Rockwell Hanford Operations

BWIP SUPPORTING DOCUMENT

End Function Activity: Site Department	Project No.: N/A	Number: SD-BWI-AR-031	Rev./Chg. No.: Rev. 0
		CIN No.: N/A Date: N/A	Page 1 Of 181 / Total Pages 181

Document Title: QUALITY EVALUATION BOARD LEVEL ASSIGNMENTS, EXPEDITED SPECIAL CASE FOR RESTART OF BOREHOLES DC-23, 24, 25, 32, and 33

Baseline Doc.: [ ] Yes [X] No Level: N/A

WBS No. or Work Package No.: ~~L3438~~ mas 06-15-87 L3F1

CEI No.: 003 ~~003438~~ mas 06-15-8

Borehole No.:	Stratigraphic Formations:	Doc. Type	Subj. Code
DC-23, 24, 25, 32, and 33	Hanford/Ringold/ Sad.Mts./Wanapum/ Grande Ronde	2047	P003 E405

Prepared by (type & sign name): T. D. Ault TD Ault
See reverse side for additional approvals

Date: 5/21/87

Abstract
(NOTE: Please limit the abstract to a total of 300 characters or less).

The activities associated with the expedited special-case restart of Boreholes DC-23, 24, 25, 32, and 33 required the application of quality assurance grading to assure that adequate controls are established. The Quality Evaluation Board (QEB) conducted the assessment from a generalized perspective to allow the application of grade levels to rotary piezometer installations including and beyond those associated with the expedited special case. Activities were divided into four categories (components): Site Excavation, Drilling, Piezometer Installation, and Geologic and Geophysical Logs. Components were further divided into items reflecting individual activities. This report discusses the process, results, and rationale for the grading and lists the quality assurance criteria to be applied to each item.

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(Continued on reverse side)

*COMPLETE DOCUMENT
(No asterisk, title page/summary of revision page only)

Prepared By: Rockwell Hanford Operations DE-AC06-77RL01030 Date: 5/21/87
(Company & Contract No.) mas 06-15-87

Used By: Rockwell Hanford Operations
(Company)

Release Stamp/Date: BWIP DC08 OFFICIALLY RELEASED 1987 JUN 24 AM 7:30

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Peer Review Identification No: N/A

Technical Review Identification No. TR-BWI-87-068

SD-BWI-AR-031, Rev. 0

Quality Evaluation Board Level Assignments, Expedited Special Case for Restart of Boreholes DC-23, 24, 25, 32, and 33

T. D. Ault, F. V. Roeck, K. M. Singleton, and A. P. Wicklund

Basalt Waste Isolation Project

May 1987

Prepared for the United States
Department of Energy under
Contract DE-AC06-77RL01030

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Quality Evaluation Board Level Assessment for Rotary Borehole Piezometer Facilities

This document presents the Quality Evaluation Board (QEB) assessment of items and activities associated with piezometer facilites. This includes borehole location, drilling, piezometer installation, monitoring and associated geologic/geophysical tests. The assessment examines these facilities from a generic standpoint. The results apply to boreholes DC-23, 24, 25, 32, 33 and other CX type boreholes. Due to the partially completed status of borehole DC-23, only piezometer installation and monitoring is affected by this grading. The objective of the quality grading process is to determine the level of control necessary for items and activities associated with these piezometer facilities.

The grading assessment is described in four separate sections within the document. The objective and process of grading are outlined in Section 1. Section 2 provides a summary of formal Quality Evaluation Board meetings and a list of the Quality Level Determinations. Section 3 describes the detail of the grading. References are listed in Section 4.

1.1 ORIGIN OF GRADED ITEMS AND ACTIVITIES

The initial list of Items and Activities to be considered in the grading assessment was generated by personnel from the Test and Operations and Science and Engineering Departments. This list was submitted informally to the manager of the Site Department for approval. The list was transmitted formally to the Quality Evaluation Board by the manager of the Site Department. The list was subsequently restructured and simplified by the QEB to facilitate the grading process.

1.2 QUALITY ASSURANCE GRADING PROCESS

Quality assurance grading was conducted in accordance with Project Management Procedures and Basalt Waste Isolation Project (BWIP) Quality Assurance Program Requirements. The grading was conducted to address the requirements set forth by the DOE BQARD (1986). To effectively apply the results to field situations it is important to understand the grading process. The remainder of Section 1 describes the process and its impact.

Application of the grading methodology is a series of judgment calls, with explanatory text to record considerations made by the QEB in arriving at the level assignments. The final determinations are subjective made by technical personnel familiar with the subject matter.

The Graded Quality Assurance process requires the completion of three standard grading forms identified below:

1. Matrix of Interaction.
2. Narrative Worksheet.
3. Consolidated Evaluation Form.

Information required to interface the forms, to define the graded items/activities, and to outline the grading criteria is presented in three additional formats (Component Summaries, Items Analysis Summaries, and Grading Checklists). The objectives of the individual forms and the specific details of their applications are outlined below.

The item/activities in the assessment were grouped into four major categories (components) and an alphanumeric identifier system was used to facilitate tracking. This identifier consists of a three letter Subject Prefix and a numeric component identifier sequence followed by individual Item numbers. The Subject Prefix "BHL" (an abbreviation for "Borehole") begins all four component identifiers. The four components are assigned a Component Identifier (001 through 004) listed below:

1. Site Evaluation and Preparation	BHL-001
2. Drilling	BHL-002
3. Piezometer	BHL-003
4. Borehole Geologic and Geophysical Logging	BHL-004

1.2.1 Component Summaries

A Component Summary precedes each Matrix of Interaction Form within Section 3 and provides a tabulation of the conclusions reached in the grading of the component. The Summary lists the items/activities, component-item identifiers, quality level assignments, and initiating events within a component. The component-item identifiers uniquely identify items and activities with a "Subject Prefix-Component Identifier-Item number" sequence that allow easy reference of any particular topic.

1.2.2 Matrix of Interaction

Matrix of Interaction Forms are composed of Items (activities) on the ordinate and Initiating Events as the abscissa. The Matrix of Interaction Forms are focal points from which the credibility of items and activities are evaluated. Credibility of an item or activity is based on the likelihood of occurrence and the impact of an associated failure relative to Waste Isolation, Data Integrity, Safety, and Project cost/schedule factors.

Credibility is evaluated in a two pass examination of the Matrix of Interaction forms. The initial evaluation eliminates Item-Initiating Event

intersections that demonstrate no potential for unfavorable interaction or were unlikely to occur (non-typical). Item-Initiating Event intersections eliminated as non-credible at this point were marked with "O" designations. Potentially credible Item-Initiating event intersections were assigned an "X". The next evaluation involves the in depth re-evaluation of all potentially credible intersections which are documented in the Item Analysis Sheets (see Section 1.2.3). Intersections determined to be non-credible on the second pass have the "X" over-struck with an "O". Where the QEB lacks sufficient expertise on a specific topic, subject matter experts are consulted for added technical information.

1.2.3 Item Analysis Summary

Item Analysis Summaries are used in conjunction with the Grading Check List and are prepared for each item/activity. These summaries contain definitions of items, track the credibility determinations and provide the rationale for the final Quality Assurance Level. The credibility determinations are evaluated on the Item Analysis Sheet as a sequence of Potential Failures, Consequences, and Credibility for each item-initiating event intersection. The results of the determination are indicated on the Matrix of Interaction Form.

1.2.3.1 Grading Check List

The Grading Checklist was used in conjunction with the Item Analysis Sheets to examine all Items. The credibility previously determined on the Matrix of Interaction and the questions posed by the checklist are considered. Items were assigned Quality Levels commensurate with the Conditions column of the grading checklist. The Grading Checklist forms provided with each item in this document represent the end product of these determinations for a given item.

1.2.3.2 Item Analysis Sheet Considerations

The determination of credibility and the assignment of Quality Assurance Levels required that positions be taken in regard to specific issues. These positions are:

1.2.3.2.1 Natural Barrier Penetration

Items or activities physically impacting natural barriers that are relied upon for waste isolation were viewed from a conservative standpoint. Where the item/activity physically modifies natural barriers a positive response is determined for Steps 1 through 3 on the Grading Checklist and the highest QA level was assigned to the control of that activity.

The definition of natural barriers important to waste isolation was derived through discussions with project personnel. The Natural Barrier is designated, for the purposes of this grading, as the volume of rock surrounding the proposed underground repository layout area that will limit

the transport of radionuclides to the accessible environment. The determination of the exact physical extent of the natural barrier is the objective of the Site Characterization activity and is not currently defined. The Quality Evaluation Board adopted the CASZ (Controlled Area Study Zone) and the stratigraphic units below the Mabton sedimentary interbed as the horizontal and upper vertical boundaries respectively for the Natural Barrier. Quality Assurance Levels are based on this definition and the assignment of more conservative definitions of the Natural Barrier will require re-evaluation of some graded items.

1.2.3.2.2 Worker Safety

Grading Check List Steps 12 and 13 address the questions of Industrial Worker Safety in relation to Quality Assurance Levels. Quality Assurance Level 2 is stipulated for items or activities whose failure can result in reportable or lost time personnel injury. The existing safety controls on the Hanford Site effectively prevent the occurrence of lost time or reportable injuries. This is indicated by the outstanding safety record of the onsite drilling operations. The occurrence of personnel injuries during drilling, testing, and monitoring activities is considered unlikely and as a result the responses to Steps 12 and 13 for all items and activities are negative.

1.2.3.3 Level Assignment

The Quality Assurance Level (QAL) for each Item and a brief rationale for level assignment are included at the conclusion of the Item Analysis Sheet. This summarizes the results of the credibility evaluation and the application of the Grading Check List. This process formed the basis for the Quality Level entry on the Consolidated Evaluation Form.

1.2.4 Narrative Work Sheet

Narrative Work Sheets summarize how and when failures can occur as well as remedial and preventative measures. This serves as a summary for the final analysis associated with each item.

1.2.5 Consolidated Evaluation Form

Consolidated Evaluation Forms (CEFs) identify individuals involved, their levels of expertise, Quality Assurance Levels, the applicable Quality Assurance Criteria, and the Program Responsibility for the applicable criteria.

The upper left hand corner of the Consolidated Evaluation Form identifies the Item under analysis, QEB members, and the subject matter experts assisting in the grading process. The expertise level of

individuals involved is presented in the top center of the page. The expertise levels range from 1 to 5 with the lowest number representing the highest level of expertise. The upper right corner of the page contains the item identifier number and identifies the Quality Assurance Level from the Grading Check List. A recommendation for Q-List consideration is also given here. The assigned quality assurance level affects the subsequent entries to the Consolidated Evaluation Form. The following section evaluates the impacts of the Quality Assurance Levels.

1.2.5.1 Quality Level Assignment Impact

The Quality Level assignments define how the Item or Activity must be controlled in final application. The assignment of a high quality assurance level may not require the application of that specific QAL throughout manufacture, procurement, and shipment of the item. The procurement of equipment, materials or services that require Level 1 controls in the final application may be purchased with Level 3 or standard industry controls. The level 1 controls can be initiated by the responsible organization through their existing program. The degree of control for the three Quality Assurance Levels are outlined below:

Quality Level 1. The highest quality level available for assignment in the BWIP. This level is assigned to Q-List items or activities and requires a comprehensive quality assurance program for compliance with applicable requirements.

Quality Level 2. The intermediate quality level available for assignment in the BWIP. This level is assigned to items and activities with importance to DOE mission objectives and requires a quality assurance program for compliance with applicable requirements that are less extensive than Level 1.

Quality Level 3. The lowest quality level available for assignment in the BWIP. This level is assigned to all items and activities included in the quality assurance program but not assigned Quality Levels 1 or 2. It requires good management, engineering, or laboratory work practices for compliance with quality assurance requirements.

The Quality Assurance Level (QAL) affects the control of a process or item. The QAL reflects the relative importance of the item and determines the rigor in which the process is planned, designed, performed, and verified. The QAL does not reflect the accuracy or precision of an item or activity. Drill cuttings (Item 8, BHL-002), for example, are important to Site Characterization and are designated Level 1. This designation does not require the data to be collected in a different manner than normal for the industry in general. It does require the process of drill cutting sample collection to be defined, controlled, and auditable. The QAL defines the extent of the required controls; the body of the Consolidated Evaluation Form identifies which of the 18 criteria are applied.

1.2.5.2 Criteria Designation and Program Responsibility

The remainder of the Consolidated Evaluation Form assigns the applicable NQA-1 criteria to the item or activity and also the organization responsible for implementing these criteria. The criteria apply unless specifically excluded in the "Justification Required" column. Criteria 1, 2, 5, 6, and 15-18 apply in all cases. The extent to which a criterion is applied is dependent on the Quality Assurance Level of the item or activity. The requirements associated with a specific criteria identify the specific aspects of the item or activity that require control. Continuation comments can modify the requirements for specific criteria, but in general the QAL-1 Items are required to address the following requirements as outlined in the Project Quality Assurance manuals.

1.2.5.3 Program Responsibility

The Program Responsibility identifies the organization most suited to incorporate the regulatory and specific technical requirements. This includes the preparation instructions, procedures, drawings, and maintenance of a quality assurance program. The QEB assigns program responsibility for each of the applicable criteria.

Where responsibility is indeterminate or is clearly multilevel, the prime responsibility is followed by the subordinate or alternate organization. The assignments are expressed in terms of integrating contractor (IC) or subcontractor (SC).

