transfer points by an underground water supply line that runs parallel to the conveyor alignment (best available design information – Section 3).

Associated activities for these items and facilities include construction, operation (use), maintenance, and reclamation.

6.2.9 H-Road and Access Roads (BABA00000)

The existing H-Road provides vehicular access to the ESF and is the main interface with the NTS. H-Road originates in Area 25 of the NTS and leads west and north to the ESF. The original ESF design included H-Road improvements (widening, grading, and paving) beginning at the J-13 well site, continuing approximately 20,500 ft, and terminating just north of the Rock and Topsoil Access Road (CRWMS M&O 1998b). These designed H-Road improvements have not been and are not expected to be implemented (CRWMS M&O 1998b). However, the current H-Road asphaltic concrete roadbed has been resurfaced with chip-and-seal surface treatment.

Access Roads provide vehicular access to individual ESF surface accommodation sites. Designated access roads evaluated herein are the H-Road and the Access Roads to the NPP, SPP, Rock and Topsoil Storage Areas, North Portal Water Storage Tanks, 69kV power line, and ESF Heliport Site. Except for H-Road, these Access Roads are approximately 24-ft wide, consist generally of 12 inches of compacted select fill material and are designed with a crown to avoid

ponding of water. Shoulder areas and drainage ditches are provided on either side of the access roads as part of the stormwater drainage system to protect the roads and facilitate drainage (CRWMS M&O 1998b). Further resurfacing and/or re-grading operations are anticipated for Access Roads. Associated activities for these items include construction, operation (use), maintenance, and reclamation.

6.2.10 Additional Auxiliary Sites (BABC00000)

6.2.10.1 Subdock Storage and Lay Down Areas

The Subdock Storage and Lay Down Areas occupy a total of approximately 15 acres, comprising approximately 13 acres southwest of, and 2 acres northeast of, H-Road and are located approximately 1 mile northwest of the booster pump station (DOE 1997, p. 9.01). Facilities located on the Subdock Storage and Lay Down Areas include unloading dock facilities and office trailers. Drainage channels are provided between the Subdock Storage and Lay Down Areas and the H-Road. The natural drainage patterns of the areas have not been significantly modified by facility/equipment or storage placement so that natural flow drainage is maintained to the southeast and impoundment areas are not created (YMP 1992c). The Subdock Storage and Lay Down Areas provide space for the unloading of vehicles and the storage of material used for surface-based testing and maintenance of various NTS facilities. Utilities provided to these areas are limited to electrical power. Associated activities for these areas include repair/construction, operation (use), maintenance, and reclamation.

6.2.10.2 ESF Weather Station, Other Meteorological, Radiological, and Geodetic Monitoring Stations

The ESF Weather Station trailer facility and tower occupy an area of approximately 0.25 acres and are located approximately 1700 ft southwest of the Booster Pump Station. Access to the ESF Weather Station/tower is provided from the northwest by means of an approximately 0.25-mile long, graded dirt (unimproved) road (DOE 1997, Part 1, p. 7A.05 and Part 2, pp. 1.30 and 1.32). The natural drainage patterns of the area have not been significantly modified by facility placement so that natural drainage is maintained to the southwest and impoundment areas are not created (YMP 1992c). The station is design to collect meteorological information that will be used in the site characterization process.

Currently, there are approximately 9 additional meteorological collection sites/stations and approximately 16 "near field" radiological monitoring sites/stations located at various locations on the ESF (DOE 1997, pp. 7A.05 and 7D.03, respectively). These facilities are generally constructed to support instrumentation for recording meteorological data and/or radiological background data used for site characterization purposes. These collection facilities may be small mobile trailers, equipment enclosures (metal "dog houses"), or other temporary platforms constructed to support data collection equipment. Solar panels, batteries, and various measurement sensors are also part of the data-collection support equipment. Because of the limited size of these facilities, the natural drainage patterns of each of the areas have not been significantly modified by facility/trailer/equipment placement.

There are six proposed geodetic monitoring sites located on controlled land in the Yucca Mountain region, but only one site is located inside the CCAB (YMP 1999a). These facilities provide stationary geodetic monuments—and their associated power and communications equipment—which use inputs from the Global Positioning System and are remotely monitored. Per CRWMS M&O (YMP 1999a), the geodetic monuments are anchored in bedrock, which is the most significant site disturbing activity associated with this study. The geodetic monument anchoring system consists of four boreholes, with a 4- to 5-inch diameter, that are 20- to 30-ft deep. Galvanized pipes are cemented into these boreholes using SikaGrout 212 Premix, Hub 100 Non-Shrink Grout, or other approved grout (Attachment II). SikaGrout 212 and Hub 100 are cementitious grouts and are similar to other such materials as evaluated herein. Several additional boreholes, which accommodate footings for other test-related equipment and a monitoring site perimeter fence, are also required. However, the activities associated with the geodetic monument anchoring boreholes completely bound these other boreholes. Connecting cables between various monitoring site components will be run in PVC conduit, which may be buried under approximately 6 inches of soil, if soil is available at the individual site locations. Construction of these monitoring sites will not involve any other significant changes to the natural grade of each site. Per CRWMS M&O (YMP 1999a), these activities are primarily conducted by California Institute of Technology personnel, who do not work under YMP QA program requirements. However, CRWMS M&O (1998a) establishes the TCO as the responsible organization for ensuring the implementation of DIE requirements applicable to all testing activities, including those testing activities conducted by non-YMP participant organizations.

Associated activities for these items and facilities include repair/construction/relocation, operation (use), maintenance, and reclamation.

6.2.10.3 Fran Ridge Borrow Pit No. 1

The Fran Ridge Borrow Pit No. 1 is located on the northeast slope of Fran Ridge and occupies approximately 80 acres. The area is approximately 100-ft southwest of the intersection of H-Road and Midway Valley Road. The borrow pit encompasses an area of approximately 1500-ft wide and 2500-ft long (Dyer 1992). Its maximum depth may reach approximately 20 ft below natural grade in the northern disturbed area, whereas natural contours are maintained in its southern portion (Dyer 1992). Access to the borrow pit is provided by H-Road. No blasting has been, or will be, required to recover the aggregate from the borrow pit. Facilities/equipment located on or near the borrow pit include a topsoil storage area; rock screening, crushing, and conveyor equipment; vehicle loading facilities; mobile shop facilities; and office trailers. The natural drainage patterns of the area have not been significantly modified by the creation of the borrow pit or equipment/facility placement so that natural drainage is maintained to the south and impoundment areas are not created (YMP 1992c). The purpose of the borrow pit is to provide a source of aggregate for construction activities in support of both ESF and SBT activities. Associated activities for these items and facilities include repair/construction, operation (use), maintenance, and reclamation.

6.2.10.4 ESF Heliport Site

Per Helner (1999), a temporary ESF Heliport Site will be constructed at the site of the ESF Wastewater Pond, which was not constructed. The topsoil had already been removed and preliminary site grading had been performed (CRWMS M&O 1998f). Per Helner (1999), current design documents will be used to control final site preparation and grading activities. A concrete pad will be poured using an existing mix design and appropriate markings will be painted on the finished concrete surface using an approved highway-striping paint. Access to the ESF Heliport Site will be provided via the unfinished Wastewater Pond Access Road. Previously approved TFMs will be used in the construction of the ESF Heliport Site. Associated activities for this accommodation include construction, operation (use), maintenance, and reclamation.

6.3 TFMs

TFM usage associated with surface ESF activities/accommodations has been discussed in the text of Section 6.2, as appropriate. The TFMs specifically noted in the previous sections and an extensive list of additional TFMs are evaluated and approved for use by this DIE. Attachment II provides a comprehensive list of TFMs that are approved for use associated with surface ESF activities/accommodations that are evaluated by this DIE. All of the Attachment II TFMs either have been specifically evaluated in Sections 10, 11, and 13, or have been judged to be sufficiently similar to the TFMs that are specifically evaluated, such that these sections bound their use. However, the TFMs identified in Attachment II are only approved for surface ESF use provided their use and quantities are consistent with the restrictions established in Section 13.3 of this DIE.

As stated in Assumption 4.8, the use of TFMs is controlled by the requirements of the TFM procedure (AP-2.17Q). The use of any TFM associated with surface ESF activities/accommodations, which is not listed in Attachment II, is evaluated as required by AP-2.17Q before its use. However, only those TFMs that are permanently committed to the site, which are not specifically exempted from reporting by this DIE, are to be reported, per the requirements of AP-2.17Q.

7. DESIGN EVENTS

The following potential events and activities were considered for evaluation: extreme precipitation and surface runoff (including PMF), earthquakes, inadvertent spills of fluids and powders, fires, explosions, and use of construction and dust suppression water during construction, operation (use), maintenance, and reclamation of surface ESF accommodations. These events are used to evaluate the temporary items discussed in Section 6.0 using criteria in (NLP-2-0).

Fires and explosions are evaluated with regard to potential impacts. Disruption of items as a result of earthquakes, fires, and explosions are not specifically evaluated in this DIE; however, deterministic failure of systems and components is used to assess the potential impacts to site characterization activities and waste isolation.

Given the DIE requirements discussed below for spill protection/containment and clean-up of released fluids, the quantities of committed fluids (other than water) retained at the site from any credible equipment or vehicle accident or failure (including from items such as the standby power system fuel tank containing approximately 5000 gal of diesel fuel) are expected to have negligible impacts to waste isolation or site characterization testing. In addition, the reporting of any committed fluids resulting from a spill, with subsequent evaluations of potential impacts to site characterization and waste isolation capabilities from those fluids, enables identification of any additional controls which may be appropriate to minimize potential impacts from accidental losses of such fluids.

8. AFFECTED Q-LIST ITEMS

8.1 REPOSITORY INTERFACES

8.1.1 Proximity to Repository Items

The facilities evaluated within this DIE include the NPP (including Optional Muck Storage Areas), SPP, Rock and Topsoil Storage Areas, ESF Muck Storage Area, Septic Tank and Surface Sanitary Sewage Leach Field, Subdock Storage and Lay Down Areas, Booster Pump Station, NPP Water Storage, H-Road, Surface Water System, Fran Ridge Borrow Pit No. 1, and ESF Weather Station. All of these facilities lie outside the Potential Repository Layout and within the CCAB, except the southeastern-most portions of the H-Road and Surface Water System, which lie outside the CCAB to the southeast (DOE 1997, pp. 9.01 and 9.04). The closest facilities (Subdock Storage and Lay Down Areas) to the Potential Repository Layout are located approximately 750 ft to the east.

8.1.2 Elevations and Locations

Elevations for the SPP, repository WE drifts, the water table, and Exile Hill crests are identified in their respective references and have been included in Table 8-1. Elevations for other ESF facilities (as identified in DOE [1997]) were determined using the individual references identified in Table 8-1 (as necessary) and the orthophotography and hypsography maps in Part 2, Section 1.0, of DOE (1997). The approximate location of each surface ESF accommodation was first determined, and then its approximate elevation (above mean sea level) was estimated using the nearest contour interval.

8.1.3 Boreholes (Existing and Planned)

Locations and depths of SBT boreholes relative to surface ESF accommodations are maintained in the CRWMS M&O Geographic Nodal Information Study and Evaluation System (GENISES) technical database. Most of the information contained in this database is displayed on maps contained in the YMP Site Atlas (DOE 1997). The DIE for SBT Activities (CRWMS M&O 1998a) also contains information on SBT boreholes relative to the location of surface ESF accommodations. The TCO has examined the testing requirements and identified potential construction and testing constraints for each borehole in its associated FWP(s). FWPs incorporate applicable requirements from this DIE and CRWMS M&O (1998a). FWPs also include appropriate requirements from the Surface-Based Testing Facilities Requirements

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Document (SBTFRD) (YMP 1997b), Field Operating Instructions (FOIs), and, in some cases, the ESFDR (YMP 1997a), as well as relevant environmental and site management requirements. No new boreholes are currently planned during the site characterization phase. However, new testing activities may be conducted in existing boreholes dependent upon site-characterization-data needs and available funding. An evaluation of potential impacts on SBT site characterization boreholes is included in Section 10.

Table 8-1. Locations and Elevations of Various Surface ESF Accommodations

Location	Elevation	Reference
NPP, surface	3700 ft	CRWMS M&O 1996b
NPP, groundwater table	2396 ft	Robison et al. 1988
Topsoil and Rock Storage Areas, surface	3800 ft	DOE 1997, Part 1, pp. 9.01 and 12.05; YMP 1992a
Surface Sanitary Sewage Leach Field	3580 ft	CRWMS M&O 1998g; DOE 1997, Part 1, pp. 9.01 and 12.06
Exile Hill, crests	3860 ft	DOE 1997, Part 2, pp. 1.32 and 1.33
ESF Heliport Site	3640 ft	CRWMS M&O 1998f, Helner 1999
Proposed Upper Block WE Drift	3494 - 3645 ft	CRWMS M&O 1993
Proposed Lower Block WE Drift	3274 - 3376 ft	CRWMS M&O 1993
Subdock Storage and Laydown Areas	3960 ft	DOE 1997, Part 1, pp. 9.01 and 12.05
Booster Pump Station	3710 ft	CRWMS M&O 1998h
NPP Water Storage Tanks	3860 ft	DOE 1997, Part 1, pp. 9.01 and 12.05
ESF Weather Station	3750 ft	DOE 1997, Part 1, pp. 7A.02 and 12.05
Fran Ridge Borrow Pit No. 1	3460 ft	Dyer 1992; DOE 1997, Part 1, p. 9.01
SPP	3805 ft	CRWMS M&O 1996c; 1996d

8.1.4 Planned and In-Process Tests

Planned and in-process site characterization tests include surface and subsurface geologic mapping and sampling, geophysical surveys, and geodetic, hydrological, meteorological and ecological studies. Locations of some of these tests are also stored in the GENISES technical database and are displayed in the Site Atlas (DOE 1997). The TCO examines the testing requirements and identifies potential construction and testing constraints for each test in its associated FWP. FWPs incorporate applicable requirements from this DIE and other applicable DIEs. FWPs also incorporate appropriate requirements from the SBTFRD (YMP 1997b), FOIs, and, in some cases, the ESFDR (YMP 1997a), as well as relevant environmental and site management requirements. The exact number of tests to be performed is not currently quantifiable due to dependencies on available budget and uncertainties in scopes of work remaining to be completed. An evaluation of potential impacts on these planned and in-process site characterization studies is included in Section 10.

8.2 POTENTIALLY AFFECTED Q-LIST ITEMS

The potentially affected items on the Q-List (YMP 1998a) are the natural barriers and permanent engineered items. Natural barriers that outcrop within the CCAB are predominantly the Alluvium, the Tiva Canyon Welded Hydrogeologic Unit (TCw), the Paintbrush Nonwelded Hydrogeologic Unit (PTn), and the Topopah Spring Welded Hydrogeologic Unit (TSw). Potential effects are also considered on the Calico Hills Nonwelded Hydrogeologic Unit (CHn) and the Saturated Zone Barrier. These barriers may be affected by the use of committed fluids or materials. The permanent engineered items include ground support, underground openings, and waste packages.

9. EXPECTED CONDITIONS

9.1 SIGNIFICANT GEOLOGIC FEATURES

The exposed geological features around the surface ESF, including the NPP, Muck Storage Area, Rock and Topsoil Storage Areas, and the Surface Water System and H-Road (elevations ranging from 3860 ft at NPP Water Storage Tanks to approximately 3300 ft at J-13 well [Thordarson 1983]), are hills and alluvial fans. The hill to the west of the ESF NPP is Exile Hill, which has a crest directly above the NPP and a second crest directly south of the first. To the east of the ESF NPP lie Fran Ridge and Alice Hill (DOE 1997, p. 5.08). These hills consist of easterly dipping units from the Miocene (Tertiary) age Tiva Canyon (TC) and Topopah Spring (TS) formations of the Paintbrush Group (Scott and Bonk 1984; Buesch et al. 1996). These units consist of welded and non-welded quartz latite and rhyolite tuffs.

Skirting the hills and ridges are Holocene, Pleistocene, and Pliocene aged alluvial/colluvial deposits, which fill the valleys, gullies, and washes. These deposits consist of poorly sorted boulders, gavels, cobbles, and sands that are partially cemented with pedogenic carbonates (Scott and Bonk 1984).

The surficial drainage is to the east through the gap between Fran Ridge and Alice Hill, then south into Fortymile Wash (DOE 1997, p. 5.08). Portions of the H-Road and Water Supply System, which pass through Fortymile Wash, are located in the 100-year flood plain (DOE 1997, p. 5.08).

Note: Several different stratigraphic nomenclatures are used in this report. These nomenclatures are based on the lithostratigraphic (Buesch et al. 1996), and hydrostratigraphic (Bodvarsson et al. 1997, Table 3.4-1; Scott and Bonk 1984) properties. A correlation between these differing stratigraphies and a discussion of their existing hydrogeologic properties are presented in CRWMS M&O (1996e).

9.2 SIGNIFICANT HYDROLOGIC FEATURES

The UZ ranges from approximately 1305-ft thick near the NPP (Table 8-1) to approximately 928-ft thick in areas of Fortymile Wash where the H-Road and the producing water well (J-13) are located (Thordarson 1983). This zone consists of the alluvium, the nonwelded Rainer Mesa Member of the Timber Mountain Tuff and the following formations of the Paintbrush Group:

TC Tuff, Yucca Mountain Tuff, Pah Canyon Tuff, and TS Tuff (Scott and Bonk 1984; Buesch et al. 1996). All units dip to the east, away from the conceptual repository. However, the alluvium and Rainier Mesa Member are not continuous over the region spanned by the surface ESF. At the NPP, the depth from the surface to the TS Tuff of the Paintbrush Group is approximately 156 ft. At this location, the thickness of the TS Tuff is approximately 936-ft thick (Scott and Bonk 1984). For areas underlying surface ESF activities, the water table is generally flat and groundwater flow is to the southeast, away from the conceptual repository (Ervin et al. 1993). At the NPP, the water table lies in the CHn unit (Scott and Bonk 1984).

9.3 HYDROGEOLOGIC, GEOCHEMICAL, AND GEOMECHANICAL CHARACTERISTICS

There are differences in the hydrogeologic properties of the formations of the Paintbrush Tuff Group (Bodvarsson et al. 1997, Table 3.4-1). The TC Tuff has a high fracture permeability, yet has a lower porosity and matrix permeability than the Pah Canyon and Yucca Mountain Tuffs. Due to the lower fracture density of the Pah Canyon and Yucca Mountain Tuffs, downward flow is interrupted and directed to run along the stratigraphy, through the fractures of the lower portion of the TCw (Bodvarsson et al. 1997, Section 2.2.3).

9.4 ANTICIPATED FAULTS, EXPECTED FRACTURE CONDITIONS

The majority of the surface ESF lies between the Bow Ridge fault and the Paintbrush Canyon fault (Scott and Bonk 1984; Table 8-1). The exceptions are the Rock and Topsoil Storage Areas and SPP, which lie immediately to the west of Bow Ridge fault, and portions of the H-Road and Water Supply System, which cross over the Paintbrush Canyon fault on the way to Fortymile Wash (Scott and Bonk 1984; Table 8-1). These two faults dip steeply towards the west and generally strike in a north-south direction.

10. IMPACT ON SITE CHARACTERIZATION TESTING

10.1 SCOPE

The scope of this section is limited to the potential interference with site characterization testing that could result from the construction, operation, maintenance, reclamation, and field activities associated with the facilities listed in Section 6 and does not extend to the evaluation of test data collection in terms of the adequacy, validity, or veracity of the data being collected for any particular test.

10.2 GENERAL SITE IMPACTS

Test interference impacts to hydrological testing throughout the surface ESF may result from ponding of surface water or the alteration of natural drainage, which creates surface runoff impoundment areas. Ponding of water due to surface construction or operation creates the potential for increased saturation of the underlying alluvium and enhanced downward percolation to the water table, creating unanticipated impacts to percolation tests, neutron moisture content profiles, and water table measurements. Surface ponding and the creation of

surface runoff impoundment areas should be minimized to the extent practical throughout the surface ESF.

Test interference impacts to hydrological testing throughout the surface ESF also may result from the intentional emplacement of water on the surface during construction and/or operation at the ESF. Water used for dust control and compaction purposes during construction may be committed to the environment while the water used to mix concrete is expected to be retained primarily in the concrete. To assess the impact that the water emplacement creates on hydrological testing and to avoid unanticipated impacts to percolation tests and neutron moisture content profiles, it is necessary to limit water application near percolation tests and neutron moisture content profiles and to record application volumes at or near other testing locations (YMP 1997c). Section 11.1 indicates that a water use limitation of 0.48 gallons per square yard per day (gal/yd²/day) (dust control and operational water use) should be established for surface ESF accommodations to limit hydrological waste isolation concerns. This limit is based on the average evapotranspiration rate at Yucca Mountain. Therefore, water applications at or below this limit are expected to be removed through atmospheric transport processes. The only potential test interference concerns related to this limited water use are near-surface water content measurements (such as in neutron boreholes, which are limited to less than five existing boreholes) and geochemical analyses of surficial materials, which may be influenced by the dissolved solids left behind by the evapotranspiration of dust control water. Some activities may require water use in excess of 0.48 gal/yd²/day, such as water for fill compaction on the NPP and SPP or water carried by excavated muck and stored in the various muck storage piles. Additional water use beyond 0.48 gal/yd²/day may result in deep percolation, which could lead to interference with other testing. However if such water use is limited to a cumulative discharge of 13.5-ft depth at any point, as indicated in Section 11.1, is not expected to interfere with any current or planned testing due to the relative locations of these facilities and testing activities (DOE 1997, pp. 12.05 and 12.06; YMP 1997c).

An additional concern related to water is the accidental (and sudden) release of large quantities (i.e., up to 250,000 gal) from the water storage tanks on the crest of Exile Hill. However, this potential release of water is expected to rapidly spread over the surface due to the sloping topography around Exile Hill and would only cover a circular area around the tanks to a radial distance of approximately 570 ft and about 0.4 inches depth. Little deep percolation would be expected from such an event. The closest testing area (DOE 1997, p. 12.06; YMP 1996; 1997d; 1997e; 1997f) to the water storage tanks is more than 1600-ft north in the ESF North Ramp (DOE 1997). Therefore, no testing impacts are expected from an accidental release.

The accidental release of organic materials and acids, particularly liquids and powders which are easily lost (committed) to the environment, should be minimized to the extent practical and be reported so that affected testing results can compensate or account for the interference. Contamination due to the release of such materials could cause potential test interference to ongoing Carbon-14 (¹⁴C) studies and other active or proposed scientific tests for the Site Characterization of Yucca Mountain (such as studies of microbial activity).

Site characterization testing results related to specific isotopes of chlorine such as Chlorine-36 (³⁶Cl) may be unpredictably altered by the introduction of salt grounding solutions or other chloride materials. The use of chlorine-containing salt (e.g., Sodium Chloride, Magnesium

Chloride, Potassium Chloride) as a grounding medium should be avoided, as its use could interfere with chlorine isotope studies being conducted by Los Alamos National Laboratory (LANL). The use of GEM[®] as a replacement grounding medium will limit potential test interference. Site characterization data may be transmitted via telephone. The assigned PIs are responsible for ensuring that adequacy, validity, and veracity of any data that has been transmitted via telephone.

10.3 EXISTING OR PLANNED BOREHOLES AND EXCAVATIONS

Test interference concerns regarding the construction and operation of the water supply and distribution system relate to the release of water and/or chlorinating agents into the subsurface which could potentially impact subsurface ESF infiltration experiments (YMP 1998b) and interfere with ³⁶Cl studies in the ESF (YMP 1997f). ³⁶Cl surface studies are evaluated specific to new planned borehole construction. Leakage in the water supply and distribution system could potentially impact tests in the existing SBT water table boreholes UE-25 WT #5, WT #13, and WT #14 (YMP 1997c), depending on the location and volume of water lost as a result of the leakage. Any near-surface testing planned adjacent to, or within 200 ft of, the ESF Water Supply System pipeline alignment could potentially be impacted if the 8-inch raw water supply line breaks, depending on the location and volume of water loss (CRWMS M&O 1998h). However, the potential for such impacts is considered to be negligible since the water supply line is only operated manually as necessary to refill the North Portal water tanks.

The input of large volumes of organic-rich sewage water into the alluvium of the leach field and underlying bedrock has the potential to alter water chemistry. This water also has the potential to eventually reach the water table. Only boreholes WT#5 and WT#14 are within the path of the potential leach field plume (Attachment IX; DOE 1997). However, previously scheduled hydrochemistry tests for either of these two boreholes have been canceled (YMP 1997c).

10.4 EXISTING/PLANNED UNDERGROUND EXCAVATIONS OR FACILITIES

Underground testing is planned along the North Ramp, Main Drift, and various testing alcoves and lateral drifts at several locations, branching from the main underground passage (YMP 1997d; 1997e; 1997f; 1998b). Because all the tests have at least some lateral offset between surface ESF activities and testing activities, their interaction is limited to migrating liquids from surface ESF accommodations to testing locations. The closest underground testing to surface ESF activities is in the North Ramp Alcove #1, lying about 150 ft inside the North Portal and at an elevation of 3696 ft (CRWMS M&O GENISES database). This alcove is higher in elevation than many portions of the surface ESF, including the various muck storage areas, and leach field. This eliminates the possibility of gravitationally driven water movement (or any other liquid) from these surface ESF locations to Alcove #1. The surface of the NPP is slightly higher, but discharge of liquids here is limited to dust control water and spills. Portions of the water supply system (on the crest of Exile Hill) are somewhat higher, but they are also 1600 ft, or more, laterally removed from Alcove #1 (Table 8-1 and CRWMS M&O 1997a, p. 12.05). Other testing locations in the underground ESF are even more distant laterally from surface ESF activities. The lateral offset combined with restrictions on intentional releases, visual observation of the various water conveyance systems and other liquid bearing systems for

accidental releases, and spill cleanup are expected to be sufficient to limit potential interference with planned underground testing.