2.0 QUALITY EVALUATION GRADING SUMMARY

Formal meeting days, personnel involved in the evaluation proceedings, specific items considered in the grading process and level assignments are summarized on the following pages:

2.1 QEB CHRONOLOGY AND PARTICIPANTS

Meeting Days: 11-10-86
11-11-86
11-12-86
11-13-86
11-14-86
11-17-86
11-18-86
11-19-86
11-20-86

Members: T. D. Ault, Advanced Geophysicist (Team Leader)
A. P. Wicklund, Principle Engineer (member)
F. V. Roeck, Advanced Scientist (member)
K. M. Singleton, Geologist (subject matter expert)
D. F. Hanlen, Staff Engineer (subject matter expert)

Subject Matter Experts (Item specific)

11-13-86
Holly Jamison, Staff Drilling Engineer: Specific drilling methods
Ted Clawson, Senior Scientist: Specific drilling methods
Dale Landon, Senior Geologist: Chip sampling applications
Rod Ledgerwood, Staff Geologist: Chip sample methods

11-17-86
Joe Jimenez, Advanced Drilling Specialist: Piezometer installation

11-18-86
Jerry Bultena, Drilling Specialist: Piezometer installation

11-19-86
Lyle Diediker, Advanced Scientist: Borehole geophysical logging
Steve Palmer, Staff Scientist: Borehole geophysical logging

11-20-86
Bob Bryce, Manager: Monitoring system installation
Bryan Nelson, Hydrologist: Monitoring system installation

2.2 ITEMS IDENTIFIED AND QA LEVEL ASSIGNMENT

		QA Level
1.	Site Evaluation and Preparation (BHL-001)	
	Item 1. Site Excavation	3
	Item 2. Survey Borehole Coordinates	1
2.	Drilling (BHL-002)	
	Item 1. Mobilization/Demobilization	3
	Item 2. Cable Tool Drilling	3
	Item 3. Set Conductor Pipe	3
	Item 4. Rotary Drilling	1
	Item 5. Spot Cementation	3
	Item 6. Set Casing/Cement	3
	Item 7. Fluid Circulation Monitoring	1
	Item 8. Drill Cuttings	1
	Item 9. Drill Rigs and Drilling Materials	3
	Item 10. Clean Borehole	3
3.	Piezometer (BHL-003)	
	Item 1. Set Cement Plug	1
	Item 2. Assemble, Measure and Place Piezometer	1
	Item 3. Tubing Test	1
	Item 4. Filter Pack Placement	1
	Item 5. Develop Piezometer	1
	Item 6. Install and Monitor Transducer	1
	Item 7. Materials	3
4.	Geologic/Geophysical logging (BHL-004)	
	Item 1. Open and Cased Hole Logs	1
	Item 2. Developmental Logs	3
	Item 3. Borehole Geologic Logs	3

3.0 QUALITY LEVEL GRADING

3.1 SITE EVALUATION AND PREPARATION COMPONENT SUMMARY (BHL-001)

Items Identified	QA Level
Item 1. Site Excavation	3
Item 2. Survey Borehole Coordinates	1

Initiating Events

Initiating Event A. External Physical Factors

Initiating Event B. Training, Procedural Deficiency, Carelessness

Initiating Event C. Design Deficiency

Initiating Event D. Failure of Item

Initiating Event E. Fire and Explosion

MATRIX OF INTERACTIONS

ITEMS (from numbered list, attached) *

INITIATING EVENTS	1	2	3	4	5	6	7	8	9	10	11	12	13	14
A - External Physical Factors	0	0												
B - Training Deficiency	0	X												
C - Design Deficiency	0	X												
D - Failure of Item	0	0												
E - Fire and Explosion	0	0												

X = Item/event have potential for unacceptable interaction.

(X) = Item/event reviewed and rejected as not consequential.

0 = Item/event reviewed and rejected as not consequential

A-6700-307

* See Component Summary (previous page) for Items Identified

3.1.1 Item 1, BHL-001-1: Site Excavation Item Analysis

Definition

This item includes the location of drill site and physical construction of graveled drill pad, access road, and excavation of mud pits. The process also includes acquisition of an excavation permit and an environmental evaluation.

Considerations

- Drill site locations are identified by BWIP personnel and coordinates are determined by plane survey.

- The excavation and surveying of drill sites is conducted under Hanford engineering construction contractor procedural controls.

- The drill pad location survey and all intermediate surveys done prior to the final network survey is considered part of this Item.

Initiating Event A1. External Physical Factors

This Initiating Event includes external physical impact, sabotage, and natural phenomena as defined below.

External physical impact, as referred to in this document, includes impacts by missile, aircraft, or radiological fallout. The likelihood of the drill location being struck by a missile or aircraft is considered by this QEB to be remote. The possibility of radiological fallout affecting drilling operations is difficult to assess given the proximity to the Hanford nuclear facilities. However, this occurrence is also considered to be unlikely. Regardless, if a drill site were destroyed by one of these external physical causes it would not cause an impact great enough to exceed the established 10 million dollar limit. These events are therefore considered non-credible for the rest of this discussion unless specifically stated otherwise.

Sabotage - Deliberate attempts to obstruct normal operations or damage the facilities can occur at any phase of borehole development. The likelihood of such an event occurring is considered by this QEB to be small. Hanford Site workers receive standard and iterative requalifying instruction to allow only authorized personnel, who have been cleared by Rockwell, to be at the well site. Standard security measures should effectively neutralize any potential acts of sabotage and is therefore considered non-credible for the rest of this discussion unless specifically stated otherwise.

Natural phenomena are defined as environmental influences such as floods, earthquakes, tornadoes, etc. The result of the most severe natural phenomena, including the loss of the piezometer borehole, would not cause

an impact exceeding the established limit of 10 million dollars. Furthermore, the possibility of such an event occurring, that would adversely affect the progress of drilling and testing operations, is considered by this QEB to be remote and therefore non-credible for the rest of this discussion unless specifically stated otherwise.

Initiating Event B1. Training, Procedural Deficiencies, or Carelessness

Potential Failure:

Locate the site in the wrong place.

Consequence:

If an error is detected before drilling has begun, mis-location would present relatively minor cost and schedule delays. If the borehole is drilled in the wrong location, it could impact the interpretation and availability of site characterization data.

Credibility:

Non-Credible. The potential for this failure is very low given the method used to site boreholes. A survey of the drill site location, before drilling commences, will confirm the proper location. If a borehole were to be mis-located the information gathered from the borehole would presumably be of some use and another borehole may be drilled, if necessary, for less than 10 million dollars.

Initiating Event C1. Design Deficiency

Potential Failure:

A poorly designed and/or constructed drill pad.

Consequence:

A drill pad that is poorly constructed and/or too small for the particular drill rig and support equipment could result in a schedule delay for rig mobilization. Incorrect placement of mud pits and/or starter hole could also cause a schedule delay.

Credibility:

Non-Credible. This potential failure is very low given the simplicity of the item. Incorrect placement or construction of mud pits and/or starter hole could be easily overcome prior to drilling.

Initiating Event D1. Failure of Item

N/A under this Item

Initiating Event E1. Fire and Explosion

Fire - There are three primary areas of concern when considering fires on the drilling rig: 1) flammable materials, 2) brush fires and, 3) natural gas.

Safety training as well as the adherence to standard industrial practices regarding the use and handling of flammable materials will effectively minimize any hazard.

Brush fires can occur due to natural causes as well as negligence. Areas immediately surrounding the drilling rig are cleared of brush and therefore it is unlikely that either situation would cause any major difficulties.

Drilling history at Hanford has not shown natural gas (methane) to be a problem. If natural gas were encountered during the drilling process it would most likely be at a depth where reverse circulation methods are employed and thereby minimize any potential impact. Monitoring for natural gas production is a common way to mitigate unforeseen adverse situations.

Routine inspection of fire fighting equipment is performed to insure its effective use should a fire occur.

Explosion - Explosions are possible wherever flammable materials are under confinement. Adherence to standard industrial safety practices regarding the use and handling of confined flammable materials will minimize the hazards.

High pressure equipment such as compressors, pumps, hydraulic equipment, etc., have the potential of explosive failure by rupture. Following established maintenance and safety practices will minimize the possibility of failure.

No activities are currently planned at drill site locations which involve materials that are in themselves explosive.

Level Assignment: Level 3

The relative ease with which changes to the location and construction of the drill site can be accomplished, as well as the confirmation of location with a coordinate survey, make this a QA Level 3 activity.

GRADING CHECK LIST

Component/Item: BHL-001-1/Site Excavation

Conditions	QAL
1. Can failure of the item, or activity contribute to a process which allows radioactive materials to reach the uncontrolled environment?	1A
2. Does the item or activity involve or affect public radiological health and safety?	1A
3. Does the item or activity involve waste isolation?	1A
4. Does this activity support or provide data to evaluate performance assessment of repository radionuclide containment capability?	1A
5. Can failure of the item or activity cause irretrievable loss of such data?	1A
6. Can the activity involve a significant change to an in-process licensing document?	2A
7. Can the activity involve a change to an in-process major procurement action?	2A
8. Can the activity involve a change to a major in-process construction action?	2A
9. Can failure of the item or activity cause a major cost overrun?	2A
10. Can failure of the item or activity cause a major schedule slippage?	2A
11. Can failure of the item or activity have an adverse impact on major non-radiological engineered systems or structures?	2A
12. Can failure of the item or activity result in personnel injury which must be individually reported to state or Federal agencies?	2B
13. Can failure of the item or activity result in a lost time personnel injury?	2B
If none of the above	(3)

NARRATIVE WORK SHEET

Name: T. D. Ault
A. P. Wicklund
F. V. Roeck
K. M. Singleton

SD-BWI-AR-031 Rev 0

BHL-001-1

Item: #1 Site Location and Excavation

HOW CAN IT FAIL? (CONSIDER EACH CONSEQUENTIAL EVENT FROM FORM A-6700-307)

Wrong location of drill site
Site too small for drilling needs
Poor excavation technique may result in pad not being level

AT WHAT STAGE(S) CAN FAILURE OCCUR? (CONSIDER LIFE CYCLE.)

Failure would occur in initial siting process or during excavation

HOW EASY IS IT TO FIX?

Before the borehole is drilled pad location and excavation is relatively easy to correct

WHAT CAN BE DONE TO PREVENT IT?

Implement sound borehole siting practices
Control the excavation process

WHAT CAN BE DONE TO MITIGATE CONSEQUENCES OF FAILURE?

Build a new pad
Correct inadequacies in current pad design

A-6700-308 (9/86)

CONSOLIDATED EVALUATION FORM

SD-BWI-AR-031 Rev. 0

Name: T. D. Ault
A. P. Wicklund
F. V. Roeck
K. M. Singleton

Level of Expertise: 1 [ ] 2 [2] 3 [ ] 4 [2] 5 [ ]

Item: #1 Site Excavation

BHL-001-1

CONDITION "A", TABLE 1 3)
CONDITION "B", TABLE 1 3)

DESIGNATED LEVEL 3

Q-LIST?

CRITERIA	JUSTIFICATION REQUIRED	PROGRAM RESPONSIBILITY	SEE CONTINUATION PAGE
1 ORGANIZATION		IC/SC	
2 QUALITY ASSURANCE		IC	
3 DESIGN CONTROL		IC	No. 1
4 PROCUREMENT DOCUMENT CONTROL		IC	No. 2
5 INSTRUCTIONS, PROCEDURES, DRAWINGS		IC/SC	
6 DOCUMENT CONTROL		IC	
7 CONTROL OF PURCHASED ITEMS/SERVICES		IC	No. 3
8 IDENTIFICATION AND CONTROL OF ITEMS	Excluded		No. 4
9 CONTROL OF PROCESS		IC	No. 5
10 INSPECTION		IC	No. 6
11 TEST CONTROL	Excluded		No. 7
12 CONTROL OF MEASURING AND TEST EQUIPMENT		IC/SC	
13 HANDLING, STORAGE, AND SHIPPING	Excluded		No. 8
14 INSPECTION, TEST, AND OPERATING STATUS		IC	No. 9
15 CONTROL OF NONCONFORMING ITEMS		IC	
16 CORRECTIVE ACTION		IC/SC	
17 QUALITY ASSURANCE RECORDS		IC/SC	
18 AUDITS		IC	

CONSOLIDATED EVALUATION FORM CONTINUATION SHEET

BHL-001 Item 1: Site Excavation

Continuation No. 1

Criterion 3: Design Control

Includes simple work order and sketch of drill pad for use by implementing organization.

Continuation No. 2

Criterion 4: Procurement Document Control

Limited to work order only.

Continuation No. 3

Criterion 7: Control of Purchased Items/Services

Limited to work order for pad construction.

Continuation No. 4

Criterion 8: Identification and Control of Items

No items to control

Continuation No. 5

Criterion 9: Control of Process

No special processes are involved. The routine process of site excavation requires the application of project constraints regarding Process Controls only.

Continuation No. 6

Criterion 10: Inspection

Verification that pad was constructed according to the Excavation Permit and/or Statement of Work.

Continuation No. 7

Criterion 11: Test Control

No testing involved.

Continuation No. 8

Criterion 13: Handling Storage and Shipping

Does not apply to Site Excavation.

Continuation No. 9

Criterion 14: Inspection, Test, and Operating Status

Acceptable status is indicated by acceptance of site construction with sign-off of the work instruction, work order and/or excavation permit.

3.1.2 Item 2, BHL-001-2: Survey Coordinates Item Analysis

Definition

The survey of borehole coordinates provides a precise location and elevation for the collar of the hole. This information will be used to locate the drill hole on site maps, in numerical models, and to establish elevations for groundwater heads and stratigraphic horizons.

Considerations

- This Item includes only the final network survey done after drilling is completed.

- The location of each borehole must be known. Hydrologic and subsurface geologic modeling of the area and subsequent site characterization is based on the location of drill holes.

- Mistakes are relatively easy to correct with varying degrees of impact depending on when errors are identified.

Initiating Event A2. External Physical Impact

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event B2. Training, Procedural Deficiencies, Carelessness

Potential Failure:

1. Incorrect coordinates identified after survey completion.

2. Loss of control points for the depth measurements within the borehole.

Consequences:

1. Incorrect coordinates would have deleterious consequences on overall modeling of the area. Impact would vary depending on the size of the error and the specific use of the data derived from the particular borehole surveyed.

2. The loss of depth measurement control points will prevent continuity of depth measurements during and after drilling and testing.

Credibility:

1. Credible. The probability of surveying errors is relatively high given poor training, inadequate procedures or general carelessness. Errors can be minimized by implementing well defined procedures, effective training of personnel, and the use of quality instrumentation.

2. Credible. The loss of measurement control points could jeopardize the results of data important to site characterization. This problem can be prevented by tying the control point(s) to the regional geodetic benchmark before the drilling activity is conducted.

Initiating Event C2. Design Deficiencies

Potential Failure:

Incorrect coordinates identified after survey completion due to a poorly designed survey.

Consequences:

Incorrect coordinates may have deleterious affects on overall modeling of the area. Impact would vary depending on the size of the error and the specific use of the data derived from the mis-surveyed borehole.

Credibility:

Credible. It is possible that the overall design of the survey could be deficient resulting in incorrect coordinates. The probability of surveying errors are relatively high given a poorly designed survey.

Initiating Event D2. Failure of Item

See discussions C2 and D2 above

Initiating Event E2. Fire and Explosion

Non-credible (see discussion under BHL-001-1, Initiating Event E1)

Level Assignment: Level 1

Given the critical need for quality borehole location survey data to overall site characterization, this Item is designated QA Level 1.

GRADING CHECK LIST

Component/Item : BHL-001-2/Survey Borehole Coordinates

Conditions	QAL
1. Can failure of the item, or activity contribute to a process which allows radioactive materials to reach the uncontrolled environment?	1A
2. Does the item or activity involve or affect public radiological health and safety?	1A
3. Does the item or activity involve waste isolation?	1A
4. Does this activity support or provide data to evaluate performance assessment of repository radionuclide containment capability?	(1A)
5. Can failure of the item or activity cause irretrievable loss of such data?	1A
6. Can the activity involve a significant change to an in-process licensing document?	2A
7. Can the activity involve a change to an in-process major procurement action?	2A
8. Can the activity involve a change to a major in-process construction action?	2A
9. Can failure of the item or activity cause a major cost overrun?	2A
10. Can failure of the item or activity cause a major schedule slippage?	2A
11. Can failure of the item or activity have an adverse impact on major non-radiological engineered systems or structures?	2A
12. Can failure of the item or activity result in personnel injury which must be individually reported to state or Federal agencies?	2B
13. Can failure of the item or activity result in a lost time personnel injury?	2B
If none of the above	3

NARRATIVE WORK SHEET

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SD-BWI-AR-031 Rev 0

BHL-001-2

Item: 2 Survey Coordinates

HOW CAN IT FAIL? (CONSIDER EACH CONSEQUENTIAL EVENT FROM FORM A-6700-307)

Incorrect coordinates

AT WHAT STAGE(S) CAN FAILURE OCCUR? (CONSIDER LIFE CYCLE.)

At any stage during the surveying process

HOW EASY IS IT TO FIX?

Relatively easy to resurvey

WHAT CAN BE DONE TO PREVENT IT?

Tight controls on the performance of the survey

WHAT CAN BE DONE TO MITIGATE CONSEQUENCES OF FAILURE?

Resurvey the borehole

A-6700-308 (9/86)

CONSOLIDATED EVALUATION FORM

SD-BWI-AR-031, Rev. 0

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Level of Expertise: 1 (1) 1 (2) 2 (3) (4) (5)

BHL-001-2

CONDITION "A", TABLE 1: 1

CONDITION "B", TABLE 1: 3

DESIGNATED LEVEL 1

Item: #2 Survey Borehole Coordinates

Q-LIST?

CRITERIA	JUSTIFICATION REQUIRED	PROGRAM RESPONSIBILITY	SEE CONTINUATION PAGE
1 ORGANIZATION		IC/SC	
2 QUALITY ASSURANCE		IC/SC	
3 DESIGN CONTROL		IC/SC	
4 PROCUREMENT DOCUMENT CONTROL		IC	
5 INSTRUCTIONS, PROCEDURES, DRAWINGS		IC/SC	
6 DOCUMENT CONTROL		IC/SC	
7 CONTROL OF PURCHASED ITEMS/SERVICES		IC	
8 IDENTIFICATION AND CONTROL OF ITEMS		IC/SC	No. 1
9 CONTROL OF PROCESS		IC/SC	No. 2
10 INSPECTION		IC/SC	No. 3
11 TEST CONTROL		IC/SC	
12 CONTROL OF MEASURING AND TEST EQUIPMENT		IC/SC	
13 HANDLING, STORAGE, AND SHIPPING	Excluded		No. 4
14 INSPECTION, TEST, AND OPERATING STATUS		IC	No. 5
15 CONTROL OF NONCONFORMING ITEMS		IC/SC	
16 CORRECTIVE ACTION		IC/SC	
17 QUALITY ASSURANCE RECORDS		IC/SC	
18 AUDITS		IC	

IC=Integrating Contractor SC=Subcontractor

CONSOLIDATED EVALUATION FORM CONTINUATION SHEET

BHL-001-2 Item 2: Survey Borehole Coordinates

Continuation No. 1

Criterion 8: Identification and Control of Items

Identification of Survey Measurements

Continuation No. 2

Criterion 9 (Control of Process):

No special processes are involved.

Continuation No. 3

Criterion 10: Inspection

Limited to surveillance activity of survey process only.

Continuation No. 4

Criterion 13: Handling, Shipping and Storage

Does not apply to surveying boreholes.

Continuation No. 5

Criterion 14: Inspection, Test, and Operating Status

Status indicated by surveillance report of survey activity.

3.2 DRILLING COMPONENT SUMMARY (BHL-002)

Items Identified	QA Level
Item 1. Mobilization/Demobilization	3
Item 2. Cable Tool Drilling	3
Item 3. Set Conductor Pipe	3
Item 4. Rotary Drilling	1
Item 5. Spot Cementation	3
Item 6. Set Casing/Cement	3
Item 7. Fluid Circulation Monitoring	1
Item 8. Drill Cuttings	1
Item 9. Drilling Rigs and Materials	3
Item 10. Clean Borehole	3

Initiating Events

Initiating Event A1. Vehicle Operation

Initiating Event B1. Sabotage

Initiating Event C1. External Physical Impact

Initiating Event D1. Natural Phenomena

Initiating Event E1. Training Deficiency

Initiating Event F1. Procedural Deficiency

Initiating Event G1. Carelessness

Initiating Event H1. Design Deficiency

Initiating Event I1. Failure of Item

Initiating Event J1. Fire

Initiating Event K1. Explosion

MATRIX OF INTERACTIONS

ITEMS (from numbered list, attached) *

INITIATING EVENTS	1	2	3	4	5	6	7	8	9	10	11	12	13	14
A - Vehicle Operation	■	0	0	0	■	■	0	0	0	0				
B - Sabotage	■	■	■	■	■	■	■	■	■	■				
C - External Physical Impact	■	■	■	■	■	■	■	■	■	■				
D - Natural Phenomena	■	■	■	■	■	■	0	■	■	■				
E - Training Deficiency	■	■	■	■	■	■	X	X	■	■				
F - Procedural Deficiency	0	■	■	X	■	■	X	X	■	■				
G - Carlessness	■	■	■	■	■	■	X	X	■	■				
H - Design Deficiency	0	0	■	■	■	■	X	0	0	0				
I - Failure of Item	■	■	■	■	■	■	X	X	■	■				
J - Fire	■	■	■	■	0	■	■	■	■	■				
K - Explosion	0	■	■	■	■	■	■	■	■	■				

X = Item/event have potential for unacceptable interaction.

(X) = Item/event reviewed and rejected as not consequential.

0 = Item/event reviewed and rejected as not consequential

A-6700-307

* See Component Summary (previous page) for Items Identified

3.2.1 Item 1. BHL-002-1; Mobilization Demobilization Item Analysis

Definition

Mobilization is the process of moving the rig onto the well site and assembling and testing the mechanical elements of the drill. Demobilization is the process of disassembling and removing the rig from the well site.

Considerations

- Cost and schedule is a minor consideration.

- Site characterization data is not a consideration under this Item.

- This Item is limited to the activity of moving the drill rig and component parts onto and off site, the functional testing and inspection of the equipment, and installation and testing of guy line anchors.

Initiating Event A1. Vehicle Operation

Potential Failures:

Damage of drill rig components

Consequence:

Minor cost and schedule delay

Credibility:

Non-Credible. Damage to the drill rig or component parts can occur during transport or assembly, but will not adversely affect the program.

Initiating Event B1. Sabotage

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event C1. External Physical Impact

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event D1. Natural Phenomena

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event E1. Training Deficiency

Potential Failure:

Mistakes can be made during drill rig assembly that may result in equipment damage and/or improper function of equipment if the crew is not properly trained.

Consequences:

A schedule delay would be the primary consequence of mistakes made during rig assembly.

Credibility:

Non-credible. Equipment is easily repaired or replaced. A mistake made at this stage would not adversely affect program.

Initiating Event F1. Procedural Deficiency

N/A - procedures under Integrating Contractor direct control are not involved in this activity.

Initiating Event G1. Carelessness

See discussion under Training Deficiency (E1)

Initiating Event H1. Design Deficiency

N/A under this Item

Initiating Event I1. Failure of Item

Potential failure:

The drill rig could potentially be assembled incorrectly.

Consequences:

Mis-assembly could lead to equipment damage and/or schedule delay.

Credibility:

Non-credible. Equipment is easily repaired or replaced. Minor cost and schedule considerations.

Initiating Event J1. Fire

Non-credible (see discussion under BHL-001-1, Initiating Event E1)

Initiating Event K1. Explosion

Non-credible (see discussion under BHL-001-1, Initiating Event E1)

Level Assignment: Level 3

The ease with which failures in mobilization and demobilization can be corrected or mitigated and their low cost and schedule impact make this a QA Level 3 activity.

GRADING CHECK LIST

Component/Item : BHL-002-1/Mobilization and Demobilization

Conditions	QAL
1. Can failure of the item, or activity contribute to a process which allows radioactive materials to reach the uncontrolled environment?	1A
2. Does the item or activity involve or affect public radiological health and safety?	1A
3. Does the item or activity involve waste isolation?	1A
4. Does this activity support or provide data to evaluate performance assessment of repository radionuclide containment capability?	1A
5. Can failure of the item or activity cause irretrievable loss of such data?	1A
6. Can the activity involve a significant change to an in-process licensing document?	2A
7. Can the activity involve a change to an in-process major procurement action?	2A
8. Can the activity involve a change to a major in-process construction action?	2A
9. Can failure of the item or activity cause a major cost overrun?	2A
10. Can failure of the item or activity cause a major schedule slippage?	2A
11. Can failure of the item or activity have an adverse impact on major non-radiological engineered systems or structures?	2A
12. Can failure of the item or activity result in personnel injury which must be individually reported to state or Federal agencies?	2B
13. Can failure of the item or activity result in a lost time personnel injury?	2B
If none of the above	(3)

NARRATIVE WORK SHEET

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SD-BWI-AR-031 Rev 0

BHL-002-1

Item: #1 Mobilization and Demobilization

HOW CAN IT FAIL? (CONSIDER EACH CONSEQUENTIAL EVENT FROM FORM A-6700-307)

Consequences of failure are damage to equipment which will have only minor cost and schedule delays

AT WHAT STAGE(S) CAN FAILURE OCCUR? (CONSIDER LIFE CYCLE.)

Failure can occur while rig is in transit to site and until rig is moved off site

HOW EASY IS IT TO FIX?

Damaged equipment can easily be replaced

WHAT CAN BE DONE TO PREVENT IT?

Conduct activity according to standard industrial practices

WHAT CAN BE DONE TO MITIGATE CONSEQUENCES OF FAILURE?

Conduct activity according to standard industrial practices

A-6700-308 (9/86)

CONSOLIDATED EVALUATION FORM

SD-BWI-AR-031, Rev. 0

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Item: #1 Mobilization/Demobilization

BHL-002-1

CONDITION "A", TABLE 1 — 3

CONDITION "B", TABLE 1 — 3

DESIGNATED LEVEL 3

Q-LIST?

CRITERIA	JUSTIFICATION REQUIRED	PROGRAM RESPONSIBILITY	SEE CONTINUATION PAGE
1 ORGANIZATION		IC	
2 QUALITY ASSURANCE		IC	
3 DESIGN CONTROL	Excluded		No. 1
4 PROCUREMENT DOCUMENT CONTROL		IC	
5 INSTRUCTIONS, PROCEDURES, DRAWINGS		IC/SC	
6 DOCUMENT CONTROL		IC	
7 CONTROL OF PURCHASED ITEMS/SERVICES		IC	
8 IDENTIFICATION AND CONTROL OF ITEMS	Excluded		No. 2
9 CONTROL OF PROCESS		IC	No. 3
10 INSPECTION		IC	No. 4
11 TEST CONTROL	Excluded		No. 5
12 CONTROL OF MEASURING AND TEST EQUIPMENT		SC	
13 HANDLING, STORAGE, AND SHIPPING		IC/SC	
14 INSPECTION, TEST, AND OPERATING STATUS		IC	No. 6
15 CONTROL OF NONCONFORMING ITEMS		IC/SC	
16 CORRECTIVE ACTION		IC	
17 QUALITY ASSURANCE RECORDS		IC	
18 AUDITS		IC	

CONSOLIDATED EVALUATION FORM CONTINUATION SHEET

BHL-002-1 - Mobilization/Demobilization

Continuation No. 1

Criterion 3: Design Control

No design control is included under this Item.

Continuation No. 2

Criterion 8: Identification and Control of Items

No items need be controlled under this Item.

Continuation No. 3

Criterion 9: Control of Process

No special processes are involved. The routine process of mobilization and demobilization requires only Process Controls.

Continuation No. 4

Criterion 10: Inspection

Limited to rig safety inspection.

Continuation No. 5

Criterion 11: Test Control

No testing is involved that is in any way critical to the project.

Continuation No. 6

Criterion 14: Inspection, Test, and Operations Status

Safety inspection documentation will record the status of rig safety inspections.