10.5 CONSTRUCTION MATERIALS, METHODS AND OPERATIONS

The use of asphaltic concrete or chip-and-seal surface treatment for road improvements and parking areas could cause contamination of soils adjacent to the roadway or parking area, primarily through physical erosion. Relatively large quantities of asphalt may be introduced into the environment through erosion, but the low solubility of asphaltic concrete or chip-and-seal surface treatment in water will limit the migration of this material to the immediate vicinity of the paved areas. The previous requirement (from the TIE for ESF H-Road Improvements, B00000000-01717-2200-00057 Rev 01, which was previously superseded by this DIE [see Table 1-1]) to control the compaction of aggregate materials below areas of application of asphaltic concrete or chip-and-seal surface treatment to limit potential contamination is no longer required. The use of a dust suppression compound, DUSTAC[®], has been proposed as an additive to the dust control water. The organic, biodegradable dust suppression compound, MARLOC[®], has also been proposed for use within the CCAB. The use of these products is intended to reduce the amount of water required to control dust. These products contain carbon compounds and could interfere with ¹⁴C isotope testing. However, no ¹⁴C testing is planned near unpaved roads or pads where this product is intended to be used (YMP 1996). (See Section 11.2.5 of this DIE for a discussion of potential waste isolation impacts associated with the use of DUSTAC[®]. The use of this product within the CCAB is prohibited based on waste isolation concerns.)

The use of fluids and materials (both organic and inorganic) are also planned for surface sites as part of the land reclamation process to restore all disturbed sites to their natural condition (Angerer 1996; YMP 1995a). Land reclamation activities evaluated here are those to be carried out for site decommissioning and topsoil storage management (YMP 1995a). Reclamation of decommissioned sites is not expected to affect site characterization testing because this activity will only be conducted at locations where planned site characterization activities have been completed. In addition, the limited use of inorganic or organic solid materials to restore the surface to its pre-disturbed, natural conditions is not expected to affect site characterization testing at other locations. Topsoil storage management is being implemented at the Topsoil Storage and the Fran Ridge borrow pit areas, which are not in the vicinity of planned isotopic or other geochemical studies of the near surface or vadose zone (YMP 1997c) that may be affected by the land reclamation materials. Surficial water will be used in limited quantities as discussed in CRWMS M&O (1996f). However, this limited water use is not expected to interfere with any current or planned testing due to the relative locations of the topsoil storage areas and testing activities (DOE 1997, pp. 12.05 and 12.06).

Surface blasting could potentially create vibrational impacts on seismic or other site characterization tests if large quantities of explosives are used or if the blasting is in close proximity to a test or testing facility. Testing-related use of vibro-seismic trucks and SBT blasting has been specifically evaluated by the DIE for SBT Activities (CRWMS M&O 1997a). Records of the time, amount of charge, and sequencing of blasts will enable the testing PI for the seismic monitoring activity to distinguish blasts from natural seismic events on the seismicity monitoring records (YMP 1998c).

No tests have been identified that rely on the standby and/or commercial electric power, which cannot be continued or repeated at a different time or location in the event of system failure. Therefore, Standby Power System (Section 6.2.3.1) failure should not result in unpredictable disruption of test data.

The ESF construction/operation, development/operation of TBM support facilities, and electrical power supply/distribution have created the potential to influence test equipment as a result of electromagnetic interference (EMI) (YMP 1997a). EMI threshold levels vary greatly from test to test based on the testing equipment used (in a number of cases equipment has not been identified which will be used for data gathering). Based on the varying threshold levels and the need to identify and protect specific test equipment/data, it has been agreed by the TCO that during the development of each FWP the organization responsible for the test will identify specific test equipment and coordinate with the A/E to survey the specific site where test equipment is to be located and determine the specific level of electromagnetic protection necessary to adequately protect testing equipment/data collection. The A/E may be required to install EMI shielding or other mitigating devices as part of implementation of the FWP (YMP 1998d).

10.6 TFM USE NOT ADDRESSED IN SECTIONS 10.2 AND 10.5

TBM construction support or disassembly accommodations and other temporary structures on the NPP and SPP may be used to store TFMs, which could create test interference if substances, such as acid, were spilled and committed to the environment. It is important that these substances not be committed to the subsurface where they could create potential test interference to nearby scientific tests (e.g., acid can change pH and corrode test equipment). Because of these concerns, the use of such liquids requires spill protection or secondary containment to limit their accidental introduction into the environment. In addition, if any spills should occur, spill cleanup as required by Federal and/or State agencies' environmental regulations (e.g., Resource Conservation and Recovery Act (RCRA), Clean Water Act (CWA), Occupational Safety and Health Administration (OSHA), etc.) for releases of hydrocarbon material, coolant, acids, or solvent leakage into the environment is also important for limiting impacts to test interference. Finally, any unrecovered spills should be reported.

Lithium Bromide (LiBr) tracer is contained in both the subsurface wastewater and the muck used to enlarge the NPP (including the Optional Muck Storage Areas). Treated subsurface wastewater containing LiBr can be used throughout the ESF as dust suppression water or for other construction purposes (Section 6.2.3.4). The tracer contained in both the muck and in the wastewater used for construction purposes on the pad or muck pile and access road does not present any test interference concerns with surface-based site characterization testing, or with testing within the subsurface ESF because the limited introduction of lithium or bromine at the surface due to these activities is expected to be insignificant compared with its continuous use for underground construction and testing water.

Chlorine compounds such as hypochlorite should not be introduced into the ESF environment before their discharge in the leach field. The location of the leach field is sufficiently removed such that the effluent has not disturbed underground tests in the ESF nor other SBT testing activities (Section 11.1.3). The chlorination facility/disinfectant feed equipment for the potable water system (CRWMS M&O 1998h), and the use of all chlorine-bearing compounds on the site,

should be controlled to minimize the potential for accidental chlorine releases via powder or solution form (see below) which could compromise test results of infiltration experiments which rely on chlorine isotope ratios (YMP 1998b). Although the use of chlorine base compounds have the potential to affect ^{36}Cl testing, hypochlorite bleach may be required to mitigate sanitation concerns. With TCO approval, limited quantities of bleach may be used for sanitation purposes within the footprint of the structures (e.g., Switch Gear Building and Change House) located on the NPP. No adverse test interference impacts are expected, provided cleanings of excess chlorine-containing bleach are disposed of in the sanitary sewer system.

Chlorination to disinfect J-13 water in the potable water system could potentially interfere with planned chlorine isotope testing (YMP 1998b). A chlorination unit next to the water storage tanks on Exile Hill is expected to handle 2.0 percent (20,000 ppm) chlorine concentrate solutions produced through the addition of calcium hypochlorite powder to water (NWI-ESF-005, Rev. 0). This concentrated chlorine solution could potentially cause test interference if it is accidentally lost to the environment and migrates, without sufficient dilution, to chlorine isotope testing areas. The natural background concentrations of chlorine in the UZ are about 70 ppm, with a natural variation (standard deviation) of 35 ppm (CRWMS M&O 1995a). There is about 10-ppm chlorine in the J-13 water to be treated (YMP 1998b). The concentrated solutions are limited to volumes of 40 gal or less at any given time (NWI-ESF-005, Rev. 0) and are only used at the chlorination unit. Therefore, precautions to minimize losses of calcium hypochlorite powder or chlorine concentrate solutions are required to limit potential test interference effects.

The potable water system will deliver dilute chlorinated water to the NPP. This water will be collected after use by the sanitary sewage system for discharge in the leach field (Section 6.2.3.6). The disinfectant chlorine is planned to be added at $0.5 \text{ ppm} \pm 0.1 \text{ ppm}$ (NWI-ESF-005, Rev. 0) to the J-13 water used in the potable water system. Chronic, low-level losses from these systems over long operating times are difficult to control or detect. However, due to the low concentration of added chlorine and the larger ambient concentration of chlorine in J-13 water, the water being lost should not be substantially different from the original J-13 water. The potential change induced in the treated J-13 water should be negligible relative to the natural variations in observed values of UZ water ($\pm 35 \text{ ppm}$ [CRWMS M&O 1995a]). Therefore, any accidental losses from the potable-water distribution system or from the sanitary sewage system are expected to have negligible effects on chlorine isotope testing. Furthermore, any significant losses would be treated as spills, and an "after-the-fact evaluation" would be performed to determine any potential impacts to site characterization data.

A one-time treatment of the additions to or modified sections of the potable water system with up to 50,000 gal of super-chlorinated water (at about 500 ppm) is required (Section 6.2.3.6). A potential for test interference exists due to the higher chlorine concentrations. Therefore, precautions should be taken to minimize losses during this operation. For the initial system treatment, the water was injected at the potable water storage tank on Exile Hill, collected from the system on the NPP in water trucks, and disposed of in Fortymile Wash (Sections 6.2.3.4, 6.2.3.5, and 6.2.3.6). For subsequent treatments of additions to this system, an appropriate quantity (less than 50,000 gal) of superchlorinated water is injected at a point upstream of the added piping, collected from the system on the NPP in water trucks, and disposed of in Fortymile Wash (best available design information – Section 3). Due to the limited quantities of use, and the direct collection for disposal in Fortymile Wash, the superchlorinated water treatment is not expected to affect chlorine isotope testing.

The use of oil-soaked sand or gravel as part of the installation of the ESF water supply tank and booster pump tank foundations (corrosion prevention) could cause test interference by changing ambient hydrological conditions through release of hydrocarbons into the underlying alluvium and bedrock (Section 6.2.3.6). Inadvertent release could alter age dating test results based on carbon isotopes. Section 6.2.3.6 indicates that the design and construction of these tank foundations incorporates an impermeable liner between the oil-soaked materials and the underlying bedrock at each tank, which will minimize test interference impacts. The surface conveyor operation has a potential to release contaminants (lubricating oils, hydraulic fluid, and grease) that may adversely impact site-characterization data (Section 10.5). The potential release of these materials into the underlying alluvium and bedrock should be minimized to the extent practical. Leakage and/or overflow of effluents from piping systems (Sections 6.2.3.4 and 6.2.3.6) could cause test interference to any future tests, by changing the natural hydrological state of the area and by introducing effluents whose properties may alter natural conditions. A regular program of visual observation of the water distribution and wastewater piping layouts for evidence of excess water saturation and/or vibrant vegetation (e.g., quarterly) should minimize this potential concern.

11. IMPACT TO WASTE ISOLATION CHARACTERISTICS

11.1 HYDROLOGY

11.1.1 Acreally Distributed Water Discharge Over or Near Potential WE Locations

As discussed in Section 6, water is discharged on the surface for dust control on the NPP and SPP, including the Optional Muck Storage Areas; unpaved access roads; and other ESF auxiliary sites. Water is also added to fill material when constructing pads and roads to improve compaction, and may be present in excavated materials stored on the surface. The majority of the surface water use for ESF activities is dust control water. Dust control water is applied primarily to the surfaces of unpaved roads and pads to limit the generation of atmospheric dust. The use of dust control water is required only when the roads or pads support activities; roads and pads that are out of service do not require dust control water. Therefore, in general, dust control water and surface water discharge are limited to selected areas and time periods.

The effects of surficial water use on potential repository performance can be evaluated by considering the steps that must occur for the release of radioactive waste to the accessible environment. Potential repository performance depends on the duration of radioactive material containment in waste containers, radionuclide release rates from waste containers that have been breached, and radionuclide transport through engineered and natural barriers to the accessible environment. In the UZ, water movement is expected to be downward, possibly accompanied by lateral movement (CRWMS M&O 1998j, Figure 2-92). Therefore, radionuclides carried in the aqueous phase are expected to move along pathways that are below and possibly lateral to potential WE locations. The UZ above WE locations is a potential pathway for radionuclides carried in the gas phase. However, no adverse effects on gaseous radionuclide transport have been linked to increased water saturation of rock overlying potential WE locations. For these reasons, water (and other materials as well) introduced at the surface should not affect radionuclide containment, release, or aqueous radionuclide transport unless it flows to or below potential WE locations.

11.1.1.1 Potential Evapotranspiration

Yucca Mountain lies in a desert environment in which the average potential evapotranspiration rate, conservatively estimated to be at least 2.6 feet per year (ft/yr), greatly exceeds the annual average precipitation, about 0.56 ft/yr (Hevesi and Flint 1993). The estimate of 2.6 ft/yr uses theoretical estimates for the potential evapotranspiration over a 13-year period (Hevesi and Flint 1993). The potential evapotranspiration estimates for the first and thirteenth years are for partial years, and therefore are smaller than for a complete year. However, these partial year values are conservatively assumed to be the entire evapotranspiration for those years in the computation of the average evapotranspiration rate. The ultimate fate of water discharged on the surface depends on both infiltration and evapotranspiration processes. However, evapotranspiration may be argued to be the more important process for water discharge at rates less than the average evapotranspiration rate. Studies of near-surface infiltration and evapotranspiration in alluvium at Yucca Mountain found that natural infiltration events did not penetrate further than 6.6 ft into the alluvium (Hevesi and Flint 1993). A calibrated mathematical model of infiltration indicated that at higher precipitation rates (up to 2.5 times the actual precipitation record, averaging about 1.4 ft/yr), shallow infiltration did not fully penetrate the alluvium or result in increased flux to the underlying formations (Hevesi and Flint 1993). The model results suggest that one factor limiting deep infiltration is that evapotranspiration (and possibly vapor flow) processes are effective at removing moisture from the alluvium at depths up to 23 ft (Hevesi and Flint 1993). Finally, the expected use of dust control water, unlike natural precipitation, is likely to be positively correlated with periods of high-potential-evapotranspiration rates. These considerations lead to the conclusion that surface water discharge limited to 2.6 ft/yr or less is unlikely to penetrate into the underlying consolidated rock or have any influence on potential repository performance.

The evapotranspiration rate may not prevent deep infiltration of water applied to surface exposures of consolidated, fractured rock. If water is ponded on these surfaces, it may be able quickly to invade the fractures and move beyond the influence of evapotranspiration processes. However, water discharged on consolidated rock surfaces is unlikely to penetrate deeply into the fractures if not ponded. Therefore, surface water discharge that does not pond on the surface is unlikely to have any influence on potential repository performance.

11.1.1.2 Deep Infiltration

Surface water discharge in excess of the potential evapotranspiration rate may infiltrate into deeper units. The potential impacts of deep percolating water on waste isolation may be evaluated with respect to the potential effects of increased water saturation on potential engineered repository components (including waste packages), release of radionuclides from waste packages, and aqueous and gaseous radionuclide transport. The impacts are discussed below in terms of near-field and far-field effects. The near-field effects are the potential changes that may occur in hydrologic conditions near waste packages. The far-field effects are the potential changes that may occur in hydrologic conditions between the potential repository elevation and the water table.

11.1.1.2.1 Deep Infiltration: Near-Field Effects

A bounding analysis of the maximum saturation at the potential repository level may be made using the propagating wave solution given in Attachment III. This solution is based on the gravity flow of excess water in the matrix. The effects of capillary pressure are neglected as a conservative assumption because capillary effects would tend to disperse introduced water and reduce peak saturations. The calculation requires some assumptions about the initial distribution of the introduced water in the rock mass. The conservative conceptual model used is that water introduced will enter fractures and saturate the surrounding matrix in the TCw unit and the TSw unit. This assumption maximizes the matrix water saturation, which is the parameter used to identify potential impact (independent of flow rates). Water that enters the much more permeable matrix of the PTn unit percolates relatively quickly to the underlying TSw unit. Therefore, we assume that water in the TCw unit percolates to the TSw through the PTn instantaneously, relative to the slower-moving excess-water saturation in low-conductivity TCw and TSw matrix. Given this conceptual model, the calculation for peak saturation at the shock front may be performed in a manner described in Attachment III. A peak water-saturation value of 0.9 is used, which is conservatively bounded by the water saturation value of 0.99 identified as the threshold value for impact in CRWMS M&O (1999a). The calculation indicates that the maximum saturation at the potential repository level should be less than 0.9 if the *cumulative surface water input*, in excess of the potential evapotranspiration rate, is less than 17.5 ft.

11.1.1.2.2 Deep Infiltration: Far-Field Effects

The criterion used is that the effect of introduced water on far-field migration of radionuclides is expected to be negligible if the subsequent increase in saturation between the potential repository and the water table does not increase the effective conductivity in the matrix by more than a factor of 2. This criterion is bounded by CRWMS M&O (1999a), which identified natural system variations in travel time to be factors of 13 to 39. To approximate the change in hydraulic conductivity under steady flow conditions, we assume that the excess water is distributed evenly between the different hydrogeologic units, such that the effective conductivity is increased by the same factor in each unit. This is conservative because we check for impact based on the new steady flow rates, which, of course, could not be maintained indefinitely because the source of added water is limited.

The increase in saturation in each unit required to increase its existing effective conductivity by a factor of 2 is computed in Attachment IV. These increased saturations can then be used to determine the *cumulative water input* at the surface in excess of the potential evapotranspiration rate that would result in such a change to the effective hydraulic conductivities. This quantity is found to be 13.5 ft.

11.1.1.3 Accidental Release from Water Storage Tanks

A worst-case accidental release of water may occur if the water storage tanks on top of Exile Hill rupture and suddenly release water. This type of water loss may exceed the above criterion for surface water application. However, up to 13.5 ft of water may infiltrate at any point in excess of the evapotranspiration limit. Infiltration of 13.5 ft of water would require impoundment of the

released water to a depth of 13.5 ft. Given the topography around Exile Hill, this depth of surface ponding is not considered likely even from a sudden release of water.

11.1.1.4 Summary

The analyses discussed above lead to the following conclusions concerning the application of water on the surface:

1. Application of dust control water at any point on the surface is unlikely to penetrate the underlying rock or affect repository performance if the application rate is less than the average potential evapotranspiration rate of 2.6 ft/yr, or 0.48 gal/yd²/day, and the discharged water does not pond on the surface.
2. The application of any water (dust control, compaction water, etc.) **in excess** of the potential evapotranspiration rate (with or without surface ponding) is unlikely to affect potential repository performance if the **cumulative excess** at any point on the surface is less than 13.5 ft over the lifetime of ESF activities.

11.1.2 Point Source Water Discharge Over or Near Potential WE Locations

A possible disturbance to the subsurface hydrology may result if there is an accidental water discharge during operation of the ESF water or wastewater conveyance systems. This primarily applies to the conveyance pipe carrying water from well J-13 to the storage tanks on Exile Hill and the NPP. This water supply and distribution system is located just east of Potential Expansion Area 6 (Section 8).

A bounding analysis for this type of event can be performed by assuming that any discharge enters the fracture system of the TCw hydrogeologic unit. The water in the fractures will percolate to the TCw/PTn boundary. Lateral spreading of the infiltrating discharge may be bounded by conservatively assuming that flow across the upper unit of the PTn (Tpcpv lithostratigraphic unit—Section 9.1) is dominated by matrix flow (Bodvarsson et al. 1997, Section 2.2.2). Given this assumption, the percolating water will spread out over the PTn until the flux of introduced water equals the saturated matrix hydraulic conductivity in the upper PTn unit. This upper unit has a saturated matrix hydraulic conductivity of 2.8×10^{-8} ft per second (Thordarson 1983). For a disturbance zone of approximately 74 ft in radius (the minimum drift spacing in current conceptual repository design [CRWMS M&O 1999b]), then the limiting flux rate is 310 gal/day. This distance is believed to be conservative because, if an accidental discharge disturbs a WE area of this size, waste packages could be arranged in the potential repository drifts around the disturbed zone without significantly affecting the local thermal loading. This would (at most) affect about 1900 square yards (yd²) of WE area, which is only 0.053 percent of the total potential repository WE area of about 3.6 million yd² (CRWMS M&O 1999b).

11.1.3 Lateral Boundary for Impacts of Water Discharge on Waste Packages, Engineered Barrier System, or Natural Barriers within the UZ

The Total System Performance Assessment – Viability Assessment (TSPA-VA) UZ flow model (Bodvarsson et al. 1997, Figure 4.2) indicates that infiltration east of the Bow Ridge Fault does

not affect flow in the UZ in the potential repository WE zones or along potential radionuclide pathways through the UZ.

11.1.4 Effects of Surface Water Discharge on Subsystem Performance in the Saturated Zone

Surface discharge east of the Bow Ridge Fault has been analyzed with respect to potential effects on the saturated zone, primarily to determine the effects of the planned sanitary sewage leach field. The saturated zone underlying the water conveyance and disposal systems may be disturbed by infiltrating water and that disturbance will propagate laterally. In this area under the leach field, the natural slope of the groundwater table (and the inferred flow direction) is to the southeast, away from potential expansion areas for WE (Ervin et al. 1993). Bounding analyses were performed (Attachment V) to address water table elevation perturbations radially away from the discharge point to locations below potential expansion areas. The analyses were based on the conservative model that the discharged water enters the saturated zone at a point, as if injected through a well. Changes to the water table elevation may be evaluated with respect to the observed natural variation in water table elevations in boreholes. The natural variations are found to be on the order of 3.3 ft (Robison et al. 1988). Therefore, if changes to the water table elevation resulting from surface discharge are 3.3 ft or less below potential WE areas, these changes are expected to have a negligible impact on repository performance. The results of these bounding calculations determined that a surface discharge of 29,000 gal/day or less over a 25-year period (i.e., the ESF design life [YMP 1997a]) would limit migration of contaminants from the discharge point to locations outside potential expansion areas and limit water table elevation changes under potential expansion areas to less than 3.3 ft.

To extend this analysis to dust control applications of water, consider the area that could be wetted at a nominal value of 0.48 gal/yd²/day (the evapotranspiration rate identified in Section 11.1.1). The 29,000 gal/day may be spread over a region larger than 60,000 yd² at this application rate.¹¹ Furthermore, any adverse effects from the addition of water (without dissolved constituents that may have adverse effects) downstream of the potential repository (downstream relative to saturated-zone flow) are difficult to identify. A groundwater table mound downstream of the repository would tend to divert and slow radionuclide movement in the saturated zone, as much as enhance such movement.

11.1.5 Shallow Excavations

Shallow excavations, 33-ft deep or less (Assumption 4.1), are required to install underground utilities, footings for surface structures, and other items. The excavations primarily will be in compacted fill or alluvium, with a smaller fraction of the excavations entering the TC Tuff. The excavations will be backfilled at the time of, or before, construction of the particular item is completed. These excavations will temporarily perturb local infiltration potential, but due to the

¹¹ Due to a substantial increase in the water loss limit applicable surface ESF accommodations located east of the Bow Ridge Fault (which includes the various ESF muck, rock, and topsoil storage areas), the previously established water controls and muck pile height requirements for each of these areas are now unnecessary. As such, the associated DIE section has been deleted by Revision 03.

limited areas and depths, and the short times that the trenches will remain open (i.e., a few weeks), these changes are expected to be negligible.

The south portal lies to the west of the Bow Ridge Fault, therefore water use activities at this location fall under the analyses summarized in Section 11.1.1.4.

11.2 GEOCHEMISTRY

11.2.1 NPP (including Optional Muck Storage Areas), Associated Structures, Utilities, and Access Road, Rock and Topsoil Storage Areas, Subdock Storage and Lay Down Areas, ESF Weather Station and Other Meteorological, Radiological, and Geodetic Monitoring Stations, and Fran Ridge Borrow Pit No. 1

A previous evaluation (CRWMS M&O 1994a) established a set of solid materials that are surficial, not intended to remain post-closure, and not significantly soluble (i.e., non-committed). These materials should not contribute noticeable, non-removable material to the environment. Therefore, they are expected to have negligible effects on the geochemistry near potential WE sites, and along potential gaseous and aqueous radionuclide pathways. The materials listed in that evaluation are (CRWMS M&O 1994a): plastic, PVC, Acrylonitrile-Butadiene-Styrene (ABS) plastic, rubber, solid metals, wood, concrete, iron, steel, aluminum, rubber, glass, sheet metal, graphite-based grounding material (GEM[®] trademarked name for Hydrous Aluminum Silicate mixed with Carbon), copper wire or plates, explosives, asphalt, asphaltic concrete, concrete curing compound, and soil containing *Road Oyl*.

A number of additional materials that are included in this evaluation for use associated with surface ESF accommodations can be regarded similarly as surficial, non-committed items such that they are expected to have negligible effects on the geochemistry near potential WE sites, and along potential gaseous and aqueous radionuclide pathways. These are: gravel for roads, chip-and-seal surface treatment, weld rod (E70XX electrodes), glue (silicone), PVC cement (PVC), silicone caulking compound [American Society for Testing and Materials (ASTM) C-920D], concrete joint sealant (elastomeric), extension joint material (particle board), insulation (extruded polystyrene), pipe thread compound (teflon), fire sealant (ASTM E-815), bentonite clay, and liner glue (PVC).

Because the solid materials discussed above are surficial, not intended to remain post-closure, and not significantly soluble (i.e., non-committed) (CRWMS M&O 1994a), the planned activities/items should not contribute noticeable, non-removable material to the environment. In addition, establishment and operation of maintenance programs can only further ensure that the solid items listed above are not expected to contribute noticeable residue to the environment. Therefore, the above non-committed materials used/stored at the surface are expected to have negligible effects on the geochemistry near potential WE sites and along potential gaseous and aqueous radionuclide pathways.

A set of fluids were listed in the previous evaluation (CRWMS M&O 1994a) that are expected to have negligible impact to waste isolation provided that plans for spill containment and clean-up exist. Such fluids are constrained to be those which are not *planned* for dispersal into the environment. Unlike solids, fluids may become part of the post-closure (committed)

environment through accidental breach of their container, even if the container is maintained. For example, mineral oil, used for transformer and circuit breaker insulation, may be retained inadvertently in the post-closure environment if spilled and not remediated. Given a plan for spill containment and clean-up, non-committed fluids used/stored at the surface are not expected to have significant effects on the geochemistry near potential WE sites and along potential gaseous and aqueous radionuclide pathways. The fluids included in the surface-based non-committed substances evaluation are (CRWMS M&O 1994a): propane, cylinders of gas standards for calibration of instruments, nitrogen and argon gases, diesel fuel, ethylene glycol (antifreeze), lubricants for machines, insulating oils, fuel oil, gasoline, hydraulic fluid, battery acid, cleaning solvents, port-a-potty fluids (e.g., *potpourri*), and powders of the materials listed above.