3.2.2 Item 2, BHL-002-2: Cable Tool Drilling Item Analysis

Definition

The cable tool drill is used to set the conductor pipe and drill to a depth of less than 100 feet. Cable tool drilling operates on a combination of hammer and suction principle. A heavy pointed bit is raised and dropped to loosen and/or break chips of rock. Water may be added and the resultant water slurry is removed from the hole with a bailer. Cable tool drilling will be conducted in accordance with standard industry practice.

Considerations

- The cost and schedule impacts of anything associated with cable tool drilling are minor.

- The cable tool rig sets the conductor pipe (see Item 3, BHL-002).

- Drill cutting samples of sediments are collected during this process (see Item 8, BHL-002).

Initiating Event A2. Vehicle Operations

N/A under this Item

Initiating Event B2. Sabotage

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event C2. External Physical Impact

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event D2. Natural Phenomena

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event E2. Training Deficiency

Potential Failure:

1. Loss of hole

2. Equipment damage

Consequences:

1. Loss of the starter hole would cause minor cost and schedule delays. The activity is easily repeatable without major impact.

2. Damaged equipment is easily replaceable. Cost and schedule are minor considerations.

Credibility:

1. Non-credible. Use of standard industry practices and drilling experience moderates the potential of failure.

2. Non-credible. Use of standard industry practices and drilling experience also moderates the potential for equipment damage.

Initiating Event F2. Procedural Deficiency

Same as E2 above

Initiating Event G2. Carelessness

Same as E2 above

Initiating Event H2. Design Deficiency

N/A under this Item

Initiating Event I2. Failure of Item

Potential failure:

Failure of the drill rig.

Consequences:

Minor cost and schedule delays would result.

Credibility:

Non-credible due to minor consequences of any failure.

Initiating Event J2. Fire

Non-credible (see discussion under BHL-001-1, Initiating Event E1)

Initiating Event K2. Explosion

Non-credible (see discussion under BHL-001-1, Initiating Event E1)

Level Assignment: Level 3

The minor consequences of any failure of cable tool drilling make it a QA Level 3 activity.

GRADING CHECK LIST

Component/Item : BHL-002-2/Cable Tool Drilling

Conditions	QAL
1. Can failure of the item, or activity contribute to a process which allows radioactive materials to reach the uncontrolled environment?	1A
2. Does the item or activity involve or affect public radiological health and safety?	1A
3. Does the item or activity involve waste isolation?	1A
4. Does this activity support or provide data to evaluate performance assessment of repository radionuclide containment capability?	1A
5. Can failure of the item or activity cause irretrievable loss of such data?	1A
6. Can the activity involve a significant change to an in-process licensing document?	2A
7. Can the activity involve a change to an in-process major procurement action?	2A
8. Can the activity involve a change to a major in-process construction action?	2A
9. Can failure of the item or activity cause a major cost overrun?	2A
10. Can failure of the item or activity cause a major schedule slippage?	2A
11. Can failure of the item or activity have an adverse impact on major non-radiological engineered systems or structures?	2A
12. Can failure of the item or activity result in personnel injury which must be individually reported to state or Federal agencies?	2B
13. Can failure of the item or activity result in a lost time personnel injury?	2B
If none of the above	(3)

NARRATIVE WORK SHEET

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SD-BWI-AR-031 Rev 0

BHL-002-2

Item: Item #2 Cable Tool Drilling

HOW CAN IT FAIL? (CONSIDER EACH CONSEQUENTIAL EVENT FROM FORM A-6700-307)

Loss of hole
Equipment damage/breakdown

AT WHAT STAGE(S) CAN FAILURE OCCUR? (CONSIDER LIFE CYCLE.)

Throughout the activity

HOW EASY IS IT TO FIX?

In general, any consequences of failure for this activity are of minimal financial and schedule impact

WHAT CAN BE DONE TO PREVENT IT?

Following standard industry practice

WHAT CAN BE DONE TO MITIGATE CONSEQUENCES OF FAILURE?

Standby equipment (if required)
Redrill hole

A-6700-308 (9/86)

CONSOLIDATED EVALUATION FORM

SD-BWI-AR-031, Rev. 0

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Level of Expertise: 1 (1) 2 (2) 2 (3) ☐ (4) ☐ (5)

BHL-002-2

CONDITION "A", TABLE 1: 3

CONDITION "B", TABLE 1: 3

DESIGNATED LEVEL 3

Item: #2 Cable Tool Drilling

Q-LIST?

CRITERIA	JUSTIFICATION REQUIRED	PROGRAM RESPONSIBILITY	SEE CONTINUATION PAGE
1 ORGANIZATION		IC	
2 QUALITY ASSURANCE		IC	
3 DESIGN CONTROL		IC	No. 1
4 PROCUREMENT DOCUMENT CONTROL		IC	No. 2
5 INSTRUCTIONS, PROCEDURES, DRAWINGS		IC/SC	
6 DOCUMENT CONTROL		IC	
7 CONTROL OF PURCHASED ITEMS/SERVICES		IC	
8 IDENTIFICATION AND CONTROL OF ITEMS	Excluded		No. 3
9 CONTROL OF PROCESS		IC	No. 4
10 INSPECTION		IC	No. 5
11 TEST CONTROL	Excluded		No. 6
12 CONTROL OF MEASURING AND TEST EQUIPMENT	Excluded		No. 7
13 HANDLING, STORAGE, AND SHIPPING	Excluded		No. 8
14 INSPECTION, TEST, AND OPERATING STATUS		IC	No. 9
15 CONTROL OF NONCONFORMING ITEMS		IC	
16 CORRECTIVE ACTION		IC	
17 QUALITY ASSURANCE RECORDS		IC	
18 AUDITS		IC	

IC-Integrating Contractor, SC-Sub

CONSOLIDATED EVALUATION FORM CONTINUATION SHEET

BHL-002-2 - Cable Tool Drilling

Continuation No. 1

Criterion 3: Design Control

Specification of hole depth and diameter.

Continuation No. 2

Criterion 4: Procurement Document Control

Procurement of cable tool drilling contractor.

Continuation No. 3

Criterion 8: Identification and Control of Items

No items to control under cable tool drilling.

Continuation No. 4

Criterion 9: Control of Process

No special processes are involved. The routine process of cable tool drilling requires only Process Controls.

Continuation No. 5

Criterion 10: Inspection

Limited to rig safety inspection.

Continuation No. 6

Criterion 11: Test Control

No testing is involved that is in any way critical to the project.

Continuation No. 7

Criterion 12: Control of Measuring and Test Equipment

No controlled items needed during this activity.

Continuation No. 8

Criterion 13: Handling, Storage, and Shipping

No special controls needed for this activity.

Continuation No. 9

Criterion 14: Inspection, Test, and Operations Status

Safety inspection documentation will record the status of rig safety inspections.

3.2.3 Item 3, BHL-002-3; Set Conductor Pipe Item Analysis

Definition

Emplacement of steel casing from ground surface into unconsolidated sediments. Used as conduit for rotary drilling fluids and to stabilize ground surface. Emplacement is conducted in conjunction with cable tool drilling in accordance with standard industrial practice.

Considerations

- Cost and schedule impact resulting from any errors made during this activity is minimal.

Initiating Event A3. Vehicle Operations

N/A under this Item

Initiating Event B3. Sabotage

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event C3. External Physical Impact

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event D3. Natural Phenomena

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event E3. Training Deficiency

Potential Failure:

Casing collapse and/or casing joint failure

Consequences:

Potential loss of hole

Credibility:

Non-credible. Loss of hole is conceivable but seldom occurs in

normal operations. No preventative mechanisms are required beyond normal industry practices.

Initiating Event F3. Procedural Deficiency

Same as E3 above.

Initiating Event G3. Carelessness

Same as E3 above.

Initiating Event H3. Design Deficiency

Potential Failure:

1. Mis-specification of casing diameter.

2. Under specification of casing quality.

Consequences:

1. Failure of cable tool hole due to casing diameter would be critical only if under sized for required rotary rig tools. Impact minor because casing can be pulled and reset.

2. Under specification may result in casing collapse or joint failure. Impact minor as stated above.

Credibility:

1. Non-credible. Mis-specification of casing is possible but not probable. Specification documents created for boreholes, and associated review processes, provide adequate control. Minimal cost of recovery from any error.

2. Non-credible. Same as 1 above.

Initiating Event I3. Failure of Item

See discussion under H3 above

Initiating Event J3. Fire

Non-credible (see discussion under BHL-001-1, Initiating Event E1)

Initiating Event K3. Explosion

Non-credible (see discussion under BHL-001-1, Initiating Event E1)

Level Assignment: Level 3

Ease with which Item failure can be corrected or mitigated, minor cost and schedule delay as well as low impact on borehole objectives make this QA Level 3 activity.

GRADING CHECK LIST

Component/Item : BHL-002-3/Set Conductor Pipe

Conditions	QAL
1. Can failure of the item, or activity contribute to a process which allows radioactive materials to reach the uncontrolled environment?	1A
2. Does the item or activity involve or affect public radiological health and safety?	1A
3. Does the item or activity involve waste isolation?	1A
4. Does this activity support or provide data to evaluate performance assessment of repository radionuclide containment capability?	1A
5. Can failure of the item or activity cause irretrievable loss of such data?	1A
6. Can the activity involve a significant change to an in-process licensing document?	2A
7. Can the activity involve a change to an in-process major procurement action?	2A
8. Can the activity involve a change to a major in-process construction action?	2A
9. Can failure of the item or activity cause a major cost overrun?	2A
10. Can failure of the item or activity cause a major schedule slippage?	2A
11. Can failure of the item or activity have an adverse impact on major non-radiological engineered systems or structures?	2A
12. Can failure of the item or activity result in personnel injury which must be individually reported to state or Federal agencies?	2B
13. Can failure of the item or activity result in a lost time personnel injury?	2B
If none of the above	(3)

NARRATIVE WORK SHEET

SD-BWI-AR-031 Rev 0

BHL-002-3

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Item: #3 Set Conductor Pipe

HOW CAN IT FAIL? (CONSIDER EACH CONSEQUENTIAL EVENT FROM FORM A-6700-307)

Failure to get casing to required depth due to geologic or mechanical problems
Failure of casing or joint failure

AT WHAT STAGE(S) CAN FAILURE OCCUR? (CONSIDER LIFE CYCLE.)

Could fail at any time

HOW EASY IS IT TO FIX?

Redrill hole and set casing or pull exsisting casing and reset

WHAT CAN BE DONE TO PREVENT IT?

Follow standard industry drilling practices

WHAT CAN BE DONE TO MITIGATE CONSEQUENCES OF FAILURE?

Observe standard industrial practices for setting conductor pipe
Keep spare parts on hand

A-6700-308 (9/86)

CONSOLIDATED EVALUATION FORM

SD-BWI-AR-031, Rev. 0

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Level of Expertise: 1 [2] 2 [ ] 3 [2] 4 [1] 5 [ ]

Item: #3 Set Conductor Pipe

BHL-002-3.
CONDITION "A", TABLE 1 3)
CONDITION "B", TABLE 1 3) DESIGNATED LEVEL 3

Q-LIST?

CRITERIA	JUSTIFICATION REQUIRED	PROGRAM RESPONSIBILITY	SEE CONTINUATION PAGE
1 ORGANIZATION		IC	
2 QUALITY ASSURANCE		IC	
3 DESIGN CONTROL		IC	No. 1
4 PROCUREMENT DOCUMENT CONTROL		IC	
5 INSTRUCTIONS, PROCEDURES, DRAWINGS		IC/SC	
6 DOCUMENT CONTROL		IC	
7 CONTROL OF PURCHASED ITEMS/SERVICES		IC	
8 IDENTIFICATION AND CONTROL OF ITEMS		IC	No. 2
9 CONTROL OF PROCESS		IC	No. 3
10 INSPECTION		IC	No. 4
11 TEST CONTROL	Excluded - No Testing Involved		No. 5
12 CONTROL OF MEASURING AND TEST EQUIPMENT	Excluded - No Data Dependent Measurements		No. 6
13 HANDLING, STORAGE, AND SHIPPING		IC	
14 INSPECTION, TEST, AND OPERATING STATUS		IC	No. 7
15 CONTROL OF NONCONFORMING ITEMS		IC	
16 CORRECTIVE ACTION		IC	
17 QUALITY ASSURANCE RECORDS		IC	
18 AUDITS		IC	

IC=Integrating Contractor SC=Subcontractor

CONSOLIDATED EVALUATION FORM CONTINUATION SHEET

BHL-002-3 - Set Conductor Pipe

Continuation No. 1

Criterion 3: Design Control

Casing diameter and general material specifications.

Continuation No. 2

Criterion 8: Identification and Control of Items

Identification and verification of materials quantity and dimension for general acceptability only.

Continuation No. 3

Criterion 9: Control of Process

No special processes are involved. The routine process of setting conductor pipe requires only Process Controls.

Continuation No. 4

Criterion 10: Inspection

Receiving inspection only.

Continuation No. 5

Criterion 11: Test Control

No testing is involved.

Continuation No. 6

Criterion 12: Control of Measuring and Test Equipment

No data dependent measurements involved.

Continuation No. 7

Criterion 14: Inspection, Test, and Operations Status

Materials acceptance only.

3.2.4 Item 4, BHL-002-4, Rotary Drilling (Activity Control) Item Analysis

Definition

This item addresses the planning, design, supervision, and documentation of rotary drilling processes (activity control). Rotary drilling will be used to extend boreholes below the conductor casing. Rotary drilling methods reduce rockmass at the drill bit face to small chips which are subsequently circulated to the surface with drilling fluids. In the case of piezometer boreholes, two methods of circulation will be employed: 1) direct circulation using drilling mud and 2) air-assist reverse circulation using water only. These two methods are considered here as a single method.

Considerations

- The drilling of boreholes with rotary methods is separated from installation of test equipment and the eventual plugging of the borehole. The siting and the associated risk analysis is an activity requiring review and risk assessment but the activity of rotary drilling is conducted according to standard oil industry practices. Experience is the key to successful drilling operations. Records tracking the drilling activity and associated decision processes need to be maintained under careful controls.