A number of additional fluids that are included in this evaluation for use at the NPP can be regarded similarly as non-committed items such that they are expected to have negligible effects on the geochemistry near potential WE sites, and along potential gaseous and aqueous radionuclide pathways. These are: thread-cutting oil, air compressor lubricating oil, tire ballast materials, silicone sealant, and cable-pull lubricant.

As stated in the evaluation of surface-based non-committed fluids and materials (CRWMS M&O 1994a), any planned non-committed fluids or materials that become retained unintentionally as part of the post-closure environment require documentation of the amounts of substance retained in the environment and evaluation of the potential waste isolation impact of that specific retention. The materials and fluids discussed above can be used throughout the surface ESF as long as they are not emplaced in a committed manner.

A few fluids, which are used in surface ESF activities/accommodations, are not in the above category and are evaluated here separately. *Polyphos 44* may be added to surface-use water to prevent scaling. Because it is used in such small concentrations (less than approximately 10 ppm in water) as a surface application (Kalia 1992), such that dilution during transport to potential repository levels should produce negligible concentrations, it is expected to have negligible impact to waste isolation.

Vapors and residues from oxygen and acetylene used for welding can reasonably be assumed to disperse and have negligible impact on waste isolation.

Any leachate that may be produced by precipitation interaction with the rock storage materials, which should not be greatly different from groundwater compositions, should be prevented from infiltrating by the liner under the rock storage area, and therefore, is expected to have negligible impact on waste isolation.

11.2.2 Optional Muck Storage Areas and Surface Conveyor

The pulverized rock and water that constitute the muck are expected to have negligible impact on the ambient geochemistry because these materials from the subsurface excavation commonly occur at the surface. Presence of the approximately 20 ppm of LiBr used to trace subsurface construction water is expected to produce negligible geochemical changes (CRWMS M&O 1995a).

The muck is not expected to carry any significant organic contaminants because the subsurface excavation and conveyance systems do not discharge any materials other than traced construction water into the muck under normal operating conditions. Organic contamination of the muck could occur, however, due to accidental discharge of organic liquids such as hydraulic fluids or diesel fuel. The exact behavior of specific organic materials in the environment is not known at present. If considered as a generic class, the organic content of the muck may be compared with soil analyses from Midway Valley and Fortymile Wash (Attachment VI). These analyses have found the organic content of soils to range from 0.2 to 0.9 percent. Therefore, a conservative but reasonable limit for the organic content is 0.2 percent. However, organic contamination is expected to be removed from muck kept at the Optional Muck Storage Areas, or contained in the NPP, to the extent practical (Assumption 4.5).

11.2.3 Use of Excavated Muck as Repository Backfill

Requirements for the geochemical characteristics of backfill have not been determined. Muck from the TS Loop is expected to be primarily welded tuff. The excavated materials, except those from minor vitric zones (YMP 1995b, 1995c, 1995d), are expected to have relatively uniform geochemical characteristics and, therefore, do not require separation. The TS Loop is to be 5 miles of 25-foot diameter TBM excavation with only the first 200 ft and a number of small (relative to the whole loop) alcoves and drifts excavated with drill-and-blast techniques (CRWMS M&O 1995a). The ECRB Cross Drift is approximately 1.75 miles of about 16.4-ft diameter TBM excavation with only the first 87 feet excavated by drill-and-blast and non-TBM mechanical excavation techniques (CRWMS M&O 1999a and best available design information – Section 3). Additional excavations using both mechanical and drill-and-blast techniques are expected. The small fraction of drill-and-blast-excavation muck may contain minor residues from blasting materials; however, these quantities are not expected to be important. Substantial excavations of nonwelded tuff, such as the proposed CH drift, may require separate storage to preserve the zeolitic character of this horizon. Use of the muck as backfill for repository closure may place severe restrictions on the acceptable organic content of the muck.

11.2.4 Surface Water Systems and Sanitary Sewage Leach Field

Substances other than water will be used and handled during construction and operation of the surface water and wastewater systems. The use of specific inert solids, fuels, and lubricants at the surface has been evaluated (CRWMS M&O 1994a). Any additional substances not previously addressed will require specific evaluation.

In addition, the subsurface wastewater streams will consist of water containing approximately 20 ppm LiBr traces (CRWMS M&O 1995a) from subsurface excavation activities and will potentially carry small quantities of petroleum-based, non-aqueous phase liquids (NAPL). LiBr has been analyzed and approved for use underground to trace construction water movement (CRWMS M&O 1999a). Any NAPL carried in water removed from the tunnel should have negligible impact to the geochemical environment near potential WE sites or along potential radionuclide pathways because controls for the quantities of NAPL discharged underground (CRWMS M&O 1999a) are more restrictive than requirements on the surface.

The sanitary sewage leach field will discharge water carrying elevated levels of dissolved organic matter, chlorides, nitrates, and other constituents. The typical organic content of raw sewage includes 210 ppm dissolved organic carbon (DOC) and 170 ppm suspended organic matter, of which 100 ppm is settleable (i.e., removable in the septic tank) and 70 ppm is nonsettleable (Fair et al. 1968, p. 20-16). These values allow a bound of ~280 ppm to be estimated for the organic content of the water dispersed in the leach field. For a flow rate of 20,000 gal/day (CRWMS M&O 1998g) over a 25-year lifetime (YMP1997a), this represents about 430,000 lbs of organic material input below the leach field. Although some of this organic input will be retained within the approximately 200 ft of alluvium/colluvium (Scott and Bonk 1984), most of it is dissolved and will likely be transported into the formations below the surface. Therefore, bounds on the potential impacts from this organic input should not be evaluated relative to the surface organic content.

Because flow through the UZ is unlikely to transport material laterally from the leach field discharge point to WE locations (Section 11.1.3), these organic materials are unlikely to interact with waste packages. Therefore, these organics pose negligible potential for impact to waste package corrosion rates and release of radionuclides from the near field environment of the engineered barrier system. Although some organic material may be retained in the UZ, most of these organics are dissolved and will likely be transported downward into the saturated zone groundwater system. The general saturated zone groundwater flow near the leach field is in a southeasterly direction (Ervin et al. 1993), away from potential WE zones. Therefore, the leach field discharge will enter the saturated zone along potential radionuclide pathways downstream of the potential repository block. In order that the potential impacts to waste isolation capabilities can be evaluated, the potential perturbation to potential aqueous radionuclide transport pathways should be bounded.

Organic inputs along potential aqueous radionuclide paths in the saturated zone may affect radionuclide transport in a variety of ways and could work to either increase or decrease radionuclide mobility. A calculation has been performed to conservatively bound the percentage of saturated-zone potential aqueous radionuclide pathways that may be perturbed by this organic influx (Attachment VII).

The potential repository and leach field may create plumes in the saturated zone that would migrate horizontally toward the CCAB boundary. The potential for impact can be evaluated in terms of the fraction of overlap between the potential sewage and radionuclide plumes within the CCAB boundary. Analyses bounding the potential plume areas are presented in Attachment VII, which show that the overlap should not exceed 14 percent. This is a conservative bound in terms of the interaction between the radionuclide plume and sewage plume because it assumes that the mixing depth for both plumes is the same. Because the radionuclide plume has migrated over a greater distance before reaching the sewage plume, the depth of mixing for the radionuclide plume should be greater than the mixing depth for the sewage plume.

11.2.5 Additives for Dust Control Water

The use of a dust suppression compound, DUSTAC[®], has been proposed as an additive to the dust control water. However, review has identified that the main constituent of this product is ammonium lignin sulfonate. Pending additional evaluation, the potential release of nitrate (from

the ammonia) is considered sufficiently limiting as to preclude the use of this product within the CCAB. The organic, biodegradable (as discussed in the following section) dust suppression compound, MARLOC[®], has also been proposed as an additive to dust control water within the CCAB. A review of this material identified negligible potential for waste isolation impacts, provided use is consistent with manufacturer recommendations.

11.2.6 Land Reclamation Materials

The proposed land reclamation materials include sources of aqueous nitrate (NO_3^-), sulfate (SO_4^{2-}), phosphate (PO_4^{3-}), and organics (Angerer 1996). These materials are potential sources of nutrients for microbes, which may accelerate waste package corrosion through enhanced microbial activity. In addition, dissolved organic as well as phosphorus species have the potential for readily complexing radionuclides (specifically actinide elements) and may facilitate radionuclide transport in the geosphere.

Inorganic salts of nitrogen, phosphorus, and sulfate, used for fertilization, may be evaluated by comparing their proposed maximum application densities to the natural variation of the mass density for these elements in Midway Valley soils. The inorganic fertilizer contains nitrogen in the form of a mono ammonium salt with a maximum of about 20 percent by weight (Angerer 1996). The maximum proposed application density of the fertilizer is 60 pounds per acre (lbs/acre) (Angerer 1996). Ammonium, or NH_4^+ , has a molecular weight of 0.0397 pounds per mole (lbs/mole) and nitrate, or NO_3^- , has a molecular weight of 0.137 lbs/mole. Therefore, each pound of ammonium contains the same amount of nitrogen as $0.137/0.0397 = 3.45$ lbs of nitrate. The mass application rate of nitrate is calculated from the mass application rate of ammonium, or $0.2 \times 60 \text{ lbs/acre} = 12 \text{ lbs/acre}$ ammonium, and multiplying by the ratio of molecular weights, or $12 \times 3.45 = 41.4 \text{ lbs/acre}$ nitrate. The sample standard deviation for the mass density of nitrate (nitrate concentration times bulk density) in the soil in Midway Valley (items 4051 through 4058 in Attachment VI) is 6.61×10^{-4} pounds per cubic foot (lbs/ft^3). Given the depth of the alluvium is at least 32.8 ft in Midway Valley (Scott and Bonk 1984), this is equivalent to a surface mass density variation of 2.17×10^{-2} pound per square foot (lbs/ft^2) or 944 lbs/acre. The maximum application rate of inorganic nitrogen in the fertilizer results in an average mass density (as nitrate) that is only about 4.4 percent of the natural variation of nitrate mass density in the soil. Therefore, the proposed local applications of fertilizer are expected to have a negligible effect on the average nitrogen composition of the soil.

A similar argument may be made for applications of phosphorus, in the form of inorganic phosphate. The inorganic fertilizer contains phosphorus, in the form of a phosphate salt with a maximum of about 20 percent by weight (Angerer 1996). The maximum proposed application density of the fertilizer is 60 lbs/acre (Angerer 1996). Phosphate, or PO_4^{3-} , has a molecular weight of 0.209 lbs/mole and phosphorus has a molecular weight of 0.0683 lbs/mole. Therefore, each pound of phosphate contains the same amount of phosphorus as $0.0683/0.209 = 0.327$ lbs of pure phosphorus. The mass application rate of phosphorus is calculated from the mass application of phosphate, or $0.2 \times 60 \text{ lbs/acre} = 12 \text{ lbs/acre}$ phosphate, and multiplying by the ratio of molecular weights, or $12 \times 0.327 = 3.92 \text{ lbs/acre}$ phosphorus. The sample standard deviation for the mass density of phosphorus (phosphorus concentration times bulk density) in the soil in Midway Valley (items 4051 through 4058 in Attachment VI) is $7.07 \times 10^{-5} \text{ lbs/ft}^3$. Given the depth of the alluvium is at least 32.8 ft in Midway Valley (Scott and Bonk 1984), this

is equivalent to a surface concentration variation of 2.32×10^{-3} lbs/ft², or 101 lbs/acre. The maximum application rate of phosphate in the fertilizer results in an average mass density (as phosphorus) that is only about 3.9 percent of the natural variation of the phosphorus mass density in the soil. Therefore, the proposed local applications of fertilizer are expected to have a negligible effect on the average phosphorus composition of the soil.

The fraction of sulfate contained in the fertilizer is not specified, but may be reasonably bounded as being less than 60 percent of the bulk weight (Angerer 1996). Therefore, given a maximum mass-application density of fertilizer of 60 lbs/acre (Angerer 1996), the maximum sulfate-application rate is about 36 lbs/acre. This mass-application rate for sulfate is much less than the 3350 lbs/acre sulfate estimated for application of AIRTROL in Attachment X. The AIRTROL application was found to have a negligible effect on natural aqueous sulfate concentrations at the nearest WE locations, and bounds any potential effects on waste isolation from sulfate in fertilizer.

A soil stabilization product called Desert Bloom, containing a ferrous oxide complex, may be used at a maximum application rate of 4 gallons per acre (gal/acre), or 0.535 cubic feet per acre (Angerer 1996). This product has a mass density of 71.3 lbs/ft³ (Angerer 1996), therefore the maximum mass application density is 38.1 lbs/acre. This may be taken to be pure iron, as a conservative bound for the application of iron. The sample standard deviation for the mass density of iron (iron concentration times bulk density) in the soil in Midway Valley (items 4051 through 4058 in Attachment VI) is 8.21×10^{-5} lbs/ft³. Given that the depth of the alluvium is at least 32.8 ft in Midway Valley (Scott and Bonk 1984), this is equivalent to a surface-mass-density variation of 2.69×10^{-3} lbs/ft², or 117 lbs/acre. The maximum application density of iron in the soil stabilization product results in an average mass density that is about 33 percent of the natural variation of iron mass density in the soil. Therefore, the proposed local applications of Desert Bloom are expected to have a negligible effect on the average iron composition of the soil.

Another soil stabilization product proposed for use is AIRTROL, which is primarily composed of gypsum (Angerer 1996). The use of AIRTROL is evaluated in Attachment X with respect to the potential changes in sulfate concentrations due to the transport of aqueous sulfate with infiltrating water from the surface to the nearest potential WE locations. This bounding calculation shows that the maximum potential changes to aqueous sulfate concentrations at potential WE locations are about 33 percent of the natural variation of measured aqueous sulfate concentrations in the UZ.

The following organic TFMs are planned for and/or are being used for reclamation and dust control activities on the site surface: wheat straw, wood fiber, M-binder, Hydroshield, Soil Master, Chem-loc, Agri-lock, and soluble and nonsoluble polyacrylamide gel. Two issues are of potential concern to waste isolation in using these and future organic TFMs on the site surface. First, the dissolution of added organic TFMs into infiltrating water to form DOC, which if allowed to migrate to the repository horizon, could provide nutrients for microbial activity that could accelerate waste package corrosion. Additionally, DOC has the potential to complex radionuclides and could facilitate the transport of complexed species to the geosphere. The second issue involves the generation of carbon dioxide (CO₂) gas in the soil zone. Water, CO₂, and nonorganic minerals are produced from the decay of soil organic matter by biologic activity

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in the soil horizons. Increased levels of CO₂ gas in the subsurface can potentially interact with both groundwater and rock minerals to alter groundwater pH and mineral stabilities in the subsurface. A recent evaluation of adding organics to the site surface was conducted, and it addresses the above issues (CRWMS M&O 1997b). The conclusions of this report are included below.

“Due to the effectiveness of microbial, physical and chemical degradation in the soil, DOC levels entering the groundwater are low and relatively insensitive to organic load at the surface. Regional variations in surface organic load under similar or differing climatic regimes have little impact on the quantity of DOC being transported to the groundwater during recharge. DOC increases only minimally due to the abundance of organic matter at the site surface or due to increased precipitation and groundwater recharge. Therefore, the effects of adding biodegradable organic TFMs to the site surface for construction, characterization, or reclamation activities should not increase DOC values in the groundwater. In addition, any long-term change in climate (i.e., return to pluvial conditions) should provide little DOC increase in the groundwater.”

“Additional CO₂ generated via respiration from the addition of organic matter during construction, characterization, or reclamation will persist only as long as the organic material remains undegraded in the soil. The turnover rates are relatively short for desert environments (less than 50 years). Therefore, the additional organic matter and elevated CO₂ levels should dissipate well before potential waste package release, thus precluding any significant impacts to waste isolation.”

The planned use of committed natural and/or synthetic **biodegradable**¹² organic TFMs to the site surface during site characterization, construction, or reclamation activities should not impact waste isolation. However, any **non-biodegradable** organic material intended to be committed would not degrade over time, and therefore could potentially impact waste isolation.

The above findings are only intended for the planned use of limited amounts of biodegradable TFMs that are fixed in the soil and not for the accidental spilling or dumping of large volumes of hydrocarbons. Large spills could potentially migrate via advection and/or diffusion to WE areas and/or the water table, thus creating large impacts to waste isolation.

¹² Biodegradable has been defined by the California Advertising Statute amended on the 30th of April 1991 as follows: “Biodegradable means that a material has the proven capability to decompose in the most common environment where the material is disposed of within 3 years through natural biological processes into nontoxic carbonaceous soil, water, CO₂ or CH₄” (Harold 1993). This is an acceptable definition with two clarifications. First, the reclamation materials described above are not being “disposed of” in the sense implied by Harold (1993). Second, biodegradation may occur more slowly in the desert environment in the vicinity of Yucca Mountain. However, such degradation is still expected to occur in much shorter time frames than would be required to adversely impact the waste isolation capabilities of the potential repository. As such, materials that would be expected to degrade to the end products described above in the desert environment surrounding Yucca Mountain within approximately 50 years may be considered to be biodegradable for the purposes of this DIE..

In summary, the proposed use of materials for land reclamation have been found to have a negligible effect on the average soil water composition or water compositions at the closest potential WE locations. Therefore, the use of these materials in the manner described is expected to have negligible adverse effects on the waste isolation characteristics of the site.

11.3 THERMAL/MECHANICAL CHARACTERISTICS

Blasting may be used if required to level ground or excavate shallow holes and trenches. Blasting will damage rock beyond that excavated, and therefore does have the potential to change the mechanical characteristics of rock surrounding a blast-excavation. Surface ESF activities are conducted primarily on unconsolidated surficial deposits or on exposed rock that is part of the TCw (Section 9.1; Scott and Bonk 1984). Damage to the TCw rock is not expected to significantly affect hydrogeologic or geochemical characteristics that may impact potential repository performance due to the highly fractured natural character of this unit. In addition, the thermal and/or mechanical characteristics of the TCw have not been identified as important characteristics relative to potential repository performance. However, damage from surface activities may penetrate and disturb the underlying PTn. The PTn is believed to have low fracture density and may be an impediment to flow in fractures between the surface and potential WE locations (Bodvarsson et al. 1997, Section 2.2.2). Therefore, it is desirable to control mechanical damage induced by surface blasting and avoid the creation of fractures in the PTn. A ground velocity of 3.9 inches per second (in/sec) has been identified as a conservative limit for potential rock damage (CRWMS M&O 1995a). The distance between the ground surface and the TCw/PTn contact is on the order of 265 ft and the PTn has an average thickness of 128 ft (CRWMS M&O 1996e). Due to the variability of the TCw unit thickness at different locations, however, a very conservative bound on damage from blasting is used to limit the potential damage zone around a blast excavation to 33 ft, which is approximately one-third of the average estimated minimum thickness of the TCw. In Attachment VIII, the relationship between induced ground velocity, distance and explosive charge is used to estimate that an instantaneous detonation of a 30 lbs of explosives would not damage more than a 33 foot zone beyond the point of blast. At all activity locations discussed in Section 6 that are sufficiently close to potential WE areas such that infiltration through the PTn may affect performance (west of NSCZC E573200, see Section 11.1.3), the thickness of the TCw is found to be at least 100 ft (Scott and Bonk 1984). Since it is assumed that surface blast holes (e.g., trenches, post-holes, lamp-posts, etc.) are not deeper than 33 ft (see Section 4.1), a 30-pound (lb) blast should not affect fracturing in the PTn.

Blasting is expected for excavation of the boxcut at the South Portal. This excavation may require the simultaneous ignition of explosive charges in several blast holes. The total amount of explosives per delay may exceed the 30 lbs discussed above, since the thickness of the TCw below finish grade for the SPP is about 220 ft (YMP 1995d). A specific analysis for blasting at this location given in Attachment VIII indicates that a 1000-lb explosive charge could damage rock to a depth of about 105 ft below the point of explosion. A simultaneous blast of the same total amount of explosive charge placed in several blast holes should result in rock damage to a smaller depth due to the more spatially distributed nature of the explosions. Therefore, a simultaneous blast in shallow blast holes containing a total of 1000 lbs of explosives at the South Portal location is not expected to damage rock in the PTn.

All other identified surface ESF activities are expected to have a negligible effect on thermal/mechanical characteristics important to potential repository performance because they are limited to the surface of the ESF.

12. IMPACT TO OTHER Q-LIST ITEMS

Any potential impacts to other Q-List (YMP 1998a) items (e.g., ground support, underground openings, etc.) are bounded by controls applied in the interest of limiting potential adverse impacts to site characterization testing (Section 10) and/or limiting potential impact to the waste isolation capabilities to the site (Section 11) such that additional requirements are not necessary.

13. ESTABLISHMENT OF CONTROLS

13.1 SUMMARY OF RESULTS

For a full discussion of the results of this evaluation, refer to Section 13.2. In summary, this evaluation concludes that several activities associated with surface ESF accommodations require QA controls to limit or prevent potential waste isolation or test interference impacts. Controls on these activities are established in Section 13.3.

The CIIs described in Section 6 are temporary and have a designed maintainable service life of 25 years (YMP 1997a).¹³ Furthermore, this DIE is predicated on these items being temporary. Any incorporation of these items or their constituents into the pre-closure or permanent repository will require a new evaluation as part of the design of permanent items.

This DIE considers the relevance of applicable requirements from the ESFDR (YMP 1997a) pursuant to ensuring that the mandates of 10CFR60, paragraph 15(c)(1) are satisfied. The following ESFDR citations, including their lower-tier subsection requirements, were considered in this evaluation:

ESFDR 3.2.1.1.1, 3.2.1.1.3.1, 3.2.1.1.3.2, 3.2.1.1.3.4, 3.2.1.1.4, 3.2.1.2.2, 3.2.1.2.3, 3.3.1, 3.4.2, 3.4.3.1, 2.4.4.1, 3.4.5.2.1, 3.4.5.3.1, 3.4.5.4.1, 3.4.5.5.1, 3.4.5.6.1, 3.4.5.7.1, 3.5.2.1, 3.5.3.1, 3.5.4.1, 3.5.6.1, 3.5.7.1, 3.5.9.1, 3.5.10.1, 3.7.2.2, and 3.8.4.2.1.

Based on the following discussions in Section 13.2, DIE-specific QA control requirements have been derived. These QA control requirements collectively address the requirements cited above. The QA control requirements derived herein are listed in Section 13.3. Individual citations from

¹³ Previous revisions of this DIE conservatively evaluated the designed ESF Muck Storage Area, including the deposited muck, as a permanent item, since it would not be removed before operation of a potential pre-closure repository. However, ESF Muck Storage Areas, including the deposited muck, are definitively addressed as not being permanent repository items in a subsequent revision of YMP (1997a). Therefore, Revision 03 of this DIE re-evaluates ESF Muck Storage Areas as being temporary. The previous classification analysis, which was prepared for this item under the requirements of M&O QAP-2-3, has also been cancelled (Wagner 1997), based on the current requirements of YMP (1997a).

YMP (1997a) are also provided with each QA control requirement to establish traceability with the applicable ESFDR requirements.

13.2 DISCUSSION/BASIS FOR CONTROLS

13.2.1 Site Drainage

13.2.1.1 NPP Site Drainage

The NPP slope (approximately 2 percent) downward and away from the North Portal is provided, along with the stormwater interceptor drainage channels and the slope of the North Portal, to prevent water from flowing into the tunnel and to prevent significant ponding on the pad. A 2 percent slope is standard engineering/construction practice for maintaining drainage. The design, location, and site orientation of temporary construction and TBM support items, or other ESF support facilities (e.g., Switchgear Building, Change House, Power Supply Substation, Subsurface Power Center, Standby/Auxiliary Power System, Compressed Air System, Tracer Injection System, Sprung/Rubb Storage Facilities, Grout Processing Facility, Medical Facility, and the pad portion of the Surface Conveyor System), are not expected to alter the flow of extreme precipitation, create ponding, or prevent surface water runoff from flowing away from the mouth of the North Portal. Based on Sections 10.2 and 11.1, it is conservatively judged that engineering controls for a required positive flow away from the North Portal are necessary. An overall 2 percent or greater slope away from the North Portal (i.e., minimum of 2 percent within standard engineering tolerances) shall be maintained. There is no maximum slope requirement away from the North Portal that requires QA controls to limit potential impacts to site characterization testing and potential hydrological impacts to the potential repository (Requirement 1). Local perturbations created by buildings and other facilities (including paving of roads, parking, storage areas, and SBT boreholes on the NPP) placed on the pad are acceptable, provided the overall drainage capability away from the ESF Starter Tunnel is maintained. Drainage away from SBT boreholes located on the NPP takes precedence over the 2 percent pad slope requirement within 30 ft of a borehole, unless adequate protection from surface water infiltration is provided. The Optional Muck Storage Areas are also sloped downward and away from the NPP/North Portal and will use sheet flow drainage design to prevent ponding on these storage areas.

The interceptor stormwater drainage channels located to the south and west of the NPP have been constructed to handle flood-water amounts greater than those which would occur during the PMF discussed in YMP (1997a). Because of the unique construction of these channels, clogging is not a credible failure. It is judged that normal maintenance and repair will be adequate to clear any significant obstructions in these channels and will be sufficient to provide adequate assurance of the proper performance of these channels.

On the NPP, local perturbations created by buildings, construction utilities/facilities, and other surface facilities placed on the pad should not be allowed to create significant ponding. The imposition of the positive flow away from the North North Portal, as discussed above, will ensure that general drainage requirements are adequate during construction and operation. Periodic visual observations for obstructions, identification of surface-runoff-impoundment areas, and repair/correction of these areas, when discovered, are considered practical methods. Further, any significant ponding created by construction equipment or buildings and other

facilities placed on the pad must also be mitigated to the extent practical (Requirement 2). After initial pad construction or modifications made for buildings and other facilities (e.g., SBT boreholes), Requirement 2 visual observations for ponding and the potential for ponding are sufficient to ensure that pad drainage requirements/slopes are maintained. Potential ponding in the Optional Muck Storage Areas is controlled in the same manner as described above.