- Standard industrial practices require a high degree of safety awareness and Hanford Site safety requirements place additional controls and inspection measures on drilling. Preventative measures effectively control these hazards.

- The failure of rotary drilling operations at any point will not result in resource or schedule cost greater than those currently established by the project as "major".

- Remedial action would be possible for all reasonable failures in the process.

- Rockwell's Surface Drilling Operations Group is responsible for piezometer drilling operations.

- Training of Rockwell and subcontractor staff will consist primarily of Hanford site-specific requirements. The experience of the drill rig operators is a basic selection criteria of the procurement process.

- Rockwell generated records of drilling activity are considered quality records and will be handled accordingly.

- Overall design specification of the boreholes is closely related to all drilling activities and techniques.

- The drilling of boreholes is separated from and does not address the post-closure sealing of these boreholes.

- Where contract operations are performed they are subject to the constraints and conditions of the contract documents controlling the activity.

- Cost and schedule evaluations are based on estimated impacts only.

Initiating Event A4. Vehicle Operations

N/A under this Item

Initiating Event B4. Sabotage

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event C4. External Physical Impact

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event D4. Natural Phenomena

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event E4. Training Deficiency

Potential Failure:

Inadequate or inappropriate decision

Consequences:

Critical decisions made without proper approval potentially jeopardize the objectives of the borehole.

Credibility:

Non-credible. Improper directives given to drilling contractors without proper authority are possible but is not likely to have major irreversible impact on borehole objectives. Clear definition of authority and emphasis on this during training will prevent its occurrence. Total loss of borehole falls in a low cost and schedule impact level as currently defined by the

project.

Initiating Event F4. Procedural Deficiency

Potential Failure:

Inadequate procedures controlling drilling and testing activities.

Consequences:

Failure or partial failure to complete an activity as planned. The consequences would vary greatly depending on what activity the procedure controlled and the criticality of that activity.

Credibility:

Credible. Procedures controlling the activities associated with drilling and testing may be deficient and/or inadequate. Many technically qualified personnel review procedures before issue but errors may not become apparent until actual implementation of the procedure. The ability to change procedures in a timely manner becomes paramount in the event a procedural flaw is identified.

Initiating Event G4. Carelessness

See discussion under E4 above.

Initiating Event H4. Design Deficiency

Potential Failure:

Inadequately designed borehole and/or piezometer configuration.

Consequences:

Ineffective piezometer installation and/or function.

Credibility:

Non-credible. The overall borehole design may be deficient but is considered unlikely because of the extensive review of the specifications by technically qualified personnel. The review process should mitigate any inadequacies in the overall design of the borehole.

Initiating Event 14. Failure of Item

Potential Failure:

1. Loss of downhole drilling equipment

2. Hole deviation

3. Drill rig failure

Consequences:

1. Loss of the tools or drill pipe may require the retrieval through a fishing operation or in the worst case may require abandonment of the hole and the drilling of an alternate borehole. This may constitute a significant cost and schedule impact, although this is dependent on the depth of the borehole at the time of failure. The objectives of the borehole could be accomplished through the drilling of a second borehole. Depending on its depth, the presence of the abandoned borehole would constitute a short and long term problem for hydrologic testing and eventual sealing. Although a potentially serious problem from an operational standpoint, this failure still represents a correctable condition and result in expenditures less than that currently considered major by the project.

2. The consequence of hole deviation is simply the non-verticality of the borehole. Possible difficulty in completing the borehole to the predetermined depth and potential problems in setting and cementing casing may result.

3. Potential failure of the drill rig exists but would result in relatively minor cost and schedule delays.

Credibility:

1. Non-credible. The loss of downhole drilling equipment and potential loss of borehole is possible but unlikely. The application of drilling equipment matched for the scale of the activity (adequate power, etc.) and experience in drilling in a particular rock type are the most effective preventative measures. No application of controls beyond that normal to the drilling industry are required.

2. Non-credible. Loss of hole verticality is not uncommon although situations are seldom extreme enough to cause the above mentioned problems. In general the survey of the borehole for verticality during drilling and at completion both moderates and quantifies

deviation.

3. Non-credible. Various mechanical failures of drill rig components are mitigated by sound routine maintenance practices and therefore occur infrequently.

Initiating Event J4. Fire

Non-credible (see discussion under BHL-001-1, Initiating Event E1)

Initiating Event K4. Explosion

Non-credible (see discussion under BHL-001-1, Initiating Event E1)

Level Assignment: Level 1

Sound activity controls and documentation techniques are necessary to assure a successful operation. The presence of the borehole and not the method used to drill the borehole is important to waste isolation. Nevertheless, the process of rotary drilling, although conducted using standard industry drilling practices, penetrates the natural barrier and therefore is assigned a QA Level of 1.

GRADING CHECK LIST

Component/Item : BHL-002-4/Rotary Drilling

Conditions	QAL
1. Can failure of the item, or activity contribute to a process which allows radioactive materials to reach the uncontrolled environment?	1A
2. Does the item or activity involve or affect public radiological health and safety?	1A
3. Does the item or activity involve waste isolation?	1A
4. Does this activity support or provide data to evaluate performance assessment of repository radionuclide containment capability?	(1A)
5. Can failure of the item or activity cause irretrievable loss of such data?	1A
6. Can the activity involve a significant change to an in-process licensing document?	2A
7. Can the activity involve a change to an in-process major procurement action?	2A
8. Can the activity involve a change to a major in-process construction action?	2A
9. Can failure of the item or activity cause a major cost overrun?	2A
10. Can failure of the item or activity cause a major schedule slippage?	2A
11. Can failure of the item or activity have an adverse impact on major non-radiological engineered systems or structures?	2A
12. Can failure of the item or activity result in personnel injury which must be individually reported to state or Federal agencies?	2B
13. Can failure of the item or activity result in a lost time personnel injury?	2B
If none of the above	3

NARRATIVE WORK SHEET

SD-BWI-AR-031 Rev 0

BHL-002-4

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K. M. Singleton
A. P. Wicklund
D. F. Hanlen
T. D. Ault

Item: #4 Rotary Drilling

HOW CAN IT FAIL? (CONSIDER EACH CONSEQUENTIAL EVENT FROM FORM A-6700-307)

1. Loss of hole
2. Compromise objective of the hole
3. Unacceptable hole deviation
4. Drilling failure

AT WHAT STAGE(S) CAN FAILURE OCCUR? (CONSIDER LIFE CYCLE.)

Failure can occur at any stage

HOW EASY IS IT TO FIX?

2. A fishing job may be required
   Move well site and drill a new hole

WHAT CAN BE DONE TO PREVENT IT?

1,3 Follow standard industry drilling practices
2. Adequate training of personnel
4. Sound maintenance practice

WHAT CAN BE DONE TO MITIGATE CONSEQUENCES OF FAILURE?

1. Have fishing tools available
2. Verify adequacy of training
1,3 Have required equipment on hand for hole completion
4. Keep spare parts on site

A-6700-308 (9/86)

CONSOLIDATED EVALUATION FORM

SD-BWI-AR-031, Rev. 0

T. D. Ault
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Name: K. M. Singleton

Level of Expertise: 1 [2] 2 [ ] 3 [3] 4 [ ] 5 [ ]

Item: #4 Rotary Drilling

BHL-002-4
CONDITION "A", TABLE 1 1)
CONDITION "B", TABLE 1 3) DESIGNATED LEVEL 1

Q-LIST?

CRITERIA	JUSTIFICATION REQUIRED	PROGRAM RESPONSIBILITY	SEE CONTINUATION PAGE
1 ORGANIZATION		IC	
2 QUALITY ASSURANCE		IC	
3 DESIGN CONTROL		IC	
4 PROCUREMENT DOCUMENT CONTROL		IC	No. 1
5 INSTRUCTIONS, PROCEDURES, DRAWINGS		IC	No. 2
6 DOCUMENT CONTROL		IC	
7 CONTROL OF PURCHASED ITEMS/SERVICES		IC	No. 3
8 IDENTIFICATION AND CONTROL OF ITEMS		IC/SC	No. 4
9 CONTROL OF PROCESS		IC	No. 5
10 INSPECTION		IC	No. 6
11 TEST CONTROL	Excluded		No. 7
12 CONTROL OF MEASURING AND TEST EQUIPMENT	Excluded		No. 8
13 HANDLING, STORAGE, AND SHIPPING	Excluded		No. 9
14 INSPECTION, TEST, AND OPERATING STATUS		IC	No. 10
15 CONTROL OF NONCONFORMING ITEMS		IC	
16 CORRECTIVE ACTION		IC	
17 QUALITY ASSURANCE RECORDS		IC	
18 AUDITS		IC	

IC=Integrating Contractor SC=Subcontractor

CONSOLIDATED EVALUATION FORM CONTINUATION SHEET

BHL-002-4 - Rotary Drilling

The penetration of natural barriers relied upon for waste isolation by this drilling requires control and documentation of drilling activity commensurate with QA Level 1. QA Level 1 controls required for rotary drilling are limited as follows.

Continuation No. 1

Criterion 4: Procurement Document Control

Procurement of drill rig, drilling services, and associated components is conducted as part of Drilling Rigs and Materials (BHL-002-9) as a Level 3 activity.

Continuation No. 2

Criterion 5: Instructions, Procedures, and Drawings

Direction and documentation of rotary drilling activities, including hold and inspection points, will be directed by procedures. Detailed drill rig operating procedures are not required.

Continuation No. 3

Criterion 7: Control of Purchased Items and Services

The control of purchased items and services will be directed under Drilling Rigs and Materials (BHL-002-9) and procured under the provisions of project controls for commercial grade items.

Continuation No. 4

Criterion 8: Identification and Control of Items

Identification and control of items required for drilling are controlled under Drilling Rigs and Materials (BHL-002-9). Drill cuttings produced as a result of rotary drilling are controlled under Drill Cuttings (BHL-002-8).

Continuation No. 5

Criterion 9: Control of Process

No special processes are involved. The routine process of rotary drilling requires the application of project requirements regarding Process Controls.

Continuation No. 6

Criterion 10: Inspections

Inspections will be conducted on hold points determined under Criterion 5. Inspection will consist of surveillance of drilling activities as determined by QA.

Continuation No. 7

Criterion 11: Test Control

Tests associated with rotary drilling (e.g., borehole geophysics, chip samples, fluid monitoring) are covered as individual items in grading.

Continuation No. 8

Criterion 12: Control of Measuring and Test Equipment

Control of measuring and test equipment is addressed under Drilling Rigs and Materials (BHL-002-9). Measurement equipment used in rotary drilling does not yield data used for Site Characterization and controls supplied under Item 1, BHL-002 are adequate. The degree of control placed on calibrated items is a function of user requirements.

Continuation No. 9

Criterion 13: Handling, Storage, and Shipping

Handling, storage, and shipping of items and materials is considered as part of Drilling Rigs and Materials (BHL-002-9) Item.

Continuation No. 10

Criterion 14: Inspection, Test, and Operating Status

Inspection status is addressed under Continuation No. 2, Criterion 5 (Instructions, Procedures, and Drawings) above.

3.2.5 Item 5, BHL-002-5; Spot Cementation Item Analysis

Definition

Spot cementation is the placement of cement in an interval of the drilled borehole to correct or improve downhole conditions. Lost circulation zones or unstable areas are examples of situations where spot cementation may be required.

Considerations

- Spot cementation will be used only above the Wanapum horizon in this type borehole.

- Spot cementation activities are of minor consequence from a cost and schedule standpoint.

- If down-hole problems are suspected, measures should be taken to understand conditions prior to cementing.

Initiating Event A5. Vehicle Operations

See discussion under BHL-002-1, Initiating Event A1

Initiating Event B5. Sabotage

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event C5. External Physical Impact

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event D5. Natural Phenomena

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event E5. Training Deficiency

Potential Failure:

1. Improper cement material, mix, or placement

2. Down-hole problems affecting cement curing

Consequences:

1. Improper material, mix or placement could cause failure of the spot cementation to correct or improve borehole conditions. Remedial action involving removal of bad cement and/or the repeat of the process is a minor consequence unless drill tools are cemented in place.

2. Down-hole temperatures, water chemistry, and fluid movements in the formation may affect cement and/or cement setting times.

Credibility:

1. Non-credible. This is not a common occurrence given the experience of cementing subcontractors that specialize in this type of work. Corrective action is easily performed and would be of minor overall impact. Experience and training are probably the greatest preventative mechanisms.

2. Non-credible. The use of qualified experienced cementing subcontractors present the most effective preventative mechanism regarding understanding of down-hole problems.

Initiating Event F5. Procedural Deficiency

See discussion E5 above.

Initiating Event G5. Carelessness

See discussion E5 above.

Initiating Event H5. Design Deficiency

See discussion E5 above.

Initiating Event I5. Failure of Item

See discussion E5 above.

Initiating Event J5. Fire

Non-credible (see discussion under BHL-001-1, Initiating Event E1)

Initiating Event K5. Explosion

Non-credible (see discussion under BHL-001-1, Initiating Event E1)

Level Assignment: Level 3

Adequacy of standard industry practices and ability to correct any failures make this a QA Level 3 activity.

GRADING CHECK LIST

Component/Item : BHL-002-5/Spot Cementation

Conditions	QAL
1. Can failure of the item, or activity contribute to a process which allows radioactive materials to reach the uncontrolled environment?	1A
2. Does the item or activity involve or affect public radiological health and safety?	1A
3. Does the item or activity involve waste isolation?	1A
4. Does this activity support or provide data to evaluate performance assessment of repository radionuclide containment capability?	1A
5. Can failure of the item or activity cause irretrievable loss of such data?	1A
6. Can the activity involve a significant change to an in-process licensing document?	2A
7. Can the activity involve a change to an in-process major procurement action?	2A
8. Can the activity involve a change to a major in-process construction action?	2A
9. Can failure of the item or activity cause a major cost overrun?	2A
10. Can failure of the item or activity cause a major schedule slippage?	2A
11. Can failure of the item or activity have an adverse impact on major non-radiological engineered systems or structures?	2A
12. Can failure of the item or activity result in personnel injury which must be individually reported to state or Federal agencies?	2B
13. Can failure of the item or activity result in a lost time personnel injury?	2B
If none of the above	(3)

NARRATIVE WORK SHEET

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SD-BWI-AR-031 Rev 0

BHL-002-5

Item: #5 Spot Cementation

HOW CAN IT FAIL? (CONSIDER EACH CONSEQUENTIAL EVENT FROM FORM A-6700-307)

1. Cement not setting
2. Tool sticking while cementing or drilling out cement
3. Cement setting harder than formation causing the hole to deviate

AT WHAT STAGE(S) CAN FAILURE OCCUR? (CONSIDER LIFE CYCLE.)

Failure could occur at any time

HOW EASY IS IT TO FIX?

1. Understand cementing problems and correct - easy
2. Easy to difficult depending on volume of cement placed
3. May be difficult depending on location in hole

WHAT CAN BE DONE TO PREVENT IT?

Personnel should be trained and follow standard industry practices

WHAT CAN BE DONE TO MITIGATE CONSEQUENCES OF FAILURE?

1. Clean hole and recement
2. Drill out cementing tools
3. Collect water samples and down-hole temperature measurements to understand cementing problems

A-6700-308 (9/86)

CONSOLIDATED EVALUATION FORM SD-BWI-AR-031 Rev 0

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Level of Expertise: 1 [ ] 2 [2] 3 [ ] 4 [ ] 5 [ ]

Item: #5 Spot Cementation

BHL-002-5

CONDITION "A", TABLE 1 3)
CONDITION "B", TABLE 1 3) DESIGNATED LEVEL 3

Q-LIST?

	CRITERIA	JUSTIFICATION REQUIRED	PROGRAM RESPONSIBILITY	SEE CONTINUATION PAGE
1	ORGANIZATION		IC	
2	QUALITY ASSURANCE		IC	
3	DESIGN CONTROL		IC	
4	PROCUREMENT DOCUMENT CONTROL		IC	
5	INSTRUCTIONS, PROCEDURES, DRAWINGS		IC/SC	
6	DOCUMENT CONTROL		IC	
7	CONTROL OF PURCHASED ITEMS/SERVICES		IC/SC	
8	IDENTIFICATION AND CONTROL OF ITEMS	Excluded		No. 1
9	CONTROL OF PROCESS		IC	No. 2
10	INSPECTION		IC	No. 3
11	TEST CONTROL	Excluded		No. 4
12	CONTROL OF MEASURING AND TEST EQUIPMENT	Excluded		No. 5
13	HANDLING, STORAGE, AND SHIPPING		IC/SC	
14	INSPECTION, TEST, AND OPERATING STATUS		IC	No. 6
15	CONTROL OF NONCONFORMING ITEMS		IC	
16	CORRECTIVE ACTION		IC	
17	QUALITY ASSURANCE RECORDS		IC	
18	AUDITS		IC	

IC=Integrating Contractor SC=Subcontractor

A-6700-309 (9-85)

CONSOLIDATED EVALUATION FORM CONTINUATION SHEET

BHL-002-5: Spot Cementation

Continuation No. 1

Criterion 8: Identification and Control of Items

Does not apply to this operation.

Continuation No. 2

Criterion 9: Control of Process

No special processes are involved. The routine process of spot cementation requires only Process Controls.

Continuation No. 3

Criterion 10: Inspection

Inspection will consist of the surveillance of the cementing activity.

Continuation No. 4

Criterion 11: Test Control

The activity of spot cementation has no testing involved.

Continuation No. 5

Criterion 12: Control of Measuring and Test Equipment

No data dependent measurements involved.

Continuation No. 6

Criterion 14: Inspection, Test, and Operations Status

The status of safety and surveillance of the activity will be recorded in documentation associated with those activities.

3.2.6 Item 6, BHL-002-6; Set Casing/Cement Item Analysis

Definition

Setting casing is the process of running and cementing a casing string or liner in a drilled borehole to isolate formations or to provide hole stability for continued drilling operations.

Considerations

- Each casing string will be cemented throughout its entire interval (disregarding conductor casing).

- Casing and cementing are to be conducted in accordance with standard industry practices.

- Cement being used will be of standard commercial grade.

- Casing is API standard quality

- No piezometers are to be set at this level.

- No data collection activities are affected by the cementation.

- Problems associated with casing and cementation are generally correctable without major cost or schedule impact.

- The cement bond between casing and the formation will be evaluated using geophysical methods.

Initiating Event A6. Vehicle Operations

See discussion under BHL-002-1, Initiating Event A1

Initiating Event B6. Sabotage

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event C6. External Physical Impact

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event D6. Natural Phenomena

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event E6. Training Deficiency

Potential Failure:

1. Makeup flaws

2. Voids in Cement

3. Borehole and/or casing collapse while setting casing.

Consequences:

1. Makeup flaws could potentially leave weak spots or joint leaks in the casing. The impact of flaws would not affect data collection activities and would not affect aquifer intercommunication in a cemented casing string.

2. Voids in the cement surrounding the casing could allow for undesirable intercommunication of groundwater in the Saddle Mountains basalt and upper sediment horizons. This would not have a great effect on borehole objectives or on waste isolation because it is assumed that the Saddle Mountains and upper sediment stratigraphy are not considered components of the natural barrier.

3. Borehole and/or casing collapse could impede the progress of casing activities but would create relatively minor cost and schedule delays.

Credibility:

1. Non-credible. The occurrence of makeup flaws is improbable. The use of the correct tongs and recommended torque reduces the possibility.

2. Non-credible. The occurrence of voids in the cement is possible. Adherence to procedures will minimize the occurrence of voids. Borehole geophysical logs are used to detect the presence of voids. Recementation is possible if required. The presence of voids in cement is of minor consequence because of their deductibility, correctability, and unimportance to waste isolation.

3. Non-credible. The possibility of borehole and/or casing collapse is possible depending on the stabilities of the formations and methods used to place the casing. Casing could be pulled and the borehole redrilled through the caved portion or casing could be milled open making this event of minor consequence.

Initiating Event F6. Procedural Deficiency

See discussion under E6 above.

Initiating Event G6. Carelessness

See discussion under E6 above.

Initiating Event H6. Design Deficiency

Potential Failure:

1. Specification of the wrong casing size and/or type.

2. Casing placed at the wrong depth.

3. Improper cement type and/or makeup.

Consequences:

1. Inability to install the casing or the specified number of piezometers.

2. Inability to monitor the correct horizon (if installed too deep), or the need to install additional casing string (if installed too shallow) leading to a size less than that needed to install multiple piezometers.

3. Poor bonding characteristic and/or inability to pump the cement around the casing to the required height.

Credibility:

1. Non-credible. The overall casing design may be deficient but is considered unlikely because of the extensive review of the specifications by technically qualified personnel.

2. Non-credible. The only critical casing string is the deepest one. The process of determining the horizon for casing depth includes geochemical analysis of chips, interpretation of the chips by geologists as well as cross checking of determinations using the geophysical logs. Given the extensive documentation of stratigraphic relationships the installation of the casing in the wrong horizon is remote. Each joint of casing is measured to 0.01 ft, tallied and cross-checked as it is installed. A mis-measurement at this stage is also considered unlikely.

3. Non-credible. Cementation of casing is a common industry practice and will be conducted by an experienced and qualified subcontractor. Should an error occur it would not be irreparable.

Initiating Event I6. Failure of Item

Potential Failure:

1. Casing failure

2. Cement failure

Consequences:

1. Consequences of casing failure would be communication of formations fluids into borehole or the prevention of piezometer placement.

2. Failure of the cement to set or be of improper volume or bonding characteristics could result in the intercommunication of fluids of different stratigraphic levels.

Credibility:

1. Non-credible. The ability to correct this situation makes it minor. The probability of casing failure at waste evaluation expected depths is low. Not expected to have effect on waste isolation.

2. Non-credible. Deductibility, correctability and lack of impact on waste isolation data make this non-credible.

Initiating Event J6. Fire

Non-credible (see discussion under BHL-001-1, Initiating Event E1)

Initiating Event K6. Explosion

Non-credible (see discussion under BHL-001-1, Initiating Event E1)

Level Assignment: Level 3

The use of casing above the Wanapum, and the lack of impact of failures on piezometer data indicates a QA Level 3 activity.

GRADING CHECK LIST

Component/Item : BHL-002-6/Set Casing and Cement

Conditions		QAL
1.	Can failure of the item, or activity contribute to a process which allows radioactive materials to reach the uncontrolled environment?	1A
2.	Does the item or activity involve or affect public radiological health and safety?	1A
3.	Does the item or activity involve waste isolation?	1A
4.	Does this activity support or provide data to evaluate performance assessment of repository radionuclide containment capability?	1A
5.	Can failure of the item or activity cause irretrievable loss of such data?	1A
6.	Can the activity involve a significant change to an in-process licensing document?	2A
7.	Can the activity involve a change to an in-process major procurement action?	2A
8.	Can the activity involve a change to a major in-process construction action?	2A
9.	Can failure of the item or activity cause a major cost overrun?	2A
10.	Can failure of the item or activity cause a major schedule slippage?	2A
11.	Can failure of the item or activity have an adverse impact on major non-radiological engineered systems or structures?	2A
12.	Can failure of the item or activity result in personnel injury which must be individually reported to state or Federal agencies?	2B
13.	Can failure of the item or activity result in a lost time personnel injury?	2B
If none of the above		(3)

NARRATIVE WORK SHEET

SD-BWI-AR-031 Rev 0

BHL-002-6

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Item: #6 Set Casign/Cement

HOW CAN IT FAIL? (CONSIDER EACH CONSEQUENTIAL EVENT FROM FORM A-6700-307)

1. The consequence of a failure of casing is the communication of fluids from the formation into the casing.
2. The consequences of a failure of cementation is the intercommunication of aquifers of the Saddle Mountains formation and/or unconfined aquifer.

AT WHAT STAGE(S) CAN FAILURE OCCUR? (CONSIDER LIFE CYCLE.)

It could fail any time

HOW EASY IS IT TO FIX?

Remedial action is possible if necessary. Recementation or repair is not difficult in most cases.

WHAT CAN BE DONE TO PREVENT IT?

Procedures in training and placement of casing and cement

WHAT CAN BE DONE TO MITIGATE CONSEQUENCES OF FAILURE?

See above - "fix"

A-6700-308 (9/86)

CONSOLIDATED EVALUATION FORM

SD-BWI-AR-031 Rev 0

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Level of Expertise: 1 [2] 2 [2] 3 4 5

Item: #6 Set and Cement Casing

BHL-002-6

CONDITION "A", TABLE 1 3)
CONDITION "B", TABLE 1 3) DESIGNATED LEVEL 3

Q-LIST?

	CRITERIA	JUSTIFICATION REQUIRED	PROGRAM RESPONSIBILITY	SEE CONTINUATION PAGE
1	ORGANIZATION		IC	
2	QUALITY ASSURANCE		IC	
3	DESIGN CONTROL		IC	
4	PROCUREMENT DOCUMENT CONTROL		IC	
5	INSTRUCTIONS, PROCEDURES, DRAWINGS		IC	
6	DOCUMENT CONTROL		IC	
7	CONTROL OF PURCHASED ITEMS/SERVICES		IC	
8	IDENTIFICATION AND CONTROL OF ITEMS		IC	No. 1
9	CONTROL OF PROCESS		IC	No. 2
10	INSPECTION		IC	No. 3
11	TEST CONTROL	Excluded		No. 4
12	CONTROL OF MEASURING AND TEST EQUIPMENT	Excluded		No. 5
13	HANDLING, STORAGE, AND SHIPPING		IC	
14	INSPECTION, TEST, AND OPERATING STATUS		IC	No.6
15	CONTROL OF NONCONFORMING ITEMS		IC	
16	CORRECTIVE ACTION		IC	
17	QUALITY ASSURANCE RECORDS		IC	
18	AUDITS		IC	

IC=Integrating Contractor

A-6700-309 (9-86)

CONSOLIDATED EVALUATION FORM CONTINUATION SHEET

BHL-002-6: Set and Cement Casing

Continuation No. 1

Criterion 8: Identification and Control of Items

Limited to identification of lot size and grade of casing shipments for general acceptability.

Continuation No. 2

Criterion 9: Control of Process

No special processes are involved. The routine process of setting and cementing casing requires the application Process Controls only.

Continuation No. 3

Criterion 10: Inspection

Inspection will consist of surveillance of the activity.

Continuation No. 4

Criterion 11: Test Control

The activity of setting and cementing casing has no testing involved.

Continuation No. 5

Criterion 12: Control of Measuring and Test Equipment

No data dependent measurements are involved.

Continuation No. 6

Criterion 14: Inspection, Test, and Operating Status

The Shift Report of Operations and surveillance records will document the status of these activities.

3.2.7 Item 7, BHL-002-7: Fluid Circulation/Monitor Fluids

Definition

Two methods of fluid circulation are planned for piezometer borehole drilling, direct circulation and air-assist reverse circulation. Direct circulation is a method whereby the drilling fluid is pumped down the inside of the drill pipe and drilling assembly, out through the drill bit nozzles, and up the annular space between the drill pipe and borehole wall. Air-assist reverse circulation is a method whereby injected air causes the drilling fluid to flow into the drill pipe and is returned to the surface through the inside of the drill pipe and the drilling assembly.

Considerations

- Fluid volume, density, and viscosity are monitored continuously during drilling operations.

- Direct circulation methods will be employed, down to the Saddle Mountain basalt, using drilling mud as the fluid medium.

- Air-assist reverse circulation methods will be employed, below the Saddle Mountain basalt, using water as the fluid medium.

- The effects of fluid loss or gain will be monitored on existing hydrologic monitoring boreholes.