13.2.1.2 SPP Site Drainage

The SPP slope (approximately 2 percent) downward and away from the South Portal is provided, along with the slope of the South Portal. The SPP slope prevents water from the pad and portal from flowing into the tunnel and prevents significant ponding on the pad.

The original design for the South Portal included an interceptor stormwater drainage channel (CRWMS M&O 1996c; 1996d). Per Section 6.2.2.2, a subsequent design analysis concluded that such mitigation features for a PMF (YMP 1997a) are not required to prevent water from flowing into the South Ramp Tunnel. The natural drainage characteristics of the SPP site are sufficient to channel stormwater away from the South Portal.

A 2 percent slope is standard engineering/construction practice for maintaining drainage. The design, location, and site orientation of temporary construction and TBM support/disassembly items, or other ESF support facilities are not expected to alter the flow of extreme precipitation. They are also not expected to create ponding or prevent surface water runoff from flowing away from the mouth of the South Ramp tunnel. It is conservatively determined, based on Sections 10.2 and 11.1, that engineering controls requiring a positive flow away from the South Portal are necessary. An overall 2 percent or greater slope for the SPP (i.e., minimum of 2 percent within standard engineering tolerances) shall be maintained. There is no maximum slope requirement away from the South Portal that requires QA controls to limit potential impact to site characterization testing and potential hydrological impacts to the potential repository (Requirement 1). Local perturbations created by temporary construction support/storage facilities (e.g., construction/disassembly equipment, TBM rail system, SBT boreholes on the SPP, etc.) placed on the pad are acceptable provided that the overall drainage capability away from the South Portal is maintained (Requirement 2). Drainage away from SBT boreholes located on the SPP takes precedence over the 2-percent pad slope requirement within 30 ft of a borehole (Requirement 2).

13.2.1.3 Storage Areas and Fran Ridge Borrow Pit No. 1 Site Drainage

The Rock Storage Area and Topsoil Storage Area are protected by interceptor stormwater drainage channels (ditches) located around the perimeter of these areas, which are designed to protect them from local flooding (Section 6.2.6). Protection afforded to the Rock Storage Area and Topsoil Storage Area and their access road by the interceptor stormwater drainage channels, directs water towards natural drainage paths. These drainage ditches also provide sufficient assurance that stormwater drainage or runoff is not directed toward the NPP or North Portal. Drainage channels are provided between the Subdock Storage and Lay Down Areas and H-Road. The natural drainage patterns of the Subdock Storage and Lay Down Areas were not been significantly modified by surface ESF accommodations or storage placement. As such, the natural drainage flow is maintained to the southeast, and impoundment areas are not created (YMP 1992c). Section 11.1 further indicates that no significant perturbation to the natural surface runoff will be created, and that surface infiltration will not be significantly altered. As

such, the potential for waste isolation impacts is negligible. Section 10.2 describes potential test interferences, which could result from potential ponding of surface water flow and alteration of natural drainage. It is conservatively judged that QA controls (Requirement 2) are required during construction, maintenance, and operation activities associated with the Rock and Topsoil Storage Areas, Subdock Storage and Lay Down Area, ESF Weather Station, Fran Ridge Borrow Pit No. 1, and their Access Roads. These QA controls are imposed to limit ponding of surface water flow and alteration of natural drainage pathways. Periodic checks for obstructions, identification of surface-runoff-impoundment areas, and repair/correction of these areas, when discovered, are considered practical methods to minimize potential test interference impact(s).

13.2.1.4 H-Road Improvements Site Drainage

Should H-Road be widened at a later date, widening, grading, and paving improvements (including the construction of enlarged stormwater drainage channels) are generally designed to enhance or maintain the performance of the local topography in preventing ponding or flooding of the roadbed due to extreme precipitation (Sections 6.2.6 and 6.2.9). The relative location and topographical relationship of the H-Road to the North Portal and NPP are judged to not result in significant surface water runoff onto the NPP base by natural drainage patterns. As such, the potential for waste isolation impacts is negligible. Section 10.2 does indicate that during road-improvement-construction activities, culvert operation should be maintained to allow for natural stormwater runoff and to prevent ponding of water during or after construction (Requirement 2).

13.2.1.5 Water Systems Site Drainage

The Booster Pump Facility pad is raised above the surrounding terrain creating a stormwater flow pattern around the facility which acts along with local topography to protect the Booster Pump Facility from ponding of water or flooding due to extreme precipitation (Section 6.2.6). The H-Road stormwater drainage channel and culvert, located between the Booster Pump Facility and H-Road, provide additional flood protection by creating an additional pathway for surface water runoff. The relative location and topographical relationship of the Booster Pump Facility to the NPP/North Portal are judged to not result in significant surface water runoff onto the NPP base by natural drainage patterns. As such, the potential for waste isolation impacts is negligible. Section 10.2 does indicate that during construction and operation activities, drainage patterns should be maintained to allow for natural stormwater runoff and to prevent ponding of water during or after construction (Requirement 2). Periodic checks/visual observations for obstructions at a frequency determined to be appropriate by the A/E, identification of surface runoff impoundment areas, and repair/correction of these areas when discovered are considered practical methods to minimize potential waste isolation or test interference impact(s).

Sections 10.2 and 11.1.1 evaluate the potential waste isolation and test interference impact created by rupture (including seismically-initiated) of the potable and fire suppression/construction water tanks on top of Exile Hill, or from emergency overflows from these tanks. These sections indicate that rupture or overflow of the tanks is expected to behave as a localized, short- duration, flood event, from which water would follow the natural run-off paths of surface water. Section 11.1.1 indicates that because of the location of the water tanks on Exile Hill and local topography, water released from those tanks would be diverted away from the North Portal; therefore, no additional QA controls are required.

13.2.1.6 Sanitation System Site Drainage

The relative location and topographical relationship of the Surface Sanitation System to the NPP/North Portal are judged to not result in significant surface water runoff onto the NPP base by natural drainage patterns. As such, the potential for waste isolation impacts is negligible. Section 10.2 indicates that test interference impacts may result from potential ponding of surface water flow and/or alteration of natural drainage. Therefore, during construction, operation (use), maintenance, and reclamation activities of the Surface Sanitation System, drainage patterns should be maintained to allow for natural stormwater runoff and to prevent ponding of water (Requirement 2). Periodic checks/visual observations for obstructions at a frequency determined to be appropriate by the A/E, identification of surface runoff impoundment areas, and repair/correction of these areas when discovered are considered practical methods to minimize potential waste isolation and test interference impact(s).

13.2.1.7 ESF Heliport Site Drainage

The ESF Heliport Site and Access Road area are located on the approximate sites of the Surface Wastewater System evaporation pond and access road, which were not constructed (Helner 1999; Section 6.2.10.4). Per the Surface Wastewater System design drawings identified in CRWMS M&O (1998f), the elevation of the ESF Heliport Site is identified as approximately 50 ft lower than that of the North Portal. It is conservatively judged that natural topography of the area is sufficient to disperse and mitigate potential effects of expected water loss or spillage sources, including stormwater. As such, the potential for waste isolation impacts is negligible. Section 10.2 indicates that test interference impacts may result from potential ponding of surface water flow and/or alteration of natural drainage. Therefore, QA controls (Requirement 2) are required for the construction, operation (use), and maintenance activities associated with the ESF Heliport Site and Access Road. Requirement 2 ensures that natural drainage patterns are maintained—to allow for natural stormwater runoff and to prevent ponding of water. Periodic checks/visual observations for obstructions; identification of surface runoff impoundment areas; repair/correction of these areas when discovered; and installation of culverts, as necessary, for the access road are considered practical methods to minimize potential waste isolation and test interference impact(s).

13.2.2 ESF Dust Suppression Water and Construction/Operational Water Use

13.2.2.1 General ESF Water Use

As indicated in Section 11.1 the normal use of water associated with surface ESF accommodations and other items described in Section 6 does not constitute a credible impact to waste isolation, if the following criteria are met. First, the application rate at any point on the surface west of the Bow Ridge Fault must be less than the average potential evapotranspiration rate of 2.6 ft/yr (about 0.48 gal/yd²/day). Second, water application at any point on the surface east of the Bow Ridge Fault must be less than 29,000 gal/day. Last, the discharged water must not pond on the surface.

A period of historically high use of ESF construction/operational and dust suppression water took place on the NPP during the 12 months ending in approximately March 1996. Total water

use (including dust suppression, compaction, and operational water use) over a one-year period reported in CRWMS M&O (1995b) indicates discharge rates of 0.37 gal/yd²/day, 0.29 gal/yd²/day and 0.25 gal/yd²/day for different periods during the year. These rates are based on actual days of water use and do not include days when no water was applied. Water application to date (CRWMS M&O 1995b) has been performed in accordance with the water use specification (CRWMS M&O 1996f) that is expected to remain effective.

The above actual usage figures are well below the average evapotranspiration rate articulated in Section 11.1.1.4, 0.48 gal/yd²/day. This indicates that surface water applied for construction, dust control, compaction of engineered fill, and facility improvement operations within the CCAB (as indicated on page 9.04 of DOE [1997]) would not reasonably be expected to exceed the average evapotranspiration rate; i.e., based on the historical use on the NPP using standard construction, operating and engineering practices in compliance with drawings and specifications (CRWMS M&O 1995b; 1996f). It is therefore judged that the application of standard construction, operating, and engineering practices (compliance with drawings and specifications) coupled with the application of ponding controls (Requirement 2) satisfies the requirement to minimize surface water use to the extent practical in accordance with YMP (1997a). The heavy water use rates provided in CRWMS M&O (1995b) include both construction/operations water use and dust control applications. Given the current maintenance mode, dust control is expected to be primary water use activity. Therefore, it is expected that water will be applied at rates well below the evapotranspiration rate—i.e., the water is expected to evaporate rather than imbibe. Further, for surface ESF accommodations east of the Bow Ridge Fault, given the extreme difference between the water limit and the anticipated water use, it is conservatively judged that records of actual water use would not provide valuable input for future Total System Performance Assessment activities. Therefore, the previous QA controls (i.e., Requirement 2 before Revision 03) for measuring water use, and reporting in accordance with the TFM Procedure (AP-2.17Q) are no longer required. The elimination of this requirement may be applied retroactively such that any outstanding water use reports are no longer required. However, an additional evaluation by the Safety Assurance Department is required for surface ESF sites west of the Bow Ridge Fault if water use activities beyond dust control and various maintenance/operations of existing surface ESF related tasks are conducted (Requirement 2).

13.2.2.2 Site Specific ESF Construction/Operational and Dust Suppression Water Use

The NPP, NPP Extension, Optional Muck Storage Areas, and Rock and Topsoil Storage Areas are located east of the Bow Ridge Fault (Section 6.2). Previous DIE revisions (i.e., before Revision 03) established muck height limits for these accommodations as well as special dust control water application limits because these accommodations are constructed from muck excavated from the subsurface ESF. Excavated muck contains additional construction water, which was to be subtracted from the previous cumulative water limit for these accommodations. This reduction in cumulative water addition restricted the amount of water that could be used for dust control to minimize the potential for waste isolation impacts. Under the new Section 11.1.4 water requirement of 29,000 gal/day east of the Bow Ridge Fault, negligible waste isolation impacts are expected if standard construction, operating, and engineering practices (compliance with drawings and specifications) are employed for dust control on the NPP, NPP Extension, Optional Muck Storage Areas, and Rock and Topsoil Storage Areas. Furthermore, the previous muck height limit is no longer applicable. Irrigation water for revegetation of the Topsoil

Storage Area is also expected to be sufficiently below the waste isolation impact limit. As discussed in Section 13.2.2.1, QA controls are no longer necessary for measuring and reporting dust control water use in these locations.

The SPP and Subdock Storage and Laydown Area are located to the west of the Bow Ridge Fault. Therefore, it is subject to the Section 11.1.1.4 limits. The SPP was constructed per the requirements of the previous (i.e., Revision 02) DIE requirements. With respect to dust control, negligible impacts to repository performance are anticipated for the SPP and Subdock Storage and Laydown Area, provided dust control water does not exceed a rate of 2.6 ft/yr or less on the pad (Section 11.1.1.4). As discussed in Section 13.2.2.1, dust control water applications at the SPP and the Subdock Storage and Lay Down Area are expected to be much less than the evaporation rate. As such, QA controls are no longer necessary for measuring and reporting dust control water use. However, an additional evaluation by the Safety Assurance Department is required to address unevaluated activities, as discussed in Section 13.2.2.1 (Requirement 2). No additional QA controls are required.

Section 11.2.2 indicates that the presence of small quantities (approximately 20 ppm) of LiBr tracer in water carried by the muck is not expected to have any significant geochemical effects. Section 10.6 concludes that no test interference to tests planned in the ESF or surface-based tests are expected due to the LiBr tracer contained in muck used for pad extension or stored in the various muck storage areas. Section 10.5 also indicates that any potential test interference, due to water applied to the NPP, NPP Extension, SPP, Optional Muck Storage Areas, Subdock Storage and Laydown Area, and Rock and Topsoil Areas during construction, operation, maintenance, and/or reclamation activities, is judged to be bounded by the controls for water use listed above and no additional QA controls are required.

13.2.2.3 General ESF Point Source Water Use

Section 11.1.4 indicates that water losses of up to 29,000 gal/day east of the Bow Ridge Fault are expected to have negligible impact on repository performance. The only potential surface ESF sources of such a water loss are the buried water supply and distribution lines, which are located east of the Bow Ridge Fault. However, water line features (e.g., check valves), coupled with the manual operation mode that is required for these systems, are judged to make such a loss implausible (Leak 1999c). As such, no QA controls are required.

13.2.2.4 Site Specific ESF Point Source Water Use

Section 11.1.4 assesses the impact of planned effluent discharge from the surface-sanitation-system leach field and provides an estimate of the impact if the point source discharge limit is exceeded east of the Bow Ridge Fault. It conservatively concluded that water losses of less than 29,000 gal/day occurring continuously over 25 years would not be able to produce migration of contaminants to potential WE locations. Further, Section 11.1.3 indicates that the most likely potential WE area that could be affected is the potential lower block expansion area (if used), which is the closest to the ESF leach field activities. The maximum effluent flow for the septic tank and leach field (CRWMS M&O 1998g) is 18,000 gal/day, which is significantly less than the maximum allowable water loss (29,000 gal/day). Therefore, no additional QA controls are warranted.

The septic tank and the dosing tank for the surface-sanitation-system sewage treatment are not intended to discharge sanitary wastewater to the surrounding environment. They are designed to be leak tight. Therefore, the only discharge to the environment foreseen for these components is accidental in nature and is of low probability. These components are located approximately between NSCZCs E573000 and E573200 (CRWMS M&O 1998g), which is significantly east of the Bow Ridge Fault boundary identified in Section 11.1.3 for water discharge. Section 11.1.3 indicates that there is very limited probability of wastewater discharge interaction with repository performance. Therefore, due to the low probability of accidental leakage of these tanks and the limited probability of waste isolation impacts, it is judged that no QA requirements for leak detection for the septic tank and the dosing tank are warranted.

The revised evaluation in Section 11.1.4 indicates that a discharge east of the Bow Ridge Fault of up to 29,000 gal/day over the 25-year design life will result in negligible impacts on repository performance. As such, the previous limit of 310 gal/day on the water conveyance and disposal systems has been superseded. However, it is judged that periodic visual observation for leakage and the repair of leaks upon discovery are prudent and conservative actions to address the waste isolation concerns the conclusion of the analyses presented in Section 11.1. QA requirements are judged necessary, therefore, to limit water loss by providing for visual observation and repair of the Surface Wastewater System and Surface Sanitation System (Requirement 3). These QA requirements include visual observation for leakage of the surface water system (supply/distribution) and unpressurized sewer piping (up to the septic tank inlet) on a quarterly basis, and repairing leaks upon discovery (Requirement 3). These requirements also include an initial visual observations of new segments of the surface water and sanitary sewer system after construction has been completed (Requirement 3). No additional QA controls are necessary.

13.2.3 TFM Emplacements, Releases, and Inadvertent Spills Associated with Surface ESF Accommodations

13.2.3.1 Fluid Releases and Inadvertent Spills

Quantities of fluids (other than water) which may be released in any credible equipment failure (including oil-filled electrical equipment) or vehicle/equipment accident are judged to be relatively small and are not expected to impact waste isolation or site characterization activities provided that such spills are removed to the extent practical. Federal and/or State agencies' environmental regulations (e.g., RCRA, CWA, OSHA) for containment and cleanup of releases of hydrocarbon material, coolant, acids, or solvent leakage into the environment are judged adequate to ensure that such spills are removed to the extent practical. Since these regulations are federal and/or state law, it is judged that QA controls for spill cleanup are not required.

To provide assurance that potential vehicle hydrocarbon leaks are identified in a timely manner, periodic checks of construction and permanently-assigned government vehicles for hydrocarbon leaks are required. Hydrocarbon leaks (in excess of drips) identified for fixed equipment and during vehicle checks shall be contained, mitigated, and/or repaired upon discovery to minimize the potential for significant releases (Requirement 5). Fluids trapped on the pad in liners or within designated holding areas should be removed in the normal course of maintenance activities and require no special removal requirements. The combination of the federal and/or state environmental laws and the QA requirements for vehicle checks and leak containment,

mitigation, and/or repair provides assurance that spills of fluids (other than water) will be minimized and mitigated to the extent practical. In addition, any unrecovered spill material is subject to QA controls on TFM reporting requirements (Requirement 6) to facilitate future TSPA activities.

13.2.3.2 Potential Site Specific Contaminant Releases and Spills

As discussed in CRWMS M&O (1995a), contaminated muck is not expected to be used for pad extension fill material. Nevertheless, any material used for the NPP extension or deposited in the Optional Muck Storage Areas is subject to federal and/or state environmental laws for soil contamination and cleanup. It is judged that compliance with these federal and/or state environmental laws provides adequate confidence that the muck used as fill material for the pad extension or stored in the ESF Muck Storage Areas will not be contaminated.

Sections 10.6 and 11.2.1 indicate that requirements are appropriate to record and provide TFM emplacement information in accordance with the TFM Procedure (AP-2.17Q). All TFMs permanently emplaced (including unrecovered spills) during construction, operation (use), maintenance, and reclamation associated with surface ESF elements/activities contained in Section 6 shall be recorded and reported, unless specifically exempted herein (Requirement 6).

Section 10.6 indicates that the surface conveyor operation may introduce a potential for the release of contaminants that could adversely impact site characterization testing or the capability of the site to isolate waste. Operating fluids of concern are lubricating oils, hydraulic fluid, and grease. The design of the conveyor system (Section 6.2.9) incorporates several features which will limit spills to the extent practical: full wind covers to enclose loaded belts on the surface conveyor, use of labyrinth seals on pulley and idler bearings to prevent grease from leaking out, use of fully enclosed chutes with a dust suppression water spray system at all transfer points, using an interlocking solenoid shutoff valve to prevent water usage when the conveyor is empty or not running, and use of a flow meter on each spray header to indicate the amount of water being used. These conventional quality features are adequate when combined with spill containment/mitigation limits described above to limit waste isolation impacts. Controls in place to limit/mitigate spills of water, hydrocarbons, and other materials are adequate to provide the necessary control (Requirements 2, 4, and 6) and no additional QA controls are required.

ESF accommodations (such as the ESF Weather Station, Surface Water System [Supply and Distribution], Surface Communications, NPP facilities, Subdock Storage and Lay Down Areas, and TBM construction support facilities [shops and maintenance facilities/off-pad shop and storage facilities]), included the installation of temporary construction electrical systems, which required use of a grounding enhancement material before completion of the 69kV Power Supply System. The standby generator fuel storage system (plus equipment pads and foundations) (if completed), compressed air equipment pads and foundations (plus oil/water containment), and additional site lighting contain portions of electrical and control systems that have required the use of grounding enhancement materials. The ESF temporary 69kV power supply system (including the substation), site grounding system, and lightning protection system also require the use of a grounding enhancement material. The South Portal Site Grounding and Lightning Protection Systems, equipment, and disassembly facilities placed on the SPP also required the use of grounding material. Should refueling become an activity conducted at the ESF Heliport

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Site, this site would also require a grounding system, which would necessitate the use of grounding enhancement material. Section 10.2 indicates that site characterization test results related to specific isotopes of chlorine can be unpredictably altered by the introduction of chlorine-containing salt grounding solutions. Prohibition on such use is therefore conservatively judged to require QA controls to limit potential impacts on site characterization (Requirement 7). (Section 10.2 also suggests that "GEM[®]" be used.)

Section 10.6 indicates potential test interference impacts on carbon (i.e., ¹⁴C) testing as part of site characterization if oil-soaked sand is used as a corrosion inhibitor (beneath the foundations of the booster and main water-storage tanks). As a measure applied to prevent unknown impacts to site characterization testing, a QA requirement is indicated to control oil leakage release into the environment. Hydrocarbon material infiltration into the soils or rock shall be minimized to the extent practical when using oil-soaked sand beneath water tanks or other similar storage vessels. Design features to implement this requirement may include, for example, the use of impermeable liners, etc. (Requirement 5). The quantities of hydrocarbon material applied and the locations shall be recorded and reported in accordance with the TFM Procedure (AP-2.17Q) (Requirement 6).

Section 10.6 indicates potential test interference impacts to infiltration experiments which rely on chlorine isotope ratios as part of site characterization testing if chlorine/chloride compounds/liquids are permanently emplaced (including chlorine material leakage from the water supply disinfection unit) into the surrounding rock and soil.¹⁴ As a measure applied to prevent unknown impacts to site characterization testing, a QA requirement is indicated to control the permanent emplacement of chlorine/chloride material/liquids into the surface environment and to avoid chlorine material leakage from the water supply disinfection unit into the underlying rock and soil (Requirement 7). Design features to implement this requirement may include, for example, the use of impermeable liners, secondary containment tanks, etc. Potable water shall not be used for construction purposes (e.g., dust suppression, compaction of engineered fill, etc.) within the CCAB (Requirement 7). Other surface use of chlorine/chloride-bearing compounds/liquids which are permanently emplaced within the CCAB will require additional evaluation and/or approval of the TCO (Requirement 7).

Section 10.6 discusses the use of treated subsurface wastewater for dust control and compaction purposes on the NPP, Pad Extension, and Surface Conveyor Access Road. Further, Section 10.6 indicates that the use of treated subsurface wastewater (that may contain small amounts of LiBr [approximately 20 ppm]) for compaction and dust control within the CCAB interposes negligible site characterization impacts. The subsurface wastewater may contain small amounts of organics, which are subject to federal and/or state environmental laws for water quality. It is judged that compliance with these federal and/or state environmental laws adequately bounds any potential waste isolation or test interference concerns associated with the use of subsurface wastewater for compaction and/or dust control within the CCAB.

¹⁴ Previous revisions of this DIE required the notification of the Hydrochemistry PI before activating the sanitary sewer and leach field system to ensure that the potential for site-characterization-data impacts could be minimized. Revision 02 of this DIE discussed the successful implementation of this QA control and effectively eliminated the requirement. Revision 03 officially removes the detailed evaluation from the DIE text, since it no longer applies.

Section 10.5 indicates that the previous TIE requirement to control soil compaction below the areas where asphaltic concrete or chip-and-seal surface treatment is applied is no longer necessary.

The use of two dust suppression compounds, DUSTAC® and MARLOC®, as additives to the dust control water for surface ESF accommodations is evaluated in Sections 10.5 and 11.2.5. Section 10.5 indicates that the application of DUSTAC® or MARLOC® in the dust control water is not expected to impact site characterization testing. Section 11.2.5 indicates that the use of MARLOC® is expected to result in negligible potential for waste isolation impacts. However, Section 11.2.5 also indicates that the main constituent of DUSTAC® is ammonium lignin sulfonate, which could potentially impact waste isolation. Pending additional evaluation of DUSTAC®, the potential release of nitrate (from the ammonia) is considered sufficiently limiting as to preclude the use of this product within the CCAB (Requirement 11).

Section 11.2.6 indicates that the proposed use of materials for land reclamation contained in (Angerer 1996) is expected to have a negligible effect on the average soil water composition or water compositions at the closest potential WE locations. Section 10.5 indicates that land reclamation materials are limited to small quantities of inorganic and solid organic materials used to restore the surface site to its pre-disturbed, natural condition and are not expected to affect site characterization testing. Therefore, the use of the reclamation materials identified in (Angerer 1996), in the manner and quantities described therein, is expected to have negligible adverse effects on the waste isolation characteristics of the site or site characterization. Reclamation materials are subject to requirements for recording and providing TFM emplacement information in accordance with the TFM Procedure (AP-2.17Q) used in reclamation activities (Requirement 6).

Based on Sections 10.5 and 11.2.6, it is conservatively judged that biodegradable organic TFMs, which are used in association with surface ESF accommodations and are lost or committed within the CCAB, have negligible potential to impact site characterization testing data or repository performance. As such, this DIE exempts biodegradable TFMs, which are specifically identified in Attachment II from the recording and reporting requirements of the TFM procedure (AP-2.17Q). Similarly, TFMs that are essentially inert also have negligible potential to impact waste isolation and test interference, as evaluated in Sections 10 and 11 of this DIE. As such, Attachment II also provides a list of inert TFMs that are specifically exempted from the recording and reporting requirements of the TFM procedure (AP-2.17Q).

13.2.4 Surface ESF Explosions (Blasting) and ESF Geomechanical Impact

Blasting materials used during surface excavation/construction will create limited fracturing in the surrounding rock mass (only the area surrounding each blast hole), as indicated in Section 11.3, providing a maximum limit of 30 lb of explosives is applied. Section 11.3 further indicates that the general use of explosive material for surface excavation is not a potential waste isolation impact (i.e., will not cause any adverse geomechanical impacts to the site) if it is limited to 30 lbs or less per delay (which limits the potential damage zone around a point of blast to 33 ft) (Requirement 10). Blasting for excavation of the boxcut at the South Portal will require the use of pre-splitting blasting techniques (Section 6.2.2.2). Section 11.3 indicates, based on site specific analysis (Attachment VIII), that the pre-splitting blasting technique of simultaneous

detonation of explosives in shallow blast holes containing a total of 1000 lbs of explosives at the South Portal location is not expected to damage rock in the PTn or create potential waste isolation impacts (Requirement 10). Section 10.5 indicates that surface blasting could potentially create vibrational impacts on seismic or other site characterization tests, if large quantities of explosives were used or if the blasting is in close proximity to a test or testing facility. Records of the date, time, amount of charge, and sequencing of blasts will enable the testing PI for the seismic monitoring activity to distinguish blasts from natural seismic events on the seismicity monitoring records. Record keeping (Requirement 9) and surface general blasting limitation of explosives quantities to 30 lbs per delay and 1000 lbs per delay for the South Portal Boxcut (blasting) (Requirement 10) are judged sufficient to limit impacts to waste isolation and site characterization activities.

Inadvertent explosions could occur on the surface of the ESF during transport or temporary storage of explosives used for surface or subsurface drill-and-blasting. However, it is judged that the potential for such an event occurring is remote enough not to warrant the need for QA controls, since the utmost care will be exercised in the interest of ensuring personnel safety. In the event that a significant uncontrolled explosion does occur, an evaluation of potential impacts to the surrounding pad, soil, and rock can be made at that time based on as-found conditions. Further, Section 11.3 indicates that the remainder of the surface ESF activities identified in Section 6 are expected to have a negligible effect on waste isolation thermal/mechanical characteristics important to potential repository performance.

Construction and use of surface ESF accommodations, and other items described in Section 6, are not judged to have any credible adverse effects on the geomechanical properties of the site, since these activities will be limited to the surface (Sections 11.1.6 and 11.3). Construction (including blasting) associated with surface ESF accommodations will not exceed 33 ft below surface grade except for the South Portal and Pad (Assumption 4.1).

13.2.5 Surface ESF Earthquakes

The credible result of a design earthquake on the NPP (including the Optional Muck Storage Areas) is acceleration of items on the pads. The temporary construction items, other NPP items described in Section 6, and ESF support facilities (Compressed Air System, 69kV Power Supply System, Standby Power System [including generators/support equipment and related facilities]) constructed on the ESF NPP are designed for earthquake damage mitigation by incorporation of the provisions of Seismic Zone 2B criteria (International Conference of Building Officials [ICBO] 1997) in accordance with YMP (1997a). The Switchgear Building and Change House are designed to Seismic Zone 2B criteria (ICBO 1997), which was the applicable ESFDR criteria for these buildings (YMP 1997a). These provisions dampen the acceleration forces created during seismic events. Even assuming significant or complete destruction of these components, including construction support facilities, by seismic or other forces, however, the pad's capability to prevent surface water runoff from ruptured firewater piping or utility systems from entering the North Portal is not expected to be compromised (due to the positive slope of the pad and other related controls discussed above). Furthermore, any release of fluids of concern would be treated as spills and handled as discussed in Section 13.2.3.2.

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The credible result of a design earthquake on the SPP is acceleration of items on the pad. The SPP design does not contain provisions for NTS surface supplied water, sewer or electric power; only temporary self-contained construction utilities and South Portal Site Grounding and Lightning Protection Systems are planned. Even assuming significant or complete destruction of these construction support/disassembly facilities, by seismic or other forces, the pad's capability to prevent surface water runoff from firefighting equipment or other temporary construction/disassembly utilities from entering the South Portal is not expected to be compromised (due to the positive slope of the pad and other related controls discussed above).

A seismic event that causes significant destruction to the Stormwater Drainage Systems, Rock and Topsoil Storage Areas, Surface Conveyor System, ESF Muck Storage Area, Fran Ridge Borrow Pit No.1, ESF Weather Station, Subdock Storage and Lay Down Areas, and Designated Access Roads including H-Road could potentially impact waste isolation if the natural surface drainage were disrupted such that ponding of water occurred and flow was directed towards the potential repository or repository facilities. However, seismic events are judged not to have a credible impact on waste isolation because the natural topographical surface features would channel surface water runoff away from the Potential Repository Block and Expansion Areas, NPP, SPP, and North and South Portals (DOE 1997, Part 1, pp.5.08 and 5.09). In addition, potential ponding of water from a seismic event would be covered by the QA controls on ponding (Requirement 2). No additional QA controls are required.

ESF Surface Wastewater system, Surface Water system (Supply and Distribution systems [buried portions]), and Sanitation system (Sewer Collection and Treatment) components are imbedded underground and are subject to limited acceleration during seismic events. Potential system piping (including seismically-initiated leakage) is, however, a credible result and is covered by the QA controls on point source discharge (Requirement 3). No additional QA controls are required.

The Booster Pump Station and North Portal Storage Tanks are designed for earthquake mitigation by incorporation of the provisions of Seismic Zone 2B criteria (ICBO 1997) which was the applicable ESFDR criteria (YMP 1997a). Even with significant or complete destruction of the structures or tanks by seismic or other forces, the water released from these facilities is covered by the QA controls on ponding (Requirement 2). No additional QA controls are required.

13.2.6 Surface ESF Fires

Fires during construction and operation of surface ESF accommodations will generally be extinguished with portable dry chemical extinguishers. CRWMS M&O (1994a) evaluates the commonly used non-aqueous fluids and solid materials used in the construction and operation of ESF surface items. CRWMS M&O (1994a) indicates that items which are not planned to be released (e.g., fire extinguisher dry chemicals) would require an "after-the-fact evaluation" of their impact on waste isolation based on the event's location and size, and the mitigation measures taken. Any potential test interference impacts would also be assessed in an "after-the-fact evaluation." As a result, chemical releases from fires during construction and operation, or extinguishing thereof, will require an "after-the-fact evaluation" when specific details of the

event become available. It is judged that the QA requirements associated with mitigation and reporting of spills are adequate to control this activity (Requirements 4 and 6).

It is further judged that, although the use of construction water for fire fighting on the NPP or SPP during construction and/or operation cannot be precluded, runoff as a result of the application of such water will flow away from the North and/or South Portals, respectively. Water used for fire fighting activities at other ESF locations is also judged to runoff and flow towards natural drainage pathways and away from both the North and South Portals (Section 11.1). Water use in such applications is still reportable under the TFM Procedure (AP-2.17Q) and can be adequately evaluated after the fact, when specific details of the event become available. It is judged that the QA requirements for sloping the NPP and SPP, QA provisions and reporting requirements of AP-2.17Q, and QA requirements concerning ponding of water on the ESF adequately provide this function (Requirements 1, 2, and 6).

13.2.7 Surface ESF Electromagnetic Interference

The construction support, TBM facilities, 69kV power supply system, and other electrical systems have the potential to influence test equipment as a result of EMI as discussed in Section 10.5. EMI threshold levels vary greatly from test to test based on the testing equipment used (in a number of cases equipment has not been identified, which will be used for data gathering). Varying EMI threshold levels necessitate identification and protection of specific test equipment/data. Therefore, the TCO has agreed that, during the development of each FWP, the organization responsible for the test will identify specific test equipment. On the behalf of the responsible organization, the TCO will coordinate with the A/E on a survey of the specific site where test equipment is to be located. The TCO and the A/E will then determine the specific level of electromagnetic protection necessary to adequately protect testing equipment/data collection. The A/E may be required to install EMI shielding or other mitigation as part of implementation of the FWP. Therefore, no additional QA controls are required.

Per Section 6.2.3.2, telephone lines may be used to transmit site characterization data, which presents a different potential for testing-related impacts attributable to EMI. However, as stated in Section 10.2, issues associated with adequacy, validity, and veracity of site characterization data that is transmitted via telephone is the responsibility of the assigned PI. Therefore, any potential data transfer requirements are addressed in the associated FWP or other applicable document. As such, no additional QA controls are required.

13.2.8 Power Failure

Section 10.5 indicates that no site characterization tests have been identified which rely on either the standby and/or commercial electric power which cannot be continued or repeated at a different time or location in the event that both the standby and commercial electrical power systems fail. Therefore, no additional QA controls are required.

13.2.9 Use of Excavated Muck as Repository Backfill

The permanence of the ESF Muck Storage Area is not predicated on an identified repository function, but rather on the fact that the ESF Muck Storage Area will remain as part of a licensed repository. In its role as a storage area, the ESF Muck Storage Area has no identified waste

isolation function. While the use of muck as backfill and/or seal material is not included in this evaluation, Section 11.2.3 has identified that segregation of TS Loop muck and the proposed CH excavated muck may be required, if the muck were to be used as backfill or seal material. As a result, an A/E evaluation, including re-evaluation of waste isolation impacts, is required before storage of CH muck with other ESF excavated muck (Requirement 8).

13.2.10 Surface/Subsurface ESF Interactions

As discussed throughout Section 6.2, various surface ESF accommodations have direct, if not continuous, interaction with their associated subsurface ESF accommodations. In three specific instances, the QA control requirements generally applicable to surface ESF activities/accommodations, as discussed in Sections 3.2.1 through 3.2.10, may not be consistent with the more stringent subsurface ESF QA control requirements, as established by CRWMS M&O (1999a). The three surface ESF accommodations in question are:

1. Surface compressed air system
2. Surface portion of the subsurface conveyor system
3. Portion of the surface water supply system that supplies water to the ESF TS Loop.

To ensure that subsurface ESF requirements are not compromised, it is conservatively judged that the applicable CRWMS M&O (1999a) QA controls shall apply to activities and temporary items associated with these surface ESF accommodations (Requirement 12) as follows:

1. Requirements 3, 7a, 8, and 10 (CRWMS M&O 1999a) shall apply to portion of the surface water supply system that supplies water to the subsurface ESF.
2. Requirements 7h, 8, 10, and 15 (CRWMS M&O 1999a) shall apply to the surface portion of the subsurface conveyor system.
3. Requirements 8, 10, and 15 (CRWMS M&O 1999a) shall apply to surface compressed air system.

These controls are sufficient to limit, to the extent practical, potential subsurface impacts attributable surface ESF interactions.

13.3 QA CONTROLS

The following QA requirements have been identified as a result of this evaluation. These requirements are to be applied in addition to other conventional design practices.

Requirement 1: The NPP and SPP (including the ESF Starter Tunnel Steel Arch Section floor of the NPP) shall be sloped downward and away from the North and South Portals, respectively, by the construction/maintenance of a 2 percent or greater slope (i.e., minimum of 2 percent within standard engineering tolerances; there is no maximum slope requirement) downward and away from the North and South Portals, respectively. Local perturbations created by (1) buildings and other facilities, including paving of roads,

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parking, storage areas/facilities, and SBT boreholes on the NPP and SPP; and (2) temporary construction support/storage facilities, construction/disassembly equipment, TBM rail system, etc., placed on the pads are acceptable, provided overall drainage is not impeded in a way that would allow significant ponding or water flow into either the North or South Portal.

NOTE: After initial pad construction or modifications made for buildings and other facilities (e.g., SBT boreholes), Requirement 2 visual observations for ponding and the potential for ponding are sufficient to ensure that pad drainage requirements/slopes are maintained.

[ESFDR 3.2.1.2.3.A, 3.2.1.2.3.B, 3.2.1.2.3.I, 3.4.2.3.1.E, 3.4.3.1.A, 3.4.3.1.B, 3.4.3.1.C, 3.4.3.1.D]

Requirement 2: Water use and ponding within the CCAB as indicated on page 9.04 of the Yucca Mountain Site Characterization Project - Site Atlas 1997 (DOE 1997) shall be minimized to the extent practical, by applying the following controls:

- (2a) Water used for construction purposes, other than dust control, maintenance, and other operations associated with existing surface ESF accommodations west of the Bow Ridge Fault requires additional evaluation by the Safety Assurance Department before initiating work.

NOTE: The previous requirement to measure and record surface ESF water use within the CCAB in accordance with AP-2.17Q has been eliminated. The elimination of this requirement may be applied retroactively such that any outstanding water use reports are no longer required. This change includes water use associated with dust control and general construction use and applies to such water use from either the surface Water Supply System or the Surface Wastewater System

- (2b) Periodic visual observations (not less frequently than once per quarter) for ponding and the potential for ponding shall be made during construction, operation (use), maintenance, and reclamation of the following areas:

- NPP (including pad extension)
- Optional Muck Storage Areas #1 and #2
- SPP
- ESF Muck Storage Area
- Stormwater Drainage Systems
- Top Soil Storage Area
- Surface Conveyor System
- Fran Ridge Borrow Pit No.1
- ESF Weather Station
- Subdock Storage and Laydown Areas
- ESF Heliport Site
- Access Roads (including H-Road)

In addition, the off-pad (NPP) portions of the Surface Sanitation System (Collection and Treatment), and Surface Water System (Supply and Distribution) shall be visually observed (at a frequently established by the A/E) for ponding and the potential for ponding during construction, operation, and maintenance.

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These periodic visual observations are intended to ensure that drainage characteristics (as discussed above) have not been altered in a way that would create surface-runoff-impoundment areas. Examples of potential sources of water impoundment include construction equipment, buildings, and other facilities that block water flow during surface construction, operation (use), and maintenance activities, such that water ponds in a sufficient volume to be pumpable using standard equipment. Any such areas shall be corrected/repared upon discovery, subject to Requirement 2c.

- (2c) Construction trenching or other excavations, which create surface impoundment areas (as described in Requirement 2b), shall be checked monthly for accumulation of water. Pumpable water in these impoundment areas shall be removed upon discovery. Pondered water as a result of non-routine water use (i.e., spillage or fire mitigation) shall be removed as soon as practical.

[ESFDR 3.2.1.2.3.A, 3.2.1.2.3.B, 3.2.1.2.3.D, 3.2.1.2.3.I, 3.4.3.1.A, 3.4.3.1.B, 3.4.3.1.C, 3.4.3.1.D, 3.4.5.3.1.F, 3.4.5.3.1.O, 3.4.5.3.1.P, 3.5.3.1.A, 3.5.3.1.B]

Requirement 3: To minimize the potential for chronic water losses (and consequent subsurface infiltration) attributable to the Surface Water System (Supply/Distribution) and the Sanitary Sewer System, a visual observation shall be conducted near areas where Surface Water System (Supply/Distribution) piping and/or components are located, upon completion of a new segment of these systems and on a quarterly basis thereafter. Any leak, as indicated by wetting of the ground surface or unusually verdant vegetation, shall be promptly repaired within ten working days of identifying the leak.

NOTE: The previous requirements for leak testing of the Sanitary Sewer System and the Surface Water System (Supply/Distribution) piping has been eliminated. The elimination of this requirement may be applied retroactively such that any outstanding leak testing is no longer required.

[ESFDR 3.2.1.2.3.A, 3.2.1.2.3.B, 3.4.5.3.1.E, 3.4.5.3.1.F, 3.4.5.3.1.G, 3.4.5.3.1.H, 3.4.5.3.1.O, 3.4.5.3.1.P, 3.4.5.3.1.V, 3.4.5.4.1.A, 3.4.5.4.1.B, 3.4.5.4.1.C, 3.4.5.6.1.A, 3.4.5.6.1.D, 3.4.5.6.1.I, 3.5.7.1.D, 3.5.7.1.E, 3.5.7.1.F, 3.5.9.1.E, 3.5.9.1.G, 3.5.9.1.J]

Requirement 4: Minimize, to the extent practical, the amount of hydrocarbons (i.e., hydraulic fluid, fuels, coolant, acids, paints, solvents, oils, oily waste/condensates, etc.) spilled and lost in the construction, operation (use), maintenance, and reclamation of surface ESF accommodations by:

- (4a) Containing, mitigating, and/or repairing hydrocarbon leakage in excess of drips (as from ruptured hoses, spills from reservoirs or tanks, etc.) from construction, operation (use), and maintenance support equipment/vehicles upon discovery, and
- (4b) Conducting periodic checks (not less than once per calendar month) on vehicles for hydrocarbon leaks.

[ESFDR 3.2.1.2.3.A, 3.2.1.2.3.B, 3.2.1.2.3.E, 3.3.1.F, 3.4.5.3.1.G]

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Requirement 5: To minimize potential test interference on carbon-based testing required for site characterization associated with surface ESF accommodations, the permanent infiltration of hydrocarbon material (such as oil-soaked sand) into the soils or rock beneath water tanks or other similar storage vessels shall be avoided. Design features to implement this requirement may include, for example, the use of impermeable liners, etc.

[ESFDR 3.2.1.2.3.A, 3.2.1.2.3.B, 3.3.1.F, 3.4.5.3.1.G]

Requirement 6: QA records shall be generated and submitted in accordance with procedure AP-2.17Q for all TFMs lost or emplaced during construction, operation (use), maintenance, and reclamation activities within the CCAB.

NOTE: The biodegradable and other inert TFMs, as defined by Section 13.2.3.2 and identified in Attachment II, lost or emplaced within the CCAB are specifically exempted from TFM recording and reporting requirements (AP-2.17Q) by this DIE. This exemption may be applied retroactively, such that any outstanding TFM reports are no longer required.

[ESFDR 3.2.1.2.3.A, 3.2.1.2.3.B, 3.4.5.3.1.F, 3.4.5.3.1.G, 3.4.5.3.1.P, 3.4.5.4.1.A, 3.5.7.1.F, 3.5.9.1.G]

Requirement 7: Minimize potential test interference on infiltration experiments which rely on chlorine isotopes ratios required for site characterization associated with surface ESF accommodations by applying the following controls:

- (7a) The use of chlorine-containing salt grounding solutions is prohibited (Section 10.2 suggests that a graphite-based material such as "GEM[®]" be used).
- (7b) Chlorine/chloride-bearing compound emplacement into soil and rock (such as leakage from the water supply system disinfection unit) shall be avoided. Design features to implement this requirement may include, for example, the use of impermeable liners, secondary containment tanks, etc.
- (7c) Potable water shall not be used for construction purposes (e.g., dust suppression, compaction of engineered fill, etc.) within the CCAB.
- (7d) Other surface use of chlorine/chloride-bearing compounds, which are to be permanently emplaced (as addressed in Requirement 7), requires evaluation and approval of the TCO.

[ESFDR 3.2.1.2.3.A, 3.2.1.2.3.B, 3.4.5.3.1.G]

Requirement 8: CH excavated muck shall not be stored with other ESF Muck without A/E evaluation (including potential waste isolation impacts) and approval.

[ESFDR 3.2.1.1.1.C.3]

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Requirement 9: Minimize the potential impact on testing and seismic monitoring activities associated with surface ESF accommodations by maintaining lifetime records of surface blasting activities which shall include recording of the date, time, location, amount of explosive in each blasting charge, and sequencing of blasts as part of the Job Package or FWP records, as applicable.

[ESFDR 3.2.1.2.3.A, 3.2.1.2.3.G]

Requirement 10: Explosive materials used for surface blasting shall conform to the following QA requirements:

(10a) The South Portal Headwall/Boxcut blasting materials shall not exceed 1000 lbs per instantaneous detonation or delay.

(10b) For surface ESF blasting other than the South Portal Headwall/Boxcut, blasting materials shall not exceed 30 lbs per instantaneous detonation or delay without additional A/E evaluation of potential waste isolation impacts.

[ESFDR 3.2.1.2.3.A, 3.2.1.2.3.G]

Requirement 11: The application of DUSTAC[®] (dust suppressant) within the CCAB is prohibited.

[ESFDR 3.2.1.2.3.A, 3.2.1.2.3.B, 3.2.1.2.3.E, 3.4.5.3.1.F, 3.4.5.3.1.G]

Requirement 12: The potential for interactions of surface ESF accommodations with the subsurface ESF shall be minimized by applying the requirements of the DIE for the Subsurface ESF (CRWMS M&O 1999a) on surface ESF accommodations as follows:

(12a) Requirements 3, 7a, 8, and 10 (CRWMS M&O 1999a) shall apply to the portion of the surface water supply system that supplies water to the subsurface ESF.

(12b) Requirements 7h, 8, 10, and 15 (CRWMS M&O 1999a) shall apply to the surface portion of the subsurface conveyor system.

(12c) Requirements 8, 10, and 15 (CRWMS M&O 1999a) shall apply to the surface compressed air system.

[ESFDR 3.2.1.2.3.A, 3.2.1.2.3.B, 3.2.1.2.3.D, 3.2.1.2.3.G, 3.2.1.2.3.I, 3.4.3.1.A, 3.4.3.1.B, 3.4.3.1.C, 3.4.3.1.D, 3.4.5.3.1.F, 3.4.5.3.1.O, 3.4.5.3.1.P, 3.5.3.1.A, 3.5.3.1.B]

The requirements shall be documented, as appropriate, in design analyses, specifications, and/or drawings to ensure that the requirements are adequately translated into implementing documents. Records generated as a result of QA requirements shall be maintained as lifetime QA records.

13.4 QUANTITATIVE TFM REQUIREMENTS

There are no quantitative TFM requirements specifically derived from this DIE.

13.5 REMOVAL REQUIREMENTS

Non-permanent items associated with surface ESF accommodations shall be removed to the extent practical before the licensed-operation phase of a repository at the Yucca Mountain site. Any incorporation of these items or their constituents into the pre-closure or permanent repository will require a new evaluation as part of the design of permanent items.

14. LIST OF REFERENCES

14.1 DOCUMENTS CITED

Angerer, J. 1996. "Revision to Planned Use of Tracers Fluids and Materials for Future Reclamation at Yucca Mountain." Interoffice Correspondence from J. Angerer (CRWMS M&O) to P. Hastings, May 15, 1996, LV.ESD.JPA-031, with attachments. ACC: MOL.19960613.0120; MOL.19990301.0052.

Bear, J. 1988. *Dynamics of Fluids in Porous Media*. New York, New York: Dover Publications. TIC: 217568.

Bodvarsson, G.S.; Bandurraga, T.M.; and Wu, Y.S., eds. 1997. *The Site-Scale Unsaturated Zone Model of Yucca Mountain, Nevada, for the Viability Assessment*. LBNL-40376. Berkeley, California: Lawrence Berkeley National Laboratory. ACC: MOL.19971014.0232.

Buesch, D.C.; Spengler, R.W.; Moyer, T.C.; and Geslin, J.K. 1996. *Proposed Stratigraphic Nomenclature and Macroscopic Identification of Lithostratigraphic Units of the Paintbrush Group Exposed at Yucca Mountain, Nevada*. Open File Report 94-469. Denver, Colorado: U.S. Geologic Survey. ACC: MOL.19970205.0061.

CRWMS M&O 1993. *Description and Rationale for Enhancement to the Baseline ESF Configuration*. B00000000-01717-0200-00089 REV 01. Las Vegas, Nevada: CRWMS M&O. ACC: NNA.19940221.0072.

CRWMS M&O 1994a. *Waste Isolation Evaluation for Use of Non-Committed Fluids and Materials at the Site Surface*. B00000000-01717-2200-00098 REV 01. Las Vegas, Nevada: CRWMS M&O. ACC: NNA.19940413.0033.

CRWMS M&O 1994b. *Exploratory Studies Facility Package 1B Change House – Bldg 5008 – First & Second Floor Plans*. BABBAF000-01717-2100-22150 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: NNA.19940620.0142.

CRWMS M&O 1994c. *ESF Building Code Analysis Change House Building 5008*. BABBAF000-01717-0200-00025 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19940712.0085.

CRWMS M&O 1995a. *Waste Isolation Evaluation: Tracers, Fluids, and Materials, and Excavation Methods for Use in the Package 2C Exploratory Studies Facility Construction*. BABE00000-01717-2200-00007 REV 04. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19950721.0172.

Determination of Importance Evaluation for the Surface Exploratory Studies Facility

CRWMS M&O 1995b. *Interoffice Correspondence LV.MGDS/SS.JJC.5/95-003 [and] Water Accountability Records – North Portal Pad*. Design Input Data Transmittal. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19960607.0124; MOL.19990301.0051; MOL.19960110.0427; MOL.19960111.0342; MOL.19960111.0343; MOL.19960607.0126.

CRWMS M&O 1995c. *ESF Blast Design Analysis*. BABE00000-01717-0200-00004 REV 04. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19951018.0185.

CRWMS M&O 1996a. *Exploratory Studies Facility Configuration Item Identification Site*. BAB000000-01717-1000-00002 REV 02. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19960715.0480.

CRWMS M&O 1996b. *Repository Advanced Conceptual Design Integrated Layout (without Calico Hills Drifting) ESF/GROA Interface – 1 of 7*. B00000000-01717-8100-00001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19961120.0064.

CRWMS M&O 1996c. *Exploratory Studies Facility South Portal Pad and Box-Cut Site and Grading Plan (including Engineering Change Request E96-0096)*. BAB000000-01717-2100-20210 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19961205.0034; MOL.19970107.0028.

CRWMS M&O 1996d. *Exploratory Studies Facility - South Portal Pad and Box-Cut Sections*. BAB000000-01717-2100-20211 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19961205.0035.

CRWMS M&O 1996e. *The Hydrologic Properties of the Unsaturated Zone at Yucca Mountain, Nevada Based on the USGS Lithologic Model Units*. BA0000000-01717-2200-00007 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19960808.0071.

CRWMS M&O 1996f. *Section 02225 Water Use for Surface Construction and Operations*. BAB000000-01717-6300-02225 REV 03. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19970528.1149.

CRWMS M&O 1997a. *Title III Evaluation Report for the Power System*. BA0000000-01717-5705-00003 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980616.0100.

CRWMS M&O 1997b. *Performance Implications to the Potential Yucca Mountain Repository by the Addition of Organics to the Site Surface: The Relations between Soil Organic Carbon, CO₂ from Soil Respiration and their Interactions with Groundwater*. BA0000000-01717-2200-00008. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19970604.0498.