- The use of reverse circulation drilling methods may result in uncertain accuracy of measurements of the loss or gain of fluids during drilling. Volumes and pressures of air required to lift the drill fluids and cuttings from the bit to the surface will vary because of the position of the cross over air-sub in the drill string and its subsequent submergence in fluid. Increased air pressure in the system will force a corresponding amount of fluid through the inner annulus and would produce an erroneous observation in the measuring system at the drill site.

- There is little possibility of radiologic hazard to drill site personnel due to radionuclide contamination of groundwater.

Initiating Event A7. Vehicle Operations

N/A under this item

Initiating Event B7. Sabotage

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event C7. External Physical Impact

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event D7. Natural Phenomena

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event E7. Training Deficiency

Potential Failure:

Mis-measurement of or miscalculation of fluid volumes.

Consequences:

Mis-measurement or miscalculation of fluid volumes could allow the misrepresentation of fluid influx or out-flow during drilling.

Credibility:

Credible. It is necessary to monitor fluid loss or gain in a controlled manner. However, due to the inherent inaccuracies in the monitoring of fluids, particularly when employing reverse circulation methods, use of the data for site characterization purposes is suspect.

Initiating Event F7. Procedural Deficiency

See discussion under E7 above.

Initiating Event G7. Carelessness

See discussion under E7 above.

Initiating Event H7. Design Deficiency

See discussion under E7 above.

Initiating Event I7. Failure of Item

See discussion under E7 above.

Initiating Event J7. Fire

Non-credible (see discussion under BHL-001-1, Initiating Event E1)

Initiating Event K7. Explosion

Non-credible (see discussion under BHL-001-1, Initiating Event E1)

Level Assignment: Level 1

In spite of the potential inaccuracy of data, the need to control this data collection activity for use in site characterization requires the assignment of QA Level 1.

GRADING CHECK LIST

Component/Item : BHL-003-7/Fluid Circulation Monitoring

Conditions	QAL
1. Can failure of the item, or activity contribute to a process which allows radioactive materials to reach the uncontrolled environment?	1A
2. Does the item or activity involve or affect public radiological health and safety?	1A
3. Does the item or activity involve waste isolation?	1A
4. Does this activity support or provide data to evaluate performance assessment of repository radionuclide containment capability?	1A
5. Can failure of the item or activity cause irretrievable loss of such data?	1A
6. Can the activity involve a significant change to an in-process licensing document?	2A
7. Can the activity involve a change to an in-process major procurement action?	2A
8. Can the activity involve a change to a major in-process construction action?	2A
9. Can failure of the item or activity cause a major cost overrun?	2A
10. Can failure of the item or activity cause a major schedule slippage?	2A
11. Can failure of the item or activity have an adverse impact on major non-radiological engineered systems or structures?	2A
12. Can failure of the item or activity result in personnel injury which must be individually reported to state or Federal agencies?	2B
13. Can failure of the item or activity result in a lost time personnel injury?	2B
If none of the above	3

NARRATIVE WORK SHEET

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SD-BWI-AR-031 Rev 0

BIIL-002-7

Item: #7 Fluid Circulation Monitoring

HOW CAN IT FAIL? (CONSIDER EACH CONSEQUENTIAL EVENT FROM FORM A-6700-307)

1. Miscalculate volumes of influx or outflow of fluids
2. Equipment malfunction

AT WHAT STAGE(S) CAN FAILURE OCCUR? (CONSIDER LIFE CYCLE.)

Failure can occur at any stage

HOW EASY IS IT TO FIX?

1. Establish training procedures with check points
2. Repair and/or calibrate

WHAT CAN BE DONE TO PREVENT IT?

1. May not be detectable using reverse circulation methods of drilling -- change to conventional methods of flushing the hole
2. Calibrate equipment prior to use and establish check points

WHAT CAN BE DONE TO MITIGATE CONSEQUENCES OF FAILURE?

1. Alternative methods of drilling
2. Establish procedures and training programs
   Maintain adequate spare parts

A-6700-308 (9/86)

CONSOLDIATED EVALUATION FORM SD-BWI-AR-031 RevO

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Level of Expertise: 1 [2] 2 [2] 3 4 5

Item: #7 Fluid Circulation Monitoring

BHL-002-7

CONDITION "A", TABLE 1 1)
)
CONDITION "B", TABLE 1 3) DESIGNATED LEVEL 1

Q-LIST?

CRITERIA	JUSTIFICATION REQUIRED	PROGRAM RESPONSIBILITY	SEE CONTINUATION PAGE
1 ORGANIZATION		IC	
2 QUALITY ASSURANCE		IC	
3 DESIGN CONTROL		IC	
4 PROCUREMENT DOCUMENT CONTROL	Excluded		No. 1
5 INSTRUCTIONS, PROCEDURES, DRAWINGS		IC	
6 DOCUMENT CONTROL		IC	
7 CONTROL OF PURCHASED ITEMS/SERVICES	Excluded		No. 2
8 IDENTIFICATION AND CONTROL OF ITEMS	Excluded		No. 3
9 CONTROL OF PROCESS		IC	No. 4
10 INSPECTION		IC	
11 TEST CONTROL		IC	No. 5
12 CONTROL OF MEASURING AND TEST EQUIPMENT		IC	
13 HANDLING, STORAGE, AND SHIPPING	Excluded		No. 6
14 INSPECTION, TEST, AND OPERATING STATUS		IC	No. 7
15 CONTROL OF NONCONFORMING ITEMS		IC	
16 CORRECTIVE ACTION		IC	
17 QUALITY ASSURANCE RECORDS		IC	
18 AUDITS		IC	

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A-6700-309 (9-85)

CONSOLIDATED EVALUATION FORM CONTINUATION SHEET

BHL-002-7: Fluid Circulation Monitoring

Continuation No. 1

Criterion 4: Procurement Document Control

No procurement involved.

Continuation No. 2

Criterion 7: Control of Purchased Items/Services

No items or services purchased.

Continuation No. 3

Criterion 8: Identification and Control of Items

No items to control.

Continuation No. 4

Criterion 9: Control of Process

No special processes are involved. The routine process of fluid circulation monitoring requires the application of Process Controls only.

Continuation No. 5

Criterion 10: Inspection

Inspection will consist of surveillance of the activity.

Continuation No. 6

Criterion 13: Handling, Shipping and Storage

No handling, shipping, or storage involved.

Continuation No. 7

Criterion 14: Inspection, Test, and Operating Status

The Shift Report of Operations and surveillance records will document the status of these activities.

3.2.8 Item 8, BHL-002-8: Drill Cutting Item Analysis

Definition

Drill cuttings are fragmental rock or sediment samples removed from the penetrated lithologies during the course of drilling (cable tool and rotary).

Considerations

- Sampling is biased by the rotary drill method and sample depths are approximate only. Lag time associated with samples arriving to the surface can cause low accuracy in drill cutting collection. Travel times for samples to reach the surface must be determined to correlate cuttings with depth.

- Geologic information from cuttings will be used as input to stratigraphic and structural models of long term tectonic stability.

- Cuttings will be used to verify test horizons by chemical analysis. Verification takes place after piezometers are installed.

- The geolograph is used for depth determination of rotary drill cutting samples. Drill depths on the geolograph are cross referenced to drill stem measurements.

- Borehole geologic logs are prepared using drill cuttings.

Initiating Event A8. Vehicle Operations

N/A under this Item

Initiating Event B8. Sabotage

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event C8. External Physical Impact

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event D8. Natural Phenomena

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event E8. Training Deficiency

Potential Failure:

1. Sample not collected according to procedure.

2. Sample lost or not collected.

3. Incorrect depth measurement.

4. Incorrect lag time equations used, inaccurate variables entered, mistake in the calculation.

Consequences:

1. Samples not collected according to procedure may cause misidentification of test horizon. A single sample collected incorrectly may not be of statistical importance. A number of samples incorrectly collected or misidentified may prevent verification of test horizon.

2. The loss of a single sample is inconsequential. A number of lost samples may prevent verification of test horizons. Note: only three to four samples are usually analyzed in the stratigraphic horizon of interest. An exception is the Cohassett flow in which approximately ten are analyzed.

3. Mis-measurement of depth will cause inaccurate measurement of the depth from which the sample came from and may cause mis-identification of stratigraphic lithologies.

4. Any inaccuracies associated with the lag time calculations would result in the misrepresentation of the actual depth from which the samples originated.

Credibility:

1. Credible. Potential for mis-collection of an individual sample is high. The potential for mis-collection of a statistically meaningful number of samples is small.

2. Non-credible. Loss of samples is a potential problem in the absence of any prescribed handling. Samples will be used in site characterization.

3. Non-credible. There is potential for mis-measuring, however, geolograph and drill string measurements before sampling should mitigate this potential. Stratigraphic lithologies are verified using geophysical techniques.

4. Non-credible. The equations used for calculating lag times are common throughout the industry. Cross checking of the variables and calculations by independent parties will minimize the chances for error.

Initiating Event F8. Procedural Deficiency

See discussion under E8 above.

Initiating Event G8. Carelessness

Potential Failure:

Loss of control points for the depth measurements within the bore hole.

Consequences:

The loss of depth measurement control points will prevent continuity of depth measurements during and after drilling and testing. This may result in errors in the estimation of chip sample depths.

Credibility:

Credible. The loss of measurement control points could jeopardize the results of data important to site characterization. This problem can be prevented by tying the control point(s) to a regional geodetic benchmark before the drilling activity is conducted.

Also see discussion under E8 above

Initiating Event H8. Design Deficiency

N/A under this Item

Initiating Event I8. Failure of Item

See discussion under E8 above

Initiating Event J8. Fire

N/A under this Item

Initiating Event K8. Explosion

N/A under this Item

Level Assignment: Level 1

Chip sampling is a site characterization data related item and will be used in site characterization. Therefore it is necessary to control and collect samples in a diligent and competent manner and is designated QA Level 1.

GRADING CHECK LIST

Component/Item : BHL-002-8/Drill Cutting

Conditions		QAL
1.	Can failure of the item, or activity contribute to a process which allows radioactive materials to reach the uncontrolled environment?	1A
2.	Does the item or activity involve or affect public radiological health and safety?	1A
3.	Does the item or activity involve waste isolation?	1A
4.	Does this activity support or provide data to evaluate performance assessment of repository radionuclide containment capability?	(1A)
5.	Can failure of the item or activity cause irretrievable loss of such data?	(1A)
6.	Can the activity involve a significant change to an in-process licensing document?	2A
7.	Can the activity involve a change to an in-process major procurement action?	2A
8.	Can the activity involve a change to a major in-process construction action?	2A
9.	Can failure of the item or activity cause a major cost overrun?	2A
10.	Can failure of the item or activity cause a major schedule slippage?	2A
11.	Can failure of the item or activity have an adverse impact on major non-radiological engineered systems or structures?	2A
12.	Can failure of the item or activity result in personnel injury which must be individually reported to state or Federal agencies?	2B
13.	Can failure of the item or activity result in a lost time personnel injury?	2B
If none of the above		3

NARRATIVE WORK SHEET

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SD-BWI-AR-031 Rev 0

Item: #8 Drill Cuttings

BHL-002-8

HOW CAN IT FAIL? (CONSIDER EACH CONSEQUENTIAL EVENT FROM FORM A-6700-307)

1. Sampling not performed according to procedure can cause misidentification of horizon
2. Loss of sample(s)

AT WHAT STAGE(S) CAN FAILURE OCCUR? (CONSIDER LIFE CYCLE.)

Failure can occur at any stage

HOW EASY IS IT TO FIX?

1. Corrective action would be very difficult
2. Loss of a sample(s) is not correctable

WHAT CAN BE DONE TO PREVENT IT?

Training and supervision of activity should prevent failure

WHAT CAN BE DONE TO MITIGATE CONSEQUENCES OF FAILURE?

Frequency of sampling mitigates impact of a single lost sample. Personnel should be retrained to minimize possibility of future failure.

A-6700-308 (9/86)

CONSOLIDATED EVALUATION FORM

SD-BWI-AR-031 Rev 0

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Level of Expertise: 1 [3], 2 [1], 3 [1], 4 [ ], 5 [ ]

Item: #8 Drill Cuttings

BHL-002-8

CONDITION "A", TABLE 1 [1]) DESIGNATED

CONDITION "B", TABLE 1 [3]) LEVEL 1

Q-LIST?

CRITERIA	JUSTIFICATION REQUIRED	PROGRAM RESPONSIBILITY	SEE CONTINUATION PAGE
1 ORGANIZATION		IC	
2 QUALITY ASSURANCE		IC	
3 DESIGN CONTROL	Excluded		No. 1
4 PROCUREMENT DOCUMENT CONTROL	Excluded		No. 2
5 INSTRUCTIONS, PROCEDURES, DRAWINGS		IC	
6 DOCUMENT CONTROL		IC	
7 CONTROL OF PURCHASED ITEMS/SERVICES	Excluded		No. 3
8 IDENTIFICATION AND CONTROL OF ITEMS		IC	
9 CONTROL OF PROCESS		IC	No. 4
10 INSPECTION		IC	No. 5
11 TEST CONTROL		IC	
12 CONTROL OF MEASURING AND TEST EQUIPMENT		IC/SC	
13 HANDLING, STORAGE, AND SHIPPING		IC/SC	
14 INSPECTION, TEST, AND OPERATING STATUS		IC	No. 6
15 CONTROL OF NONCONFORMING ITEMS		IC	
16 CORRECTIVE ACTION		IC	
17 QUALITY ASSURANCE RECORDS		IC	
18 AUDITS		IC	

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A-6700-309 (9-86)

CONSOLIDATED EVALUATION FORM CONTINUATION SHEET

BHL-002-8: Drill Cuttings

Continuation No. 1

Criterion 3: Design Control

No design systems involved.

Continuation No. 2

Criterion 4: Procurement Document Control

Procurement not required where Rockwell personnel are responsible for the collection of drill cuttings.