CRWMS M&O 1998a. *Determination of Importance Evaluation for Surface-Based Testing Activities*. BAA000000-01717-2200-00101 REV 00/ICN 02. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980202.0314, MOL.19980722.0259, and MOL.19981208.0074.

CRWMS M&O 1998b. *Title III Evaluation Report for the Access Road System*. BABA00000-01717-5705-00001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980910.0877.

Determination of Importance Evaluation for the Surface Exploratory Studies Facility

CRWMS M&O 1998c. *Title III Evaluation Report for the Muck Storage*. BABCC0000-01717-5705-00001 REV 02. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19981109.0391.

CRWMS M&O 1998d. *Title III Evaluation Report for the North Portal Pad Drainage*. BABBB0000-01717-5705-00001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19981217.0063.

CRWMS M&O 1998e. *Title III Evaluation Report for the Surface and Subsurface Communication System*. BAB000000-01717-5705-00014 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990105.0136.

CRWMS M&O 1998f. *Title III Evaluation Report for the Waste Water Systems*. BA0000000-01717-5705-00007 REV 01. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19981019.0150.

CRWMS M&O 1998g. *Title III Evaluation Report for the Sanitation System*. BABBDC000-01717-5705-00001 REV 02. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980728.0008.

CRWMS M&O 1998h. *Title III Evaluation Report for the Surface Portion of the Non-Potable Water System*. BABBDB000-01717-5705-00001 REV 01. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19981202.0501.

CRWMS M&O 1998i. *Title III Evaluation Report for the Conveyor System*. BABFCB000-01717-5705-00001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19981214.0103.

CRWMS M&O 1998j. "Unsaturated Zone Hydrology Model." Chapter 2 of *Total System Performance Assessment-Viability Assessment (TSPA-VA) Analyses Technical Basis Document*. B00000000-01717-4301-00002 REV 01. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19981008.0002.

CRWMS M&O 1999a. *Determination of Importance Evaluation for the Subsurface Exploratory Studies Facility*. BAB000000-01717-2200-00005 REV 07/ICN 02. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990211.0800; MOL.19990215.0260; MOL.19990317.0092.

CRWMS M&O 1999b. *Reference Design Description for a Geologic Repository*. B00000000-01717-5707-00002 REV 02. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990301.0225.

CRWMS M&O 1999c. *Title III Evaluation Report for the Compressed Air System*. BA0000000-01717-5705-00006 REV 0. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990402.0168.

de Marsily, G. 1986. *Quantitative Hydrogeology Groundwater Hydrology for Engineers*. Orlando, Florida: Academic Press, Inc. (ISBN 0-12-208916-2) TIC: 208450.

Determination of Importance Evaluation for the Surface Exploratory Studies Facility

DOE (U.S. Department of Energy) 1997. *Yucca Mountain Site Characterization Project Site Atlas 1997*. Las Vegas, Nevada: Yucca Mountain Site Characterization Office. TIC: 236826.

Domenico, P.A. and Schwartz, F.W. 1990. *Physical and Chemical Hydrogeology*. New York, New York: John Wiley & Sons, Inc. (ISBN 047150744-X) TIC: 234782.

Dyer, J.R. 1992. "Request for Waste Isolation Evaluation, Fran Ridge Borrow Pit 1 for Exploratory Studies Facility (ESF) Phase 1A Construction Activities." Letter from J.R. Dyer (DOE/YMSCO) to L.D. Foust (CRWMS M&O), November 25, 1992. RSED:JMB-1083, with enclosure. ACC: NNA.19921211.0136.

Ervin, E.M.; Luckey, R.R.; and Burkhardt, D.J. 1993. "Summary of Revised Potentiometric-Surface Map of Yucca Mountain and Vicinity, Nevada Flow-System Modeling, Yucca Mountain, Nevada." *High level Radioactive Waste Management Proceedings of the Fourth Annual International Conference, Las Vegas, Nevada, April 26-30, 1993*. 2, 1554-1558. La Grange Park, Illinois: American Nuclear Society. TIC: 208542.

Fair, G.M.; Geyer, J.C.; and Okun, D.A. 1968. *Water Purification and Wastewater Treatment and Disposal*. Volume 2 of *Water and Wastewater Engineering*. New York, New York: John Wiley & Sons, Inc. (ISBN 0-471-25131-3) TIC: 242319.

Fischer, H.B.; List, E.J.; Koh, R.C.Y.; Imberger, J.; and Brooks, N.H. 1979. *Mixing in Inland and Coastal Waters*. San Diego, California: Academic Press. (ISBN 0-12-258150-4) TIC: 239312.

Flint, L.E. 1998. *Characterization of Hydrogeologic Units Using Matrix Properties, Yucca Mountain, Nevada*. Water-Resources Investigations Report 97-4243. Denver, Colorado: U.S. Geological Survey. ACC: MOL.19980429.0512.

Harold, S. 1993. *Biodegradability: Review of the Current Situation*. Derbyshire, United Kingdom: Lubrizol International Laboratories. TIC: 242774.

Harris, M.W. 1996. "Approval of Material for Use in the Test and Waste Isolation and Evaluation Zone (TWIEZ)." Letter from M.W. Harris (CRWMS M&O) to S.J. Brocoum (DOE/YMSCO), January 9, 1996, LV.ESR.KWB.01/96-005. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19960312.0144.

Helner, M. 1999. "Construction Criteria for Heliport." E-mail from M. Helner to D. Jenkins (CRWMS M&O), February 4, 1999. ACC: MOL.19990225.0413.

Hevesi, J.A. and Flint, A.L. 1993. "The Influence of Seasonal Climatic Variability on Shallow Infiltration at Yucca Mountain." *High Level Radioactive Waste Management Proceedings of the Fourth Annual International Conference, Las Vegas, Nevada, April 26-30, 1993*. 122-131. La Grange Park, Illinois: American Nuclear Society. TIC: 208542.

Kalia, H. 1992. "List of Tracers, Fluids, and Materials Assessment for North Portal Area." Memorandum from H. Kalia (LANL) to A. Brandstetter (CRWMS M&O), November 10, 1992, TWS-EES-13-LV-11-92-13, with attachment. ACC: NNA.19940418.0099.

Determination of Importance Evaluation for the Surface Exploratory Studies Facility

Leak, J. 1999a. "TERs Planned for FY00." E-mail from J. Leak to D. Jenkins (CRWMS M&O), March 1, 1999. ACC: MOL.19990301.0054.

Leak, J. 1999b. "Permanent Power Lines to Test Wells and Busted Butte." E-mail from J. Leak to R. Wemheuer (CRWMS M&O), January 15, 1999. ACC: MOL.19990225.0412.

Leak, J. 1999c. "Potential Water Loss from Non-Potable Water System." E-mail from J. Leak to D. Jenkins (CRWMS M&O), February 24, 1999. ACC: MOL.19990225.0414.

Montalvo, H. 1995. "Optional Muck Storage Configuration Item (CI)." Interoffice correspondence from H. Montalvo (CRWMS M&O) to R. Wemheuer, September 26, 1995, LV.ESSD.HM.9/95.187. ACC: MOL.19960422.0378.

Montalvo, H. 1996. "Height of Muck Storage Area." Interoffice Correspondence from H. Montalvo (CRWMS M&O) to R. Wemheuer, January 24, 1996, LV.ESSD.HM.1/96.09, with attachments. ACC: MOL.19960703.0209.

Robison, J.H.; Stephens, D.M.; Luckey, R.R.; and Baldwin D.A. 1988. *Water Levels in Periodically Measured Wells in the Yucca Mountain Area, Nevada, 1981-87*. Open-File Report 88-468. Denver, Colorado: U.S. Geological Survey. ACC: NNA.19890306.0113

RSN (Raytheon Services Nevada) 1993. Proctor Test, Maximum Density and Optimum Moisture, Common Fill. Las Vegas, Nevada: Raytheon Services Nevada. ACC: DRC.19980728.0128.

Schenker, A.R.; Guerin, D.C.; Robey, T.H.; Rautman, C.A.; and Barnard, R.W. 1995. *Stochastic Hydrogeologic Units and Hydrogeologic Properties Development for Total-System Performance Assessments*. SAND94-0244. Albuquerque, New Mexico: Sandia National Laboratories. ACC: MOL.19960318.0528.

Scott, R.B. and Bonk, J. 1984. *Preliminary Geologic Map of Yucca Mountain, Nye County, Nevada, with Geologic Sections*. Open-File Report 84-494. Denver, Colorado: U.S. Geological Survey. TIC: 203162

Sobolik, S.R.; Ho, C.K.; Dunn, E.; Robey, T.H.; and Cruz, W.T. 1996. *Sensitivity of Hydrological Performance Assessment Analyses to Variations in Material Properties, Conceptual Models, and Ventilation Models*. SAND94-0779. Albuquerque, New Mexico: Sandia National Laboratories. ACC: MOL.19971009.0607.

Thordarson, W. 1983. *Geohydrologic Data and Test Results from Well J-13, Nevada Test Site, Nye County, Nevada*. Water-Resources Investigations Report 83-4171. Denver, Colorado: U.S. Geological Survey. ACC: NNA.19870518.0071.

van Genuchten, M.T. 1980. "A Closed-Form Equation for Predicting the Hydraulic Conductivity of Unsaturated Soils." *Soil Science Society American Journal*, 44, (5), pp 892-898. Madison, Wisconsin: Soil Science Society of America. (ISBN 0361-5995) TIC: 217327.

Determination of Importance Evaluation for the Surface Exploratory Studies Facility

Wagner, R.C., ed. 1997. "Cancellation of Muck Storage Area Classification Analysis." Interoffice Correspondence from R.C. Wagner (CRWMS M&O) to R.D. Snell (CRWMS M&O), July 28, 1997, LV.SA.DMJ.7/97-093. ACC: MOL.19971204.0394.

Weast, R.C. 1979. *CRC Handbook of Chemistry and Physics*. 60th Edition, 1979 – 1980. Boca Raton, Florida: CRC Press. TIC: 245312.

Whitham, G.B. 1974. *Linear and Nonlinear Waves*. New York, New York: John Wiley & Sons. (ISBN 0-471-94090-9) TIC: 239310.

YMP (Yucca Mountain Site characterization Project) 1992a. *Exploratory Studies Facility Package 1A Topsoil & Rock Storage Areas, Site and Grading Plans*. YMP-025-1-CIVL-PL137, Rev. 0. Las Vegas, Nevada: Yucca Mountain Site Characterization Office. ACC: NNA.19930907.0182.

YMP 1992b. *Exploratory Studies Facility Package 1A Topsoil & Rock Storage Areas, Sections*. YMP-025-1-CIVL-PL138, Rev. 3. Las Vegas, Nevada: Yucca Mountain Site Characterization Office. ACC: MOL.19960426.0295.

YMP 1992c. *Exploratory Studies Facility Package 1A Probable Maximum Flood (PMF) Flood Plain*. YMP-025-1-CIVL-PL117, Rev. 0. Las Vegas, Nevada: Yucca Mountain Site Characterization Office. ACC: NNA.19930907.0173.

YMP 1994a. *Exploratory Studies Facility Package 1A, Starter Tunnel Gen Arrangement Section (Sht. 1)*. YMP-025-1-MING-MG122, Rev. 2. Las Vegas, Nevada: Yucca Mountain Site Characterization Office. ACC: MOL.19950626.0114.

YMP 1994b. *Exploratory Studies Facility Package 1A Water Supply Profile*. YMP-025-1-CIVL-PR128, Rev. 0. Las Vegas, Nevada: Yucca Mountain Site Characterization Office. ACC: MOL.19950626.0147.

YMP 1994c. *Exploratory Studies Facility Package 1A Water Storage Tank Access Trail Waterline, Plan & Profile*. YMP-025-1-CIVL-PR127, Rev. 1. Las Vegas, Nevada: Yucca Mountain Site Characterization Office. ACC: MOL.19950626.0148.

YMP 1994d. *Exploratory Studies Facility Package 1A Electrical Switchgear Bldg 5010 Floor Plan*. YMP-025-1-7007-AR101, Rev. 2. Las Vegas, Nevada: Yucca Mountain Site Characterization Office. ACC: MOL.19950626.0220 and MOL.19960529.0511.

YMP 1994e. *Exploratory Studies Facility Package 1A Electrical Switchgear Bldg 5010 Elevations & Sections*. YMP-025-1-7007-AR103, Rev. 2. Las Vegas, Nevada: Yucca Mountain Site Characterization Office. ACC: MOL.19950620.0222 and MOL.19960529.0512.

YMP 1995a. *Reclamation Implementation Plan*. YMP/91-14, Rev. 1. Las Vegas, Nevada: Yucca Mountain Site Characterization Office. ACC: MOL.19970109.0256.

Determination of Importance Evaluation for the Surface Exploratory Studies Facility

YMP 1995b. *Yucca Mountain Site Characterization Project Geologic Cross-Sections North Ramp of Exploratory Studies Facility*. YMP-95-373.0. Las Vegas, Nevada: Yucca Mountain Site characterization Project. ACC: MOL.19960402.0778.

YMP 1995c. *Yucca Mountain Site Characterization Project Geologic Cross-Sections Main Drift of Exploratory Studies Facility*. YMP-95-374.0. Las Vegas, Nevada: Yucca Mountain Site characterization Project. ACC: MOL.19960402.0779.

YMP 1995d. *Yucca Mountain Site Characterization Project Geologic Cross-Sections South Ramp of Exploratory Studies Facility*. YMP-95-375.0. Las Vegas, Nevada: Yucca Mountain Site characterization Project. ACC: MOL.19960402.0780.

YMP 1996. *Hydrochemistry Tests in the Exploratory Studies Facility*. Field Work Package FWP-ESF-96-008, Rev. 0. Las Vegas, Nevada: Yucca Mountain Site Characterization Office. ACC: MOL.19970224.0096.

YMP 1997a. *Exploratory Studies Facility Design Requirements*. YMP/CM-0019, Rev. 2, ICN 1. Las Vegas, Nevada: Yucca Mountain Site Characterization Office. ACC: MOL.19960926.0065 and MOL.19980107.0544.

YMP 1997b. *Surface-Based Testing Facilities Requirements Document*. YMP/CM-0022 Rev. 2, ICN 1. Las Vegas, Nevada: Yucca Mountain Site Characterization Office. ACC: MOL.19980219.0904.

YMP 1997c. *Surface-Based Borehole Instrumentation and Monitoring*. Field Work Package FWP-SB-97-009, Rev. 0. Las Vegas, Nevada: Yucca Mountain Site Characterization Office. ACC: MOL.19980429.0253.

YMP 1997d. *Geologic Mapping of the Exploratory Studies Facility*. Field Work Package FWP-ESF-96-010, Rev. 0. Las Vegas, Nevada: Yucca Mountain Site Characterization Office. ACC: MOL.19971007.0574.

YMP 1997e. *Perched-Water Testing in the Exploratory Studies Facility*. Field Work Package FWP-ESF-96-011, Rev. 0. Las Vegas, Nevada: Yucca Mountain Site Characterization Office. ACC: MOL.19971007.0581.

YMP 1997f. *Consolidated Sampling in the ESF*. Field Work Package FWP-ESF-96-009, Rev. 0. Las Vegas, Nevada: Yucca Mountain Site Characterization Office. ACC: MOL.19971007.0567.

YMP 1998a. *Q-List*. YMP/90-55Q, Rev. 5. Las Vegas, Nevada: Yucca Mountain Site Characterization Office. ACC: MOL.19980513.0132.

YMP 1998b. *Moisture Studies in the ESF*. Field Work Package FWP-ESF-96-004, Rev. 3. Las Vegas, Nevada: Yucca Mountain Site Characterization Office. ACC: MOL.19981123.0208.

YMP 1998c. *Seismic Monitoring*. Field Work Package FWP-SB-97-007 Rev. 2. Las Vegas, Nevada: Yucca Mountain Site Characterization Office. ACC: MOL.19980831.0177.

YMP 1998d. *ESF Data Collection Systems*. Field Work Package FWP-ESF-96-001, Rev. 1. Las Vegas, Nevada: Yucca Mountain Site Characterization Office. ACC: MOL.19960803.0007.

YMP 1999a. *Geodetic Monitored Network*. Field Work Package FWP/SB-98-010, Rev. 0. Las Vegas, Nevada: Yucca Mountain Site Characterization Office. ACC: MOL.19990324.0033.

14.2 CODES, STANDARDS, REGULATIONS, AND PROCEDURES

10 CFR 60. Energy: Disposal of High Level Radioactive Wastes in Geologic Repositories. Readily Available.

AP-2.17Q, Rev. 0, ICN 0. *Tracers, Fluids, and Materials Data Reporting and Management*. Las Vegas, Nevada: Yucca Mountain Site Characterization Office (YMSCO). ACC: MOL.20000223.0500.

ICBO (International Conference of Building Officials) 1997. *1997 Uniform Building Code*, Volume 2. Whittier, California: ICBO. (ISBN 1-884590-89-6) TIC: 233818.

NLP-2-0, Rev. 5, ICN 1. *Determination of Importance Evaluations*. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000713.0360.

NWI-ESF-005, Rev. 1. *Potable Water System Operation and Maintenance*. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19991013.0356.

15. ATTACHMENTS

Attachment	Title
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I	List of Acronyms
II	TFMs Evaluated for Use Associated with the Surface ESF
III	Bounding Analysis to Determine Maximum Saturation Change at the Potential Repository Level for a Given Input of Deep Infiltrating Water
IV	Bounding Calculation for Changes to Advective Transport from Potential WE Locations to the Water Table
V	Bounding Calculation for Recharge to the Saturated Zone
VI	Research Soil Analysis
VII	Bounding Calculation for Radionuclide and Sewage Plumes in the Saturated Zone
VIII	Bounding Calculation for the Extent of Rock Damage from a Surface Blast
IX	Potential Plume Patterns in the Saturated Zone
X	Transport of Dissolved Sulfate from the Ground Surface to Potential WE Locations

ATTACHMENT I

Determination of Importance Evaluation for the Surface Exploratory Studies Facility

ATTACHMENT I

LIST OF ACRONYMS

Determination of Importance Evaluation for the Surface Exploratory Studies Facility**LIST OF ACRONYMS**

General Note: This DIE addresses several SBT boreholes by their individual project identification numbers. The DIE for SBT Activities (CRWMS M&O 1998a) should be used in lieu of this acronym list to interpret SBT-related acronyms and other pertinent information, which is encoded into these identification numbers.

ABS	Acrylonitrile-Butadiene-Styrene
A/E	Architect/Engineer
AP	Administrative Procedure
ASTM	American Society for Testing and Materials
CCAB	Conceptual Controlled Area Boundary
CFR	Code of Federal Regulations
CH	Calico Hills
CHn	Calico Hills Nonwelded Hydrogeologic Unit
CI	Configuration Item
CII	Configuration Item Identifier
cm	Centimeter(s)
cm ² /sec	Square Centimeters Per Second
cm ³ /sec	Cubic Centimeters Per Second
¹⁴ C	Carbon-14
³⁶ Cl	Chlorine-36
CWA	Clean Water Act
CRWMS	Civilian Radioactive Waste Management System
DIE	Determination of Importance Evaluation
DOC	Dissolved Organic Carbon
DOE	United States Department of Energy
ECRB	Enhanced Characterization of the Repository Block

Determination of Importance Evaluation for the Surface Exploratory Studies Facility

EMI	Electromagnetic Interference
ESF	Exploratory Studies Facility
ESFDR	Exploratory Studies Facility Design Requirements
FOI	Field Operating Instruction
ft	Feet
ft ²	Square Feet
ft/yr	Feet Per Year
FWP	Field Work Package
gal	Gallon(s)
gal/acre	Gallon(s) Per Acre
gal/day	Gallon(s) Per Day
gal/yd ² /day	Gallon(s) Per Square Yard Per Day
GENISES	Geographic Nodal Information Study and Evaluation System
GROA	Geologic Repository Operations Area
ICBO	International Conference of Building Officials
in/sec	Inches Per Second
JP	Job Package
km	Kilometer(s)
kV	Kilovolt(s)
LANL	Los Alamos National Laboratory
lb	Pound
lbs	Pounds
lbs/acre	Pounds Per Acre
lbs/ft ²	Pounds Per Square Foot

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lbs/ft ³	Pounds Per Cubic Foot
lbs/mole	Pounds Per Mole
LiBr	Lithium Bromide
m ³ /day	Cubic Meters Per Day
m	Meter(s)
M&O	Management and Operating Contractor
MSDS	Material Safety Data Sheet
NAPL	Non-Aqueous Phase Liquid
NLP	Nevada Line Procedure
NPP	North Portal Pad
NSCZC	Nevada State Central Zone Coordinate
NTS	Nevada Test Site
OCRWM	Office of Civilian Radioactive Waste Management
OSHA	Occupational Safety and Health Administration
PI	Principal Investigator
PMF	Probable Maximum Flood
ppm	Parts Per Million
PPV	Peak Particle Velocity
PTn	Paintbrush Nonwelded Hydrogeologic Unit
PVC	Polyvinyl Chloride
QA	Quality Assurance
QAP	M&O Quality Administrative Procedure(s)
RCRA	Resource Conservation and Recovery Act
RSN	Raytheon Services Nevada
sec	Second(s)

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SBT	Surface-Based Testing
SBTFRD	Surface-Based Testing Facilities Requirements Document
SNL	Sandia National Laboratories
SPP	South Portal Pad
TBM	Tunnel Boring Machine
TCO	Test Coordination Office
TC	Tiva Canyon
TCw	Tiva Canyon Welded Hydrogeologic Unit
TFM(s)	Tracers, Fluids, and Materials
TIE	Test Interference Evaluation
TSPA	Total System Performance Assessment
TSPA-VA	Total System Performance Assessment – Viability Assessment
TS	Topopah Spring
TSw	Topopah Spring Welded Hydrogeologic Unit
UPS	Uninterruptible Power Supply
UZ	Unsaturated Zone
WE	Waste Emplacement
WIE	Waste Isolation Evaluation
yd ²	Square Yard
YMP	Yucca Mountain Site Characterization Project
YMSCO	United States Department of Energy Yucca Mountain Site Characterization Office

ATTACHMENT II

Determination of Importance Evaluation for the Surface Exploratory Studies Facility

ATTACHMENT II

TFMs EVALUATED FOR USE ASSOCIATED WITH THE SURFACE ESF

Determination of Importance Evaluation for the Surface Exploratory Studies Facility**TFMs EVALUATED FOR USE ASSOCIATED WITH THE SURFACE ESF**

General Notes: The TFM's listed below have been reviewed and are used to establish a TFM baseline for this evaluation. All Group 1 and Group 2 TFM's that are permanently emplaced, intentionally or unintentionally, are subject to DIE Requirement 6. Group 1 and 2 TFM's are also subject to the recording requirements of procedure AP-2.17Q. Group 3 TFM's are exempted from TFM reporting and recording requirements (AP-2.17Q). Any use of TFM's that have been prohibited by this DIE is also reportable per AP-2.17Q requirements. See the notes at the end of this TFM attachment for other applicable notes relative to the individual TFM's Group 2 below.

Group 1: **Approved for use in accordance with manufacturer's directions and precautions relative to application, storage, disposal, etc., if applicable.**

- 1 007 - Chemical Sharpener (torch tip cleaner)
- 2 ABS plastic
- 3 Aervoe-Pacific Marking Paint
- 4 American Polywater SpliceMaster Cable Cleaner Type GX
- 5 Argon (Noble Gas)
- 6 Austin Powder Company - Detonating Cord
- 7 Austin Powder Company - Dynamites Series
- 8 Austin Powder Company - Emulex 500 and 700 Series
- 9 Austin Powder Company - Gelatin and Semi-Gelatin Dynamites
- 10 Austin Powder Company - Shock*Star Tubing
- 11 Blastoff (for improvement of traction on rails)
- 12 Brazaloy (welding flux)
- 13 Burke Non-Ferrous, Non-Shrink Grout
- 14 Burke/EDOCO Acrylic Bondcrete CM-0170
- 15 Burrell Fibercrete
- 16 Burrell Shotcrete
- 17 Carlon Standard Clear PVC Solvent Cement
- 18 Caulk, Alex Plus
- 19 Clor-D-Tect 1000 (for analysis for chlorinated compounds used in oil)
- 20 Clor-D-Tect 4000 (for analysis for chlorinated compounds used in oil)
- 21 Concrete
- 22 Copper Wire or Plates
- 23 CRC Extreme Duty Silicon
- 24 Crosslinked Polyethylene Backer Rod
- 25 Crushed Rock Chips from NTS Area 1 shaker plant, for paving roads
- 26 Delvo Stabilizer, set retarder admixture for concrete

Determination of Importance Evaluation for the Surface Exploratory Studies Facility

- 27 Deomatic Urinal Screens
- 28 Detacord – 18 grain Detonating Cord
- 29 Detonation Cord – 200 grain
- 30 DYNO-Nobel Explosive - K622A
- 31 DYNO-Nobel IRESPLIT Semi-Gelatin Dynamite
- 32 DYNO-Nobel UNIGEL Semi-Gelatin Dynamite
- 33 Electrical Cable
- 34 Endust, for furniture cleaning and polishing
- 35 Ensign-Bickford - K622B
- 36 Ensign-Bickford PRIMACORD Detonating Cords
- 37 Ensign-Bickford PRIMADET Non-Electric Delay Detonator Noiseless Lead-In-Line (NLIL)
- 38 Ensign-Bickford PRIMADET Non-Electric Delay Detonators (LP) Series
- 39 Ensign-Bickford PRIMADET Non-Electric Delay Detonators (MS) Series
- 40 Ensign-Bickford PRIMADET non-electric detonators and lead-in lines
- 41 Ensign-Bickford Shock Tube
- 42 Epoxy Resin, Blue Paint and Activator, for sealing steam-cleaning pad
- 43 Fencing Materials
- 44 Firedam 150 Caulk
- 45 Flowcable, powder admixture for cement grout
- 46 FX-250 rapid-setting mortar (powder and liquid)
- 47 Glass
- 48 Gravel (for roads)
- 49 Helium (Noble Gas)
- 50 HPS Shotcrete Accelerator
- 51 Hub 100 Non-Shrink Grout
- 52 ICI Explosives CORDTEX Detonating Cord
- 53 ICI Explosives EXEL Flexible Plastic Shock Tubes
- 54 ICI Explosives EXEL Lead-In Line instantaneous detonator
- 55 ICI Explosives EXEL LP Long Delay Detonator
- 56 ICI Explosives EXEL MS Short Delay detonator
- 57 ICI Explosives GELDYN Semi-Gelatin Dynamite (cartridges)
- 58 ICI Explosives XACTEX Semi-Gelatin Dynamite (cartridges)
- 59 Iresplit D&D1
- 60 ITP Standard Backer Rod (including Hot Rod XL)
- 61 Kit 82-A1 (Scotchcast 4)
- 62 Kit 82-A2 (Scotchcast 4)
- 63 Krypton (Noble Gas)
- 64 Lead free solder

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65	Lithium Bromide (LiBr)
66	M28R metal magnetic particle weld-testing powder (iron)
67	Magnum 65 Detonator Sensitive Emulsion Explosive
68	MARKAL Paintstik "B" and "B 3/8" markers
69	MB-QSL 100, liquid shotcrete accelerator
70	MB-SF, accelerator, silica-fume mineral admixture for concrete, shotcrete
71	Meyco Rockbolt and Anchor Grout, cement grout
72	NEMA 61 Grey, for painting switchgear equipment
73	Neon (Noble Gas)
74	Nitrogen Gas
75	Non-Ferrous Shrink Grout No. CM-0010
76	Pentaerythritol Tetranitrate (PETN) Detonating Cord
77	Pentaerythritol Tetranitrate (PETN) Detonators
78	Plastic
79	Polar Tex 1 Class I Cellulite R-30 Insulation
80	Polyheed, cement dispersing agent
81	POWERCORD 60-, 100-, 150-, 200-grain Detonating cords
82	PVC
83	R-12 (Forane), Food Freezant 12
84	Rebar
85	Rheobuild 1000, cement dispersing agent
86	Rheobuild 2500, cement dispersing agent
87	Rim Huggers, for toilets
88	Rockbolts
89	S5Z Wil-X Cement Grout (B)
90	Sanford "Mean Streak" Waterproof Marking Sticks
91	Sheet Metal
92	Shotshell Primers No. 209
93	Sigunit L20 Liquid, shotcrete set accelerator
94	Sigunit NC Liquid, shotcrete set accelerator
95	Sigunit Powder, shotcrete set accelerator
96	Sikacrete 950, silica-fume admixture for concrete
97	Sikacrete 950DP, densified dry powder microsilica admixture for concrete
98	SikaGrout 212 Premix, cementitious mixture
99	Sikament 300, water-reducing liquid admixture for concrete
100	SikaTard 902/908/914, set retarder admixture for concrete
101	SikaTell 100, liquid shotcrete admixture
102	SikaTell 200, liquid shotcrete admixture
103	Silica Flour

Determination of Importance Evaluation for the Surface Exploratory Studies Facility

104	Silica Sand
105	Silli-Soda-Crete Grout (including Type I/II cement, sodium silicate, and Pozzolith 100-XR dispersing agent)
106	Soda Ash (for Geotechnical Testing Use Only Near the North Portal)
107	Solid Metals - Iron-Aluminum-Steel
108	Stay-Silv 400023 brazing flux
109	Steel
110	Sulfur Hexafluoride (SF ₆)
111	Super Filter Coat No. 412
112	SUVA-COLD MP [®] (tetra fluoroethane)
113	TD 210 rubber insulating compound
114	Terraset B-1000 System (Part A and Part B)
115	Thermo Trap
116	Tire Ballast Materials
117	Tremproof waterproofing
118	Tub and Tile Caulk
119	Velcro Adhesive
120	Weld Rod (E70XX electrodes)
121	Weld-Aid Tip Dip - 006 Nozzle Gel
122	White & Wib Hi Performance Acrylic Paint
123	Wil-X Cement/Grout
124	Wire mesh
125	Xenon (Noble Gas)
126	Zinc It Cold Galvanize, for galvanizing metal surfaces

Group 2: **Approved for use subject to special requirements and in accordance with manufacturer's directions and precautions relative to application, storage, disposal, etc.**

1	1275 Almaplex Industrial Lubricants	1
2	1607 Contact Cleaner	1,2
3	2001 Monolec Wire Rope Lubricant	1
4	3752 Almagard Vari-purpose Lubricant	1
5	3M 1606 Cable Cleaner and Degreaser	1
6	3M SCOTCH-WELD DP-190 Grey Epoxy Adhesive	1
7	3M Super 77 Spray Adhesive	1
8	605 Almasol Vari-purpose Gear Lubricant	1
9	607 Almasol Vari-purpose Gear Lubricant	1
10	803 Bone White Ind'l High Gloss Enamel	1

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11	A-55 Clean Fuel	1
12	ACTI-BRITE, for cleaning refrigeration coils	1
13	Adhesive, Panel, Henry 444 F.R.P.	1
14	Aero-Flor Bondcast – component A, bonding agent	1
15	Aero-Flor Bondcast – component B, bonding agent	1
16	Air Compressor Lubricating Oil	1
17	Air Kontrol Filter Spray	1
18	Alkyd Resin-Hige Gloss Enamel, for painting Change House	1
19	Amorphous Synthetic Silica Gel, for analysis of soil hydrocarbon content	1
20	Ansul "Foray" dry chemical fire suppression agent	1
21	Aqua Resin Clear with and without dye	1
22	Asphaltic Concrete	1
23	ATF Dextron (automatic transmission fluid)	1
24	Austinite 15 - ANFO blasting agent	1
25	Bar-ox Alkyd Shop/Field Primer - 41820	1
26	Barafoam®	1
27	Batteries/Battery Acid	2
28	Battery Terminal Protector, for vehicle maintenance	1
29	Bentonite Clay	2
30	Bortz Paint Thinner	1
31	Butyl rubber adhesive	1
32	Calcium hypochlorite	1,2
33	Caterpillar Dry Film Lubricant, greasing lubricant	1
34	CC-2 Preparation Kit (Cable Cleaner)	1
35	CEDAR FIBER (for Geotechnical Testing use only near the North Portal)	1
36	CELLOPHANE (for Geotechnical Testing use only near the North Portal)	1
37	Ceminert K Basecoat, Type II – Comp. C, for floor installation in Change House	1
38	Ceminert K Basecoat, Type II – Comp. D, for floor installation in Change House	1
39	Ceraglaze IP756 Epoxy-Polyester Coating	1
40	Chevron Soluble Oil HD (Machining Oil)	1
41	Chevron Special LS Diesel Fuel	1
42	Chlorides	2
43	Citgo C-500 Motor Oil, SAE 30	1
44	Citra Spray Paint Numbers 2124, 2125, 2133, 2137, 2143, 2148, 2155, 2156, 2163, 2169, 2171, 2175, 2178, 2182, 2183, 2187, 2190, and 2192	1
45	CITRIKLEEN (parts cleaner/degreaser)	1
46	Cleaning Solvents	1,2
47	Colonel Steel, for cleaning stainless steel	1
48	Concrete Joint Sealant (elastomeric)	1

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49	COTTONSEED HULLS (for Geotechnical Testing use only near the North Portal)	1
50	Cove Base Adhesive (Henry #440), for installing Change House cove base	1
51	CRC Moly Lube	1
52	CRC Quick Clean	1
53	Cresset Crete-Lease 727 release agent	1
54	Crown HD Open Gear and Wire Rope Lube	1
55	CRS-2H Emulsion asphaltic concrete paving material (used for chip and seal paving)	1
56	Cylinders of Gas Standards for Calibration of Instruments	1
57	DB-Series Oil	1
58	Decosheen W440 Acrylic Enamel Paint	1
59	Devcon Sure Shot Super Epoxy Resin and Hardener	1
60	Devguard Industrial Gloss Enamel	1
61	Devguard Tank and Structural Primer	1
62	Diesel Fuel	1
63	Disinfectants and Cleaners	1,2
64	Dow Corning 4 electrical insulating compound	1
65	Dow Corning plastic adhesive 739	1
66	Dow Corning Silicone Rubber Compounds (DOW CORNING 200(R) FLUID, 1000 CST)	1
67	DPD 1A, for chemical analysis of chlorine content in the water distribution system	1,2
68	DPD 1B, for chemical analysis of chlorine content in the water distribution system	1,2
69	DPD 3, for chemical analysis of chlorine content in the water distribution system	1,2
70	Drive Train Fluid HD SAE 30	1
71	Drive Train Fluid HD SAE 50	1
72	Dura-Lith Grease EP NLGI 2	1
73	Engine Brite Heavy Duty Engine Cleaner, for cleaning grease from equipment parts	1
74	ENVIROPLUG FINE (for Geotechnical Testing use only near the North Portal)	1
75	Epple 28 sealant	1
76	Ethylene Glycol and Propylene Glycol Alcohol Solutions (antifreeze)	1
77	Expansion Joint Material (particle board)	1
78	EZ MUD [®] PLUS (for Geotechnical Testing use only near the North Portal)	1
79	Fast Production Enamel F75RC4	1
80	FE-36 fire suppressant agent	1
81	Fibercrete, Quikcrete	1
82	Fire Sealant (ASTM E-815)	1
83	Firefighter PG Freeze Protection Fluid, antifreeze for Change House sprinkler system	1
84	Fiske Brothers Refining Co. Fiske No. 35 Soluble Oil (cutting oil)	1

ATTACHMENT II

Determination of Importance Evaluation for the Surface Exploratory Studies Facility

85	Floor Waxes and Finishes	1
86	Flux - Paste Regular 1	1
87	Foster 36-10, Weatherite Mastic (roof sealant)	1
88	FR-40 Fire Retardant Material (wood treatment)	1
89	FS 601 Elastomeric Firestop Sealant	1
90	Fusion RC Rubber Cleaner, Cat No. CH-RC-Q	1
91	GAI Cutting Oil, for glass cutting	1
92	Gasoline	1
93	GE Silocones Silicone Rubber Compounds (SILGLAZE-II/SILGLAZE 2800, SILOGLAZE 2900)	1
94	Gear Compound EP ISO 220	1
95	Gear Compound EP ISO 320	1
96	GEM [®]	1
97	Genetron 22 Refrigerant Gas	1
98	Glass cleaners and Soaps	1,2
99	Glue (silicone)	1
100	Greenlee-Textron Blue Gel Cable Pulling Compound	1
101	Grey Primer Epoxy and Activator, for priming surface of oil/water separator tank	1
102	Hot Black Cement, Cat No. HC-BLK-Q	1
103	Hot Fusion Fabric Primer, Cat No. HP-FP-Q	1
104	Hydraulic Fluid	1
105	Hydraulic Oil AW ISO 46	1
106	HYDROGEL (for Geotechnical Testing use only near the North Portal)	1
107	Hypochlorite Bleach (for sanitation purposes within the footprint of structures [e.g., Switch Gear Building and Change House] located on the North Portal Pad)	2
108	ICI Explosives POWERSplit Detonator Sensitive Slurry Explosive (cartridges)	2
109	Industrial Gloss Enamel White, for painting Change House	1
110	Insulating Oils	1
111	Insulation (extruded polystyrene)	1
112	ITW-Philadelphia Resins Corp. Ramset EPCON System Hardener Ceramic 6 formula	1
113	ITW-Philadelphia Resins Corp. Ramset EPCON System Resin Ceramic 6 formula	1
114	John Deere & Company Hy-Gard Transmission and Hydraulic Oil	1
115	LHD-1, LHD-5 Duct Sealing Compound	1
116	Liner Glue (PVC)	1
117	Litton/Kester flux-cored solder wire	1
118	Lubricants for Machines	1
119	Lubrication Engineers 9200 Almasol Dry Film Lubricant	1
120	Lubrication Engineers, Inc., 608 Almagard Vari-Purpose Gear Lubricant	1

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121	Macklanburg-Duncan POLYCEL Expanding Foam	1
122	Master Builder MicroAir - air entraining agent	1
123	Matheson Gas Products POLY-ETCH Active Sodium Solution	1
124	MC or SC-70 Cutback, liquid asphalt for paving roads	1
125	MD-200 Panel & Form adhesive	1
126	Mollub-Alloy 777-2 lubrication grease	1
127	Monoammonium phosphate dry chemical fire suppression agent	1
128	National Floor Sweep	1
129	Natural Degreaser, No. 14005	1
130	Omni-Pak enamel touch up, for touch up painting of Change House lockers	1
131	Option 1 (Relton) (water based metal working fluid)	1
132	Pag Oil-UCON Refrigeration Lubricant (R-134a), for lubricating compressor circuits	1
133	Para-Chem Southern, Inc. Kraloy PVC Pipe Cement	1
134	Permasheen W901 Acrylic Semi Gloss Paint	1
135	pH Electrode Storage Solution (3910001), for storing electrodes	1
136	Pipe Thread Compound (teflon)	1
137	Plastic Steel 5-Minute Putty Hardener – SF	1
138	Plastic Steel 5-Minute Putty Resin – SF	1
139	Plumber's Putty, Oatey, for sealing plumbing connections in Change House	1
140	Polyester adhesive, HIT C-100 (2 parts)	1
141	Polyurethane Clear finish, for office trailer doors	1
142	Port-a-potty Fluids (e.g., potpourri)	1
143	Primer, Quick Dry Industrial - IP520 Red	1
144	Propane	1
145	PVC Cement	1
146	QUIK-GEL® (for Geotechnical Testing Use Only Near the North Portal)	1
147	R-404A refrigerant gas, for servicing ice maker in Switchgear Building	1
148	Rawlplug Co. Chem-stud Anchor Capsules	1
149	Rectorseal Corp. HURRICANE HOMER PVC Solvent Cement	1
150	Resbond 907GF-6 Adhesive	1
151	Rinse Agent, RP355, for cleaning respirators	1
152	RPM Heavy Duty Motor Oil SAE 15W-40	1
153	RPM Universal Gear Lube SAE 80W-90	1
154	RPM Universal Gear Lube SAE 85W-140	1
155	Rubutex Contact Adhesive	1
156	Rubber	1
157	Rust Reformer, for coating steel tanks	1

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158	Rust-O-Thane Polyurethane and Activator, for surface coating of oil/water separator tank	1
159	Rust-Oleum paint, aerosol	1
160	SAE 90, Chevron RPM Gear Oil (transmission oil)	1
161	Safety Kleen Corp. Safety-Kleen #6638 Premium Gold Solvent	1
162	Scotch Brand 1602 Insulating Sealer (red)	1
163	Scotchcast Brand Flame Retardant Compound	1
164	Scotchkote Brand Electrical Coating	1
165	Seamfil, for sealing Change House counter tops	1
166	Select Seal Primer for Concrete, for Change House construction	1
167	Select Seal U-227 Part A, for sealing expansion joints in the Change House	1
168	Select Seal U-227 Part B, for sealing expansion joints in the Change House	1
169	Seymore Marking Paint, 16-657	1
170	Shellzone (R) All Season Antifreeze (ethylene and diethylene glycol)	1,2
171	Shot-Set 250, liquid accelerator	1
172	Silicone Caulking Compound (ASTM C-920D)	1
173	Silicone Sealants	1
174	Soda Lime	
175	Solar Salt	2
176	Spartan Cote (#2610), for sealing Change House floor	1
177	Special Respirator Cleaner Plus, PK300, for cleaning and sanitizing respirators	1,2
178	Spra-Fect 1760 Disinfectant Deodorant	1,2
179	Spray Stain, Walnut 601 (wood stain)	1
180	Stay-Clean 40028 (Lead Free) soldering flux	1
181	Structovis EHD, Lubricating Oil	1
182	Styrofoam	1
183	Sulfur Dioxide in Nitrogen, for calibration of diesel exhaust analysis equipment	1
184	SUNISO 3GS, viscosity=150 (specially refined oil for air conditioning compressors)	1
185	Tactoo GPA-72 hi-temp construction adhesive	1
186	TF-15 drilling lubricant, for drilling in Change House	1
187	Thinner, Industrial Spray - IP887	1
188	Thread cutting oil	1
189	Type HP Cleaner/Degreaser	1
190	United Duct Sealer	1
191	Vapor-Safe Coating, Foster 30-80	1
192	VEEfoam Concentrate, for mine rescue firefighting	1
193	Vortex Disinfectant	1,2
194	Water (non-potable and chlorinated)	2

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195	WELD-ON P-70 Primer for PVC and CPVC plastic pipe	1
196	Wood	1
197	Xylene, Bortz, for floor installation in the Change House	1
198	ZEP Dyna 143	1

Group 3: Biodegradable and other inert TFMs approved for surface ESF use within the CCAB, provided use is consistent with manufacturer's directions and precautions, relative to application, storage, disposal, etc., as applicable. These TFMs are exempt from the recording and reporting requirements of the TFM procedure (AP-2.17Q).

- 1 Agri-lock
- 2 Airtrol
- 3 Banana Oil, for respirator training
- 4 Chem-loc
- 5 Desert Bloom
- 6 DRiWATER
- 7 Hay
- 8 Hydroshield
- 9 M-binder
- 10 MARLOC[®] for dust suppression on roads, pads, and parking areas
- 11 Organic and Chemical Fertilizers
- 12 Perlite
- 13 Polyacrylamide gel (soluble and nonsoluble)
- 14 Polyphos 44
- 15 Seed
- 16 Soda Lime
- 17 Soil Master
- 18 Straw and Mulch
- 19 Vermiculite
- 20 Water (Non-potable)
- 21 Wood Fiber

NOTES:

1. These materials contain organic material. They have decomposition or combustion products that have the potential to interfere with site characterization testing (i.e., chlorine or carbon) and/or waste isolation. Refer to DIE Requirements 4 and 5.
2. These materials either contain chlorides or react with water to form products such as hydrochloric acid and acetic acid. Hydrochloric acid and other chloride-bearing materials could bias ³⁶Cl measurements. Refer to DIE Requirement 7.

Determination of Importance Evaluation for the Surface Exploratory Studies Facility

ATTACHMENT III

**BOUNDING ANALYSIS TO DETERMINE MAXIMUM SATURATION CHANGE AT
THE POTENTIAL REPOSITORY LEVEL FOR A GIVEN INPUT OF DEEP
INFILTRATING WATER**

Determination of Importance Evaluation for the Surface Exploratory Studies Facility**BOUNDING ANALYSIS TO DETERMINE MAXIMUM SATURATION CHANGE AT THE POTENTIAL REPOSITORY LEVEL FOR A GIVEN INPUT OF DEEP INFILTRATING WATER**

Assume that water introduced at the surface migrates through fractures and saturates the local matrix in the TCw and TSw hydrogeologic units. Due to the relatively high matrix permeabilities in the PTn hydrogeologic unit (CRWMS M&O 1996e), the movement of water through this unit is assumed to be relatively rapid (compared with movement in the welded tuff matrix), and therefore will be ignored in the following calculations. The potential repository level is assumed to be overlain by 319 meters (m) of welded tuff (depth from the surface minus the PTn thickness) (Schenker et al. 1995). The water will migrate due to the effects of capillary and gravity forces; however, here it is assumed that the motion is driven only by gravitational forces. This is a conservative assumption because capillary forces will act to disperse the excess water in three dimensions thus lowering peak saturations. The mass conservation equation for vertical, one-dimensional, gravity driven unsaturated flow is (Bear 1988, p. 496),

$$\phi \frac{\partial S}{\partial t} + \frac{\partial q(S)}{\partial z} = 0 \quad (\text{Eq. III-1})$$

where S = water saturation

$q(S)$ = flux of water (flow rate per unit area)

ϕ = porosity

Using Darcy's Law for unsaturated, non-capillary (the gradient is unity in the vertical direction) flow gives,

$$q(S) = K(S) \quad (\text{Eq. III-2})$$

where $K(S)$ = effective hydraulic conductivity

Substituting this into Equation (III-1), expanding the second partial derivative, and rearranging results in the following conservation of mass expression

$$\frac{\partial S}{\partial t} + c(S) \frac{\partial S}{\partial z} = 0 \quad (\text{Eq. III-3})$$

where

$$c(S) = \frac{1}{\phi} \frac{dK(S)}{dS} \quad (\text{Eq. III-4})$$

Determination of Importance Evaluation for the Surface Exploratory Studies Facility

Equation (III-3) is a first-order, nonlinear, hyperbolic equation, which represents kinematic waves. For these general systems, the migration of an initial "pulse" will develop a steep saturation gradient at the leading edge followed by an extended zone of decreasing saturation above the existing uniform initial saturation (Whitham 1974). As the pulse moves, the leading saturation "shock" will decay due to the spreading of the saturation excess behind the shock. An expression for the behavior of the shock is available from a method of characteristics solution (Whitham 1974, p. 55)

$$\left\{ \frac{1}{\phi} (K_2 - K_1) + (S_1 c_1 - S_2 c_2) \right\} \frac{(\xi_1 - \xi_2)}{(c_1 - c_2)} = \int_{\xi_2}^{\xi_1} S d\xi \quad (\text{Eq. III-5})$$

where ξ_1 = characteristic coordinate in front of shock

ξ_2 = characteristic coordinate behind shock

K_1, S_1, c_1 are functions of ξ_1

K_2, S_2, c_2 are functions of ξ_2

To solve Equation (III-5) for a specific problem, we need to introduce the initial saturation profile for the integral on the right hand side. The initial profile used is a "square wave," where the rock is saturated ($S_{2i} = 1$) over a length L (from the surface) with the remainder of the rock saturation at its initial undisturbed value ($S_{1i} = 0.74$). Given this initial profile, the integral in Equation (III-5) can be represented as,

$$\int_{\xi_2}^{\xi_1} S d\xi = (\xi_1 - L) S_{1i} + (L - \xi_2) S_{2i} \quad (\text{Eq. III-6})$$

In the general case, the shock begins to decay when the upstream characteristic curve originates from $\xi_2 = 0$. In this case, $\xi_2 = 0$ and $S_1 = S_{1i} = 0.74$ for all $t \geq 0$. Equating Equation (III-5) to Equation (III-6), substituting the values for ξ_2, S_{1i} , and S_{2i} , and solving for ξ_1 gives,

$$\xi_1 = \frac{L(c_1 - c_2)}{\frac{1}{\phi} (K_2 - K_1) - c_2 \frac{(S_2 - 0.74)}{(1 - 0.74)}} \quad (\text{Eq. III-7})$$

Expressions for the characteristics with $\xi_2 = 0$ are modified from (Whitham 1974),

$$z(t) = \xi_1 + c_1 t \quad (\text{Eq. III-8})$$

and

$$z(t) = c_2 t \quad (\text{Eq. III-9})$$

Determination of Importance Evaluation for the Surface Exploratory Studies Facility

where $z(t)$ is the position of the shock. Solving these for t gives,

$$t = - \frac{\xi_1}{(c_1 - c_2)} \quad (\text{Eq. III-10})$$

Substituting Equation (III-7) for ξ_1 in Equation (III-8) gives,

$$t(S_2) = \frac{L}{c_2 \frac{(S_2 - 0.74)}{(1 - 0.74)} - \frac{(K_2 - K_1)}{\phi(1 - 0.74)}} \quad (\text{Eq. III-11})$$

and substituting this into Equation (III-9) gives,

$$z(S_2) = \frac{Lc_2}{c_2 \frac{(S_2 - 0.74)}{(1 - 0.74)} - \frac{(K_2 - K_1)}{\phi(1 - 0.74)}} \quad (\text{Eq. III-12})$$

Given an offset from waste packages of 319 m in welded tuff (Schenker et al. 1995), let $z(S_2) = 319$ m. Also, let the peak saturation for the shock front, S_2 , be 0.9 (which is a value bounded by threshold value of 0.99 identified in CRWMS M&O [1999a]).

An expression for $K(S)$ is given by the following (van Genuchten 1980, Equation [III-8]),

$$K(S_n) = K_s (S_n^{1/2}) \left\{ 1 - \left(1 - S_n^{\frac{\beta}{\beta-1}} \right)^{1-\frac{1}{\beta}} \right\}^2 \quad (\text{Eq. III-13})$$

where

$$S_n = \frac{S - S_r}{1 - S_r} \quad (\text{Eq. III-14})$$

and

K_s = saturated hydraulic conductivity

β = shape parameter

S_r = irreducible water saturation

Even though several lithologic units are involved, the hydrologic behavior will be assumed to be similar to the TSw subunit Tptpln. Required parameters for the Tptpln matrix (potential repository level) are (CRWMS M&O 1996e):

$$\beta = 1.748$$

$$S_r = 0.05$$

Determination of Importance Evaluation for the Surface Exploratory Studies Facility

Equation (III-12) may be rearranged to solve for L. Note that the saturated hydraulic conductivity, K_s , and the porosity, ϕ , cancel out of the final expression and therefore do not need to be assigned numerical values. Using Equations (III-12), (III-13), (III-14), and the parameter values, L is calculated to be 98.8 m. This initially saturated zone is distributed over the Tpcrn lithologic unit, and 17.8 m of the Tptrn lithologic unit (Table III-1). The porosities and initial saturations (S_i) of these lithologic units are given below (CRWMS M&O 1996e) with these saturated thickness (h):

Table III-1. Lithologic Unit Properties

Lithologic Unit j	Thickness (saturated) h (m)	Porosity ϕ	Initial Saturation S_i
1 [Tpcrn]	81	0.11	0.62
2 [Tptrn]	17.8	0.20	0.45

The total quantity (depth) of water, H, introduced to create the saturated zone, L, may be computed from the following summation:

$$H = \sum_{j=1}^2 h_j \phi_j (1 - S_{ij}) \quad (\text{Eq. III-15})$$

This summation gives a total depth of 5.3 m (17.5 ft) of water for deep infiltration.

ATTACHMENT IV

Determination of Importance Evaluation for the Surface Exploratory Studies Facility

ATTACHMENT IV

**BOUNDING CALCULATION FOR CHANGES TO ADVECTIVE TRANSPORT FROM
POTENTIAL WE LOCATIONS TO THE WATER TABLE**

*Determination of Importance Evaluation for the Surface Exploratory Studies Facility***BOUNDING CALCULATION FOR CHANGES TO ADVECTIVE TRANSPORT FROM POTENTIAL WE LOCATIONS TO THE WATER TABLE**

Assume that the deep infiltrating water is spread within the hydrogeologic units between the potential repository level and the water table. From previous analyses (see main text), the increase in hydraulic conductivity that may noticeably affect repository performance is about a factor of 2 (Section 11.1.1.2.2). The increases in saturation below the repository level required to increase the effective hydraulic conductivity by a factor of 2 is calculated in this Attachment. An expression for the effective hydraulic conductivity as a function of water saturation, $K(S)$, is given by (van Genuchten 1980),

$$K(S_n) = K_s (S_n^{1/2}) \left\{ 1 - \left(1 - S_n^{\frac{\beta}{\beta-1}} \right)^{1-\frac{1}{\beta}} \right\}^2 \quad (\text{Eq. IV-1})$$

where

$$S_n = \frac{S - S_r}{1 - S_r} \quad (\text{Eq. IV-2})$$

and

K_s = saturated hydraulic conductivity

β = shape parameter

S_r = irreducible water saturation.

The properties of the hydrogeologic units and subunits between the repository and the water table are provided in Table IV-1 (CRWMS M&O 1996e; Schenker 1995[†]):

Table IV-1. Lithologic Unit Parameter Distribution

Lithologic Unit j	Thickness h (m)	Shape Parameter β	Porosity ϕ	Residual Saturation S_r	Initial Saturation S_i
1 [Tptpln]	61 [†]	1.748	0.13	0.05	0.74
2 [Tptpv3]	15	2.232	0.05	0.12	0.48
3 [Tptpv1&2]	64	1.560	0.23	0.12	0.89
4 [Tac]	127	1.916	0.29	0.12	0.88

Determination of Importance Evaluation for the Surface Exploratory Studies Facility

The effective hydraulic conductivities, K , and normalized initial saturations, S_{ni} , may be computed from Equations (IV-1) and (IV-2), respectively. Equation (IV-1) may then be used to compute the perturbed normalized saturations, S_{np} , in the different subunits that correspond to effective hydraulic conductivities that are twice the initial value. Finally, Equation (IV-2) may be used to compute the perturbed saturation, S_p . The computed saturation parameters for each affected lithologic unit are listed in Table IV-2.

Table IV-2. Lithologic Unit Saturation Parameters

Lithologic Unit j	Normalized Initial Saturation S_{ni}	Normalized Perturbed Saturation for 2 $K(S_{ni})$, S_{np}	Final Perturbed Saturation S_p
1 [Tptpln]	0.726	0.810	0.819
2 [Tptpv3]	0.409	0.480	0.542
3 [Tptpv1&2]	0.875	0.937	0.945
4 [Tac]	0.864	0.946	0.952

The depth of water, H , represented by the increased saturations in each unit, $S_p - S_i$, may be computed from,

$$H = \sum_{j=1}^2 h_j \phi_j (S_{pj} - S_{ij}) \quad (\text{Eq. IV-3})$$

Using the given parameter values the value of H may be computed from Equation (IV-3) and is found to be 4.1 m (13.5 ft).

Determination of Importance Evaluation for the Surface Exploratory Studies Facility

ATTACHMENT V

BOUNDING CALCULATION FOR RECHARGE TO THE SATURATED ZONE

Determination of Importance Evaluation for the Surface Exploratory Studies Facility**BOUNDING CALCULATION FOR RECHARGE TO THE SATURATED ZONE**

Assume that water discharge from a buried, continuous point source results in recharge to the saturated zone equivalent to injection through a recharge well. Recharge is assumed to occur over the operational life of the facility, t_0 . The solution for water-table elevation changes, s , resulting from injection through a recharge well over a time period, t_0 , is given by superposing the solutions for an injection well starting at $t = 0$ and a pumping well starting at $t = t_0$ (Domenico and Schwartz 1990, pp. 145 and 162):

$$s(r,t) = \frac{Q}{4\pi T} \left\{ \int_{\gamma}^{\infty} \frac{e^{-x}}{x} dx - H(t-t_0) \int_{\zeta}^{\infty} \frac{e^{-x}}{x} dx \right\} \quad (\text{Eq. V-1})$$

where

- $s(r,t)$ = change in water table elevation (cm)
- r = radial distance from injection point (cm)
- t = time (seconds [sec])
- Q = source flux (cubic centimeters per second [cm^3/sec])
- T = aquifer transmissivity (square centimeters per second [cm^2/sec])
- $H(t - t_0)$ = step function (equal to 1 if $t - t_0 > 0$; but equal to 0 if $t - t_0 < 0$)
- $\gamma = (Sr^2) / (4Tt)$
- $\zeta = (Sr^2) / (4T(t-t_0))$
- S = aquifer storativity

Changes in the saturated zone may impact potential repository performance through changes in water table elevation and changes in the slope of the water table. The water table elevation is an important characteristic below potential WE locations because this affects the distance radionuclides must migrate through the UZ before entering the saturated zone. Changes to the water table slope affects water flow rates in the saturated zone and, therefore, rates of radionuclide movement in the saturated zone.

There is no waste isolation concern before WE, waste package failure and radionuclide migration to the saturated zone. However, changes to water table elevation below potential WE zones may leave residual effects in the UZ beyond the time frame associated with movement of the water table. Therefore, the effects of water table elevation changes below potential WE zones due to ESF activities are considered for all times.

Potential WE zones lie at least 1 kilometer (km) from NSCZC E573200 in Midway Valley (DOE 1997), therefore, $r = 1$ km.

The design life of the ESF is 25 years (YMP 1997a), therefore,

$$t_0 = 25 \text{ years} = 7.884 \times 10^8 \text{ sec.}$$

Determination of Importance Evaluation for the Surface Exploratory Studies Facility

A minimum bound for the transmissivity is estimated to be on the order of (Sobolik et al. 1996, transmissivity zone 10), $T \sim 10 \text{ cm}^2/\text{sec}$.

The storativity may be estimated from the effective porosity, which is equivalent to the product of the porosity times the gas saturation (1 minus the water saturation). The porosity and water saturations near the water table may be taken as values for the CHz thermal/mechanical units to be 0.331 and 0.97, respectively (Flint 1998), resulting in a value for storativity, S , of 0.009.

The time derivative of Equation (V-1) is (for $t > t_0$)

$$\frac{\partial s}{\partial t} = \frac{Q}{\pi S r^2} \{ \gamma \exp(-\gamma) - \zeta \exp(-\zeta) \} \quad (\text{Eq. V-2})$$

The time when s is a maximum may be found by setting this expression equal to 0 and using the parameter values given above. The zero of ds/dt may be found by observation to occur at a time $t = 7.886 \times 10^8 \text{ sec}$. Using Equation (V-1), the maximum value of s at this time may be computed to be $s = 0.0421Q$, where s is in centimeters (cm) and Q is in cm^3/sec . Changes to the water table elevation may be evaluated with respect to the observed natural variation in water table elevations in boreholes. The natural variations are found to be on the order of 1 m (Robison et al. 1988). Therefore, if changes to the water table elevation resulting from surface discharge are 1 m or less below potential WE areas, these changes are expected to have a negligible impact on repository performance. Given a maximum perturbation of $s = 100 \text{ cm}$ (roughly the natural variation in water table elevation observed in wells [Robison et al. 1988]), the limiting value for Q is found to be $Q = 2377 \text{ cm}^3/\text{sec} = 205 \text{ cubic meters per day (m}^3/\text{day)}$.

The slope of the water table defines the driving force for flow in the saturated zone and affects saturated groundwater velocities and transport of radionuclides in the saturated zone. The discharge on the surface will percolate to the saturated zone and create a groundwater mound around the point of entry in the saturated zone. The mound will result in a flow pattern with a strong radially outward component near the percolation entry point in the saturated zone. Depending on the percolation rate, the resulting change in the water-table slope may exceed a lower bound for the natural gradient of about 2×10^{-4} (Ervin et al. 1993) east-southeast (away from potential WE locations) to some distance around the point of recharge, and may result in the migration of contaminants carried by the recharge water toward potential WE locations.

The slope of the water table resulting from water injection is given by:

$$\frac{\partial s}{\partial r} = \frac{Q}{2\pi T r^2} \{ H(t-t_0) e^{-\zeta} e^{-\gamma} \} \quad (\text{Eq. V-3})$$

Rearranging Equation (V-3) to solve for Q gives,

$$Q = (2\pi T r) (\partial s / \partial r) \{ H(t-t_0) e^{-\zeta} - e^{-\gamma} \}^{-1} \quad (\text{Eq. V-4})$$

A surrogate criterion used to bound impact due to changes in water-table slope and potential migration of contaminants is to limit discharge such that contaminants carried by the recharge

Determination of Importance Evaluation for the Surface Exploratory Studies Facility

water cannot migrate below potential WE locations. Using Equation (V-3), the parameter values given above, and the limiting $2377 \text{ cm}^3/\text{sec}$ flow, the water-table slope is found to lie within 1 percent of the existing value 25 years after termination of recharge. This occurs at about 10 percent of the earliest time that radionuclides may enter the saturated zone (300 years after potential WE [10CFR60]). Therefore, contaminant migration towards potential WE locations over the 25-year ESF design life should revert to migration away from such locations before radionuclide arrival.

If recharge to the saturated zone is restricted such that a water-table slope reversal does not occur below potential WE locations, then contaminant movement will be restricted similarly. That is, contaminants carried by the recharge water will not migrate to locations in the saturated zone below potential WE locations. The slope for the limiting case is computed along a line between the point of recharge and the nearest potential WE location. Equation (V-4) may be used to solve for Q with $t = 25$ years and $\partial s/\partial r = -2 \times 10^{-4}$. The limiting value of Q is found to be $Q_{\max} = 110 \text{ m}^3/\text{day} = 29,000 \text{ gal/day}$.

A comparison of the injection recharge limitations computed due to changes in water-table elevation and changes in water-table slope indicates that any potential waste isolation impacts are more sensitive to the effects of changes in water-table slope than elevation. Therefore, limitations on surface discharge with respect to effects on the saturated zone are bounded by the flow rate limited to $110 \text{ m}^3/\text{day}$ (29,000 gal/day).

ATTACHMENT VI

Determination of Importance Evaluation for the Surface Exploratory Studies Facility

ATTACHMENT VI

RESEARCH SOIL ANALYSIS

Kevin Blomquist
EG&G Energy Measurements
316 E. Atlas Circle
No. Las Vegas, NV 89030

DATE RECEIVED: 11/02/92

CSU SOIL TESTING LABORATORY
Room 6, Vocational Education Building
Fort Collins, CO 80523
303-491-5061
DATE: 01/19/93
BILLING:

RESEARCH SOIL ANALYSIS

Yucca Mountain Project*

Lab #	Sample ID #	-----ppm-----								mg/kg		%		g/cm ³	
		NO ₃ -N	NH ₄ HCO ₃ -P	DTPA K	Extract Zn	Fe	Mg	Na	SO ₄ -S	% OM	CaCO ₃ Equiv.	Bulk Density	meg/100g CEC		
R4044	Rec. 1-1	Top of Yucca #4H	4	1.4	604	0.4	2.9	250.0	105.0	0.35	1.7	5.3	1.09	20.8	
4045	Rec. 1-2		26	3.4	500	0.4	2.5	234.0	133.0	1.50	1.6	6.3	1.26	21.0	
4046	Rec. 1-3		16	2.8	529	0.2	2.2	243.0	123.0	2.12	1.5	3.3	1.43	22.1	
4047	Rec. 1-4		6	2.0	412	0.5	1.9	212.0	196.0	0.11	1.3	4.3	1.46	21.0	
4048	Rec 2-1	Midway valley	7	5.7	320	0.1	1.5	65.7	422.0	34.09	0.9	33.3	1.06	11.7	
4049	Rec 2-2		3	1.4	488	0.1	1.4	199.0	282.0	0.66	0.6	3.2	1.27	18.9	
4050	Rec 2-3		7	0.3	481	0.2	2.7	227.0	152.0	1.12	0.6	0.7	1.25	18.6	
4051	Rec 4-1		25	4.1	618	0.8	1.8	198.0	175.0	2.42	0.7	5.1	1.34	13.1	
4052	Rec 4-2	Fortymile wash	9	2.0	785	0.4	1.5	187.0	192.0	0.58	0.6	7.8	1.42	14.5	
4053	Rec 4-3		2	2.8	636	0.3	1.7	174.0	218.0	0.96	0.5	5.2	1.47	12.2	
4054	Rec 4-4		4	2.3	650	0.3	2.3	182.0	223.0	1.43	0.5	7.6	1.28	14.0	
4055	Rec 5-1		2	2.0	851	0.5	2.9	187.0	219.0	0.27	0.3	3.8	1.46	14.8	
4056	Rec 5-2	Exile Hill trenches	2	1.7	821	0.6	2.9	148.0	420.0	0.73	0.3	7.4	1.35	14.3	
4057	Rec 5-3		5	2.8	1150	0.5	4.3	203.0	405.0	1.96	0.9	7.8	1.39	18.0	
4058	Rec 5-4		2	1.4	908	0.6	3.1	191.0	278.0	1.12	0.4	2.9	1.44	15.6	
4059	JF. 3-1		13	1.7	715	0.6	3.8	87.3	112.0	1.89	0.2	1.1	1.32	5.6	
4060	JF. 3-2	TA Hill	5	0.8	694	0.3	3.8	95.3	150.0	26.48	0.2	9.9	1.43	6.3	
4061	JF. 3-3		4	2.5	701	0.2	3.5	87.1	55.8	0.96	0.2	1.6	1.51	5.8	
4062	TA. -1		5	5.7	1010	0.2	2.8	157.0	28.2	1.27	0.8	1.6	1.32	13.0	
4063	TA. -2		10	2.5	549	0.4	2.9	204.0	389.0	48.69	0.7	3.6	1.49	14.0	
4064	TA -3	Trenches	3	2.3	594	0.3	3.4	251.0	442.0	161.80	0.8	2.9	1.42	20.2	
4065	Rec. 2-4		5	3.4	175	0.2	3.7	68.7	85.2	9.60	0.4	6.3	1.23	11.9	

RESEARCH SOIL ANALYSIS

Determination of Importance Evaluation for the Surface Exploratory Studies Facility

ATTACHMENT VI

ATTACHMENT VII

Determination of Importance Evaluation for the Surface Exploratory Studies Facility

ATTACHMENT VII

**BOUNDING CALCULATION FOR RADIONUCLIDE AND SEWAGE PLUMES IN
THE SATURATED ZONE**

Determination of Importance Evaluation for the Surface Exploratory Studies Facility**BOUNDING CALCULATION FOR RADIONUCLIDE AND SEWAGE PLUMES IN THE SATURATED ZONE**

The sewage leach field lies about 2.5 km (1.6 miles) from the accessible environment (the CCAB boundary in Attachment IX). The sewage "plume" in the saturated zone will disperse laterally as contaminants migrate toward the controlled area boundary. The width of the plume, W_s , (containing about 95 percent of the mass) may be estimated using an advection-diffusion model (Fischer et al. 1979)

$$W_s = 4(2D_T t)^{\frac{1}{2}} \quad (\text{Eq. VII-1})$$

where D_T is the transverse dispersion coefficient. D_T may be estimated by (de Marsily 1986),

$$D_T = \alpha_T V \quad (\text{Eq. VII-2})$$

where α_T is the transverse dispersivity and V is the average linear groundwater flow velocity. An estimate for the transverse dispersivity is given by (de Marsily 1986; CRWMS M&O 1995a)

$$\alpha_T = 0.1\left(\frac{2}{3}\right)L_s \quad (\text{Eq. VII-3})$$

where L_s is the distance from the leach field to the controlled area boundary. The time to a distance L_s is given by L_s/V . Combining Equations (VII-1) through (VII-3) gives

$$W_s \sim \left\{\frac{32}{15}\right\}^{\frac{1}{2}} L_s \quad (\text{Eq. VII-4})$$

For the leach field, $L_s = 2.5$ km (Attachment IX) resulting in a plume width at the accessible environment of 3.7 km. Therefore, the portion of the saturated zone affected by the sewage plume within the CCAB may be estimated from the region shown in Attachment IX. This area is found to be 4.6 km². A similar calculation may be performed for the potential radionuclide plume in the saturated zone originating from the conceptual repository block. Because the conceptual repository block is relatively wide (about 3 km [CRWMS M&O 1996b]), this width is added to the dispersive spreading term to give the total plume width,

$$W_r \sim 3 \text{ km} + \left\{\frac{32}{15}\right\}^{\frac{1}{2}} L_r \quad (\text{Eq. VII-5})$$

where L_r is the distance traveled. Because the potential repository source is diffuse, the shortest distance between the potential repository block and the controlled area boundary along the inferred direction of saturated flow is used as a conservative estimate for L_r , which is found to be about 5 km (Attachment IX). Using Equation (VII-5), W_r is found to be 10.3 km. The area of the potential radionuclide plume within the CCAB boundary, shown in Attachment IX, is 33.3 km². Therefore, the ratio of the potential sewage-plume area to potential radionuclide-plume area in the controlled area is 14 percent.

Determination of Importance Evaluation for the Surface Exploratory Studies Facility

ATTACHMENT VIII

**BOUNDING CALCULATION FOR THE EXTENT OF ROCK DAMAGE FROM A
SURFACE BLAST**

Determination of Importance Evaluation for the Surface Exploratory Studies Facility**BOUNDING CALCULATION FOR THE EXTENT OF ROCK DAMAGE FROM A
SURFACE BLAST**

The relationship between ground velocity (PPV, in/sec), distance (R, ft), and explosive mass (W, lbs) is given by (CRWMS M&O 1995c):

$$PPV = 133 \left(\frac{R}{W^{\frac{1}{3}}} \right)^{-1.5} \quad (\text{Eq. VIII-1})$$

Let the damage (or fractured) zone velocity, PPV, be 100 millimeters per second (3.9 in/sec) (CRWMS M&O 1995a). Setting $R = 32.8$ ft (10 m), substituting the value of PPV, and solving for W gives **W = 30 lbs**.

For a 1000-lb explosive charge and a damage velocity of 100 millimeters per second (3.9 in/sec), Equation (VIII-1) may be used to find that the damage zone would extend to a distance of about 105 ft from the point of explosion.

ATTACHMENT IX

Determination of Importance Evaluation for the Surface Exploratory Studies Facility

ATTACHMENT IX

POTENTIAL PLUME PATTERNS IN THE SATURATED ZONE

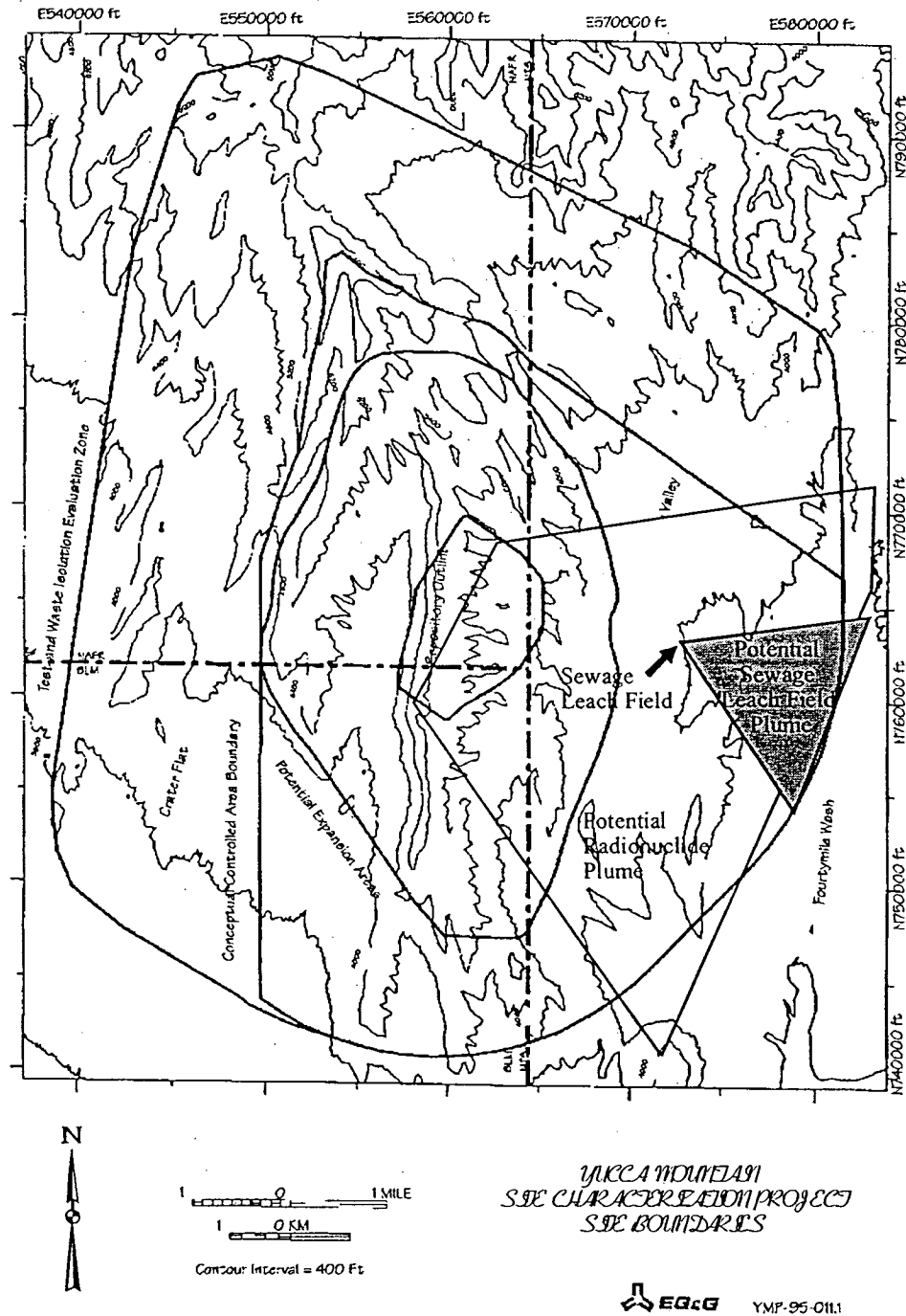
*Determination of Importance Evaluation for the Surface Exploratory Studies Facility***POTENTIAL PLUME PATTERNS IN THE SATURATED ZONE**

Figure IX-1. Potential plume patterns in the saturated zone for radionuclide releases from the conceptual repository and contaminants from the sanitary sewage discharge

ATTACHMENT X

Determination of Importance Evaluation for the Surface Exploratory Studies Facility

ATTACHMENT X

**TRANSPORT OF DISSOLVED SULFATE FROM THE GROUND SURFACE TO
POTENTIAL WE LOCATIONS**

*Determination of Importance Evaluation for the Surface Exploratory Studies Facility***TRANSPORT OF DISSOLVED SULFATE FROM THE GROUND SURFACE TO
POTENTIAL WE LOCATIONS**

The use of certain soil stabilization products (in particular, AIRTROL) will introduce calcium sulfate (gypsum: $\text{CaSO}_4 \cdot 2 \text{H}_2\text{O}$) at the ground surface (Angerer 1996). Due to the relatively high equilibrium solubility of calcium sulfate in water, the dissolution process will be bounded by a model of instantaneous and complete dissolution. Given the potential application of this material over large areas, the subsequent transport and dilution of the dissolved sulfate will be modeled as a one-dimensional advection-diffusion process. The peak concentration C_{\max} (in space) at a given time from an instantaneous release of a mass M of sulfate is given by (Bear 1988, p. 628),

$$C_{\max} = \frac{M}{\phi S \sqrt{4\pi D_L t}} \quad (\text{Eq. X-1})$$

where ϕ is the porosity, t is time, S is the water saturation, and D_L is the longitudinal dispersion coefficient. The water saturation has been added to this expression to account for the water volume per unit bulk volume under unsaturated conditions. This approximation is based on a steady, uniform infiltration and saturation distribution. The dispersion coefficient is given approximately by (de Marsily 1986)

$$D_L = 0.1xu / (\phi S) \quad (\text{Eq. X-2})$$

where x is the distance between the surface and some point underground and u is the infiltration rate. This approximation is based on an analogy between dispersive transport processes during infiltration in the UZ with similar processes during flow in the saturated zone. The arrival time for the peak concentration at a given point may be approximated by the advective travel time (Bear 1988, p. 629) where the porosity factor, ϕ , has been generalized to, ϕS , because of the unsaturated flow condition.

$$t = x / (u / (\phi S)) \quad (\text{Eq. X-3})$$

Substituting Equations (X-2) and (X-3) into Equation (X-1) gives,

$$C_{\max} = \frac{M}{\phi S x \sqrt{0.4\pi}} \quad (\text{Eq. X-4})$$

The approximate mass of sulfate per unit area may be calculated from the estimated maximum application density for AIRTROL of 6726 kilograms per hectare (Angerer 1996), and a mass fraction of sulfate in gypsum of 55.8 percent (Weast 1979, p. B-67). This gives a sulfate mass application density of about 0.375 kilograms per square meter. The minimum distance between the surface and potential WE locations is 200 m, and the porosity and water saturation in the host rock for WE are 0.13 and 0.74, respectively (CRWMS M&O 1996e). Substituting these values into Equation (X-4) gives a C_{\max} of 0.0174 kilograms per cubic meter, or 17.4 ppm. The natural variation (sample standard deviation) of aqueous sulfate concentration in the UZ has been found to be about 53 ppm (CRWMS M&O 1995a). Therefore, the proposed local applications of AIRTROL are expected to have a negligible effect on the average aqueous sulfate concentrations at the nearest potential WE locations.