Continuation No. 3

Criterion 10: Inspection

Inspection will consist of surveillance of the activity.

Continuation No. 4

Criterion 9: Control of Process

No special processes are involved. The routine process of drill cutting collection requires the application of Process Controls only.

Continuation No. 5

Criterion 10: Inspection

Inspection will consist of surveillance of the activity.

Continuation No. 6

Criterion 14: Inspection, Test, and Operating Status

The Shift Report of Operations and surveillance records will document the status of this activity.

3.2.9 Item 9, BHL-002-9; Workover and Drilling Rigs and Materials Item Analysis

Definitions

The Rotary Drilling Rig is used to drill the piezometer borehole by exerting downward and rotational force; to circulate fluids and drill cuttings, and as support equipment during casing installation, cementations, running of geophysical tools and related activities.

The Cable Tool Drilling Rig is used to drill the starter hole by percussion action, drive conductor pipe and provide samples by bit and bailer methods.

The Workover Rig is used in support of piezometer installations and to conduct specific borehole tests involving packers.

Considerations

- This Item includes the drill and workover rigs plus all associated support equipment and tools including, but not limited to, the following: pumps, tanks, compressors, generators, storage facilities, packers, drill pipe, breakout tools, drill collars, mixers, hand tools, slips, swivels, trailers and trucks.

- This Item includes all perishable and irretrievable procured materials including, but not limited to the following: drill bits, drilling muds, casing, cement, casing shoes, centralizers, float shoes, DV tools, lost circulation material, fuel, lubricants, additives, etc.

- All procured supporting services and equipment including, but not limited to: non-calibrated tools, cementing, geophysical logging, tubing test, water hauling, fuel delivery, refuse pickup and sanitary facility services.

- Tools and equipment that require calibration will meet nationally recognized standards regarding tolerances, precision, storage and handling specifications and recalibration schedules. In the case where no national standards have been formulated (e.g., geophysical tools) it is the responsibility of the user of the information to determine the desired level of precision needed for data application.

Initiating Event A9. Vehicle Operations

N/A under this Item

Initiating Event B9. Sabotage

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event C9. External Physical Impact

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event D9. Natural Phenomena

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event E9. Training Deficiency

N/A under this Item

Initiating Event F9. Procedural Deficiency

N/A under this Item

Initiating Event G9. Carelessness

N/A under this Item

Initiating Event H9. Design Deficiency

N/A under this Item

Initiating Event I9. Failure of Item

Potential Failure:

Failure of drill or workover rig or support equipment.

Consequences:

The consequences of rig or support equipment failure vary depending on what stage in the operation failure occurs. Rig or support equipment failure would not be of a critical nature because of the ability to perform repairs with minor cost and schedule delays.

Credibility:

Non-credible. Rig or support equipment failure is unlikely to

occur and will be prevented by frequent inspection and proper maintenance practices. The results of any failure would be minor and easily corrected.

Initiating Event J9. Fire

Non-credible (see discussion under BHL-001-1, Initiating Event E1)

Initiating Event K9. Explosion

Non-credible (see discussion under BHL-001-1, Initiating Event E1)

Level Assignment: Level 3

The ease with which the failure of the drill rig, workover rig, or support equipment can be prevented or corrected and the lack of impact on site characterization makes these a QA Level 3 Item.

GRADING CHECK LIST

Component/Item : BHL-002-9/Drill Rigs and Materials

Conditions		QAL
1.	Can failure of the item, or activity contribute to a process which allows radioactive materials to reach the uncontrolled environment?	1A
2.	Does the item or activity involve or affect public radiological health and safety?	1A
3.	Does the item or activity involve waste isolation?	1A
4.	Does this activity support or provide data to evaluate performance assessment of repository radionuclide containment capability?	1A
5.	Can failure of the item or activity cause irretrievable loss of such data?	1A
6.	Can the activity involve a significant change to an in-process licensing document?	2A
7.	Can the activity involve a change to an in-process major procurement action?	2A
8.	Can the activity involve a change to a major in-process construction action?	2A
9.	Can failure of the item or activity cause a major cost overrun?	2A
10.	Can failure of the item or activity cause a major schedule slippage?	2A
11.	Can failure of the item or activity have an adverse impact on major non-radiological engineered systems or structures?	2A
12.	Can failure of the item or activity result in personnel injury which must be individually reported to state or Federal agencies?	2B
13.	Can failure of the item or activity result in a lost time personnel injury?	2B
If none of the above		(3)

NARRATIVE WORK SHEET

SD-BWI-AR-031 Rev 0

BHL-002-9

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Item: #9 Workover Rig and Materials

HOW CAN IT FAIL? (CONSIDER EACH CONSEQUENTIAL EVENT FROM FORM A-6700-307)

Failure of drill rig would have minor consequences only

AT WHAT STAGE(S) CAN FAILURE OCCUR? (CONSIDER LIFE CYCLE.)

At any stage of completion work

HOW EASY IS IT TO FIX?

Repair or replace the workover rig

WHAT CAN BE DONE TO PREVENT IT?

Procedures, training, preventative maintenance, frequent inspections

WHAT CAN BE DONE TO MITIGATE CONSEQUENCES OF FAILURE?

Readiness of supplies, spare parts
Procedures and training

A-6700-308 (9/86)

CONSOLIDATED EVALUATION FORM

SD-BWI-AR-031 Rev 0

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Level of Expertise: 1 (1) | 1 (2) | 2 (3) | (4) | (5)

BHL-002-9

CONDITION "A", TABLE 1: 3

CONDITION "B", TABLE 1: 3

DESIGNATED LEVEL 3

Item: Drill Rigs and Materials

Q-LIST?

	CRITERIA	JUSTIFICATION REQUIRED	PROGRAM RESPONSIBILITY	SEE CONTINUATION PAGE
1	ORGANIZATION		IC	
2	QUALITY ASSURANCE		IC	
3	DESIGN CONTROL	Excluded		No. 1
4	PROCUREMENT DOCUMENT CONTROL		IC/SC	
5	INSTRUCTIONS, PROCEDURES, DRAWINGS		IC	
6	DOCUMENT CONTROL		IC	
7	CONTROL OF PURCHASED ITEMS/SERVICES		IC/SC	
8	IDENTIFICATION AND CONTROL OF ITEMS		IC	No. 2
9	CONTROL OF PROCESS	Excluded		No. 3
10	INSPECTION		IC	No. 4
11	TEST CONTROL	Excluded		No. 5
12	CONTROL OF MEASURING AND TEST EQUIPMENT		IC	
13	HANDLING, STORAGE, AND SHIPPING		IC/SC	
14	INSPECTION, TEST, AND OPERATING STATUS		IC	No. 6
15	CONTROL OF NONCONFORMING ITEMS		IC	
16	CORRECTIVE ACTION		IC	
17	QUALITY ASSURANCE RECORDS		IC	
18	AUDITS		IC	

IC=Integrating Contractor SC=Subcontractor

A-6700-302 (9-86)

CONSOLIDATED EVALUATION FORM CONTINUATION SHEET

BHL-002-9: Drill Rigs and Materials

Continuation No. 1

Criterion 3: Design Control

No design criteria needed.

Continuation No. 2

Criterion 8: Identification and Control of Items

Limited to calibrated tools and equipment.

Continuation No. 3

Criterion 9: Control of Process

No special processes or process controls are involved.

Continuation No. 4

Criterion 10: Inspection

Inspection is limited to general acceptance of items and materials as meeting specification requirements.

Continuation No. 5

Criterion 11: Test Control

No testing involved under this Item.

Continuation No. 6

Criterion 14: Inspection, Test, and Operating Status

Limited to calibrated equipment.

3.2.10 Item 10, BHL-002-10: Clean Hole Item Analysis

Definition

Cleaning of the borehole is conducted to clear the borehole fluids of materials that would otherwise interfere with the objective of the video camera. This may be accomplished by using either a downhole submersible pump or by reverse circulation methods.

Considerations

- This activity is non-complex, routine using standard hardware with the results easily inspected upon completion.

Initiating Event A10. Vehicle Operations

N/A under this Item

Initiating Event B10. Sabotage

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event C10. External Physical Impact

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event D10. Natural Phenomena

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event E10. Training Deficiency

Potential Failure:

Pump failure due to mishandling and/or improper use.

Consequences:

Failure would result in downhole fluids remaining turbid. Corrective action would be to replace or repair pump and reset.

Credibility:

Non-credible. All activities associated with this item can be conducted again with a minimal cost.

Initiating Event F10. Procedural Deficiency

See discussion under E10 above.

Initiating Event G10. Carelessness

See discussion under E10 above.

Initiating Event H10. Design Deficiencies

N/A under this Item

Initiating Event I10. Failure of Item

See discussion under E10 above.

Initiating Event J10. Fire

Non-credible (see discussion under BHL-001-1, Initiating Event E1)

Initiating Event K10. Explosion

Non-credible (see discussion under BHL-001-1, Initiating Event E1)

Level Assignment: Level 3

The application of standard industry practices and lack of impact on other activities gives this Item a QA Level of 3.

GRADING CHECK LIST

Component/Item : BHL-002-10/Clean Hole

Conditions	QAL
1. Can failure of the item, or activity contribute to a process which allows radioactive materials to reach the uncontrolled environment?	1A
2. Does the item or activity involve or affect public radiological health and safety?	1A
3. Does the item or activity involve waste isolation?	1A
4. Does this activity support or provide data to evaluate performance assessment of repository radionuclide containment capability?	1A
5. Can failure of the item or activity cause irretrievable loss of such data?	1A
6. Can the activity involve a significant change to an in-process licensing document?	2A
7. Can the activity involve a change to an in-process major procurement action?	2A
8. Can the activity involve a change to a major in-process construction action?	2A
9. Can failure of the item or activity cause a major cost overrun?	2A
10. Can failure of the item or activity cause a major schedule slippage?	2A
11. Can failure of the item or activity have an adverse impact on major non-radiological engineered systems or structures?	2A
12. Can failure of the item or activity result in personnel injury which must be individually reported to state or Federal agencies?	2B
13. Can failure of the item or activity result in a lost time personnel injury?	2B
If none of the above	(3)

NARRATIVE WORK SHEET

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SD-BWI-AR-031 Rev 0

BHL-002-10

Item: #10 Clean Borehole

HOW CAN IT FAIL? (CONSIDER EACH CONSEQUENTIAL EVENT FROM FORM A-6700-307)

Equipment failure
Carelessness, drop pump or pipe down hole
The consequence of failure would be the inability to examine borehole with television camera

AT WHAT STAGE(S) CAN FAILURE OCCUR? (CONSIDER LIFE CYCLE.)

Failure can occur at any stage

HOW EASY IS IT TO FIX?

Easy - Pull pump and reset
Easy - Fish out and replace

WHAT CAN BE DONE TO PREVENT IT?

Establish procedures and training personnel

WHAT CAN BE DONE TO MITIGATE CONSEQUENCES OF FAILURE?

Training programs on procedures

A-6700-308 (9/86)

CONSOLIDATED EVALUATION FORM SD-BWI-AR-031 Rev 0

Name: T. D. Ault, A. P. Wicklund, F. V. Roeck, K. M. Singleton

Level of Expertise: 1 (1) 1 (2) 2 (3) ( ) (4) ( ) (5)

Item: #10 Clean Borehole

BHL-002-10

CONDITION "A", TABLE 1 3)
)
CONDITION "B", TABLE 1 3) DESIGNATED LEVEL 3

Q-LIST?

CRITERIA	JUSTIFICATION REQUIRED	PROGRAM RESPONSIBILITY	SEE CONTINUATION PAGE
1 ORGANIZATION		IC	
2 QUALITY ASSURANCE		IC	
3 DESIGN CONTROL	Excluded		No. 1
4 PROCUREMENT DOCUMENT CONTROL	Excluded		No. 2
5 INSTRUCTIONS, PROCEDURES, DRAWINGS		IC	
6 DOCUMENT CONTROL		IC	
7 CONTROL OF PURCHASED ITEMS/SERVICES	Excluded		No. 3
8 IDENTIFICATION AND CONTROL OF ITEMS	Excluded		No. 4
9 CONTROL OF PROCESS		IC	No. 5
10 INSPECTION	Excluded		No. 6
11 TEST CONTROL	Excluded		No. 7
12 CONTROL OF MEASURING AND TEST EQUIPMENT	Excluded		No. 8
13 HANDLING, STORAGE, AND SHIPPING	Excluded		No. 9
14 INSPECTION, TEST, AND OPERATING STATUS	Excluded		No. 10
15 CONTROL OF NONCONFORMING ITEMS		IC	
16 CORRECTIVE ACTION		IC	
17 QUALITY ASSURANCE RECORDS		IC	
18 AUDITS		IC	

IC=Integrating Contractor

A-6700-309 (9-86)

CONSOLIDATED EVALUATION FORM CONTINUATION SHEET

BHL-002-10: Clean Borehole

Continuation No. 1

Criterion 3: Design Control

No design required.

Continuation No. 2

Criterion 4: Procurement Document Control

No procured items.

Continuation No. 3

Criterion 7: Control of Purchased Items/Services

No items or services to control under this Item.

Continuation No. 4

Criterion 8: Identification and Control of Items

No controlled Items needed.

Continuation No. 5

Criterion 9: Control of Process

No special processes are involved. The routine process of setting pumps and/or cleaning the borehole requires only Process Controls.

Continuation No. 6

Criterion 10: Inspection

Inspection of the activity is not required. Inspection of the results of the activity is accomplished by the down-hole camera.

Continuation No. 7

Criterion 11: Test Control

No testing is involved in this activity.

Continuation No. 8

Criterion 12: Control of Measuring and Test Equipment

No controlled items needed during this activity.

Continuation No. 9

Criterion 13: Handling, Storage, and Shipping

No special controls needed for this activity.

Continuation No. 10

Criterion 14: Inspection, Test, and Operations Status

Does not apply to this activity.

3.3 PIEZOMETER COMPONENT SUMMARY (BHL-003)

Items Identified Under Piezometer (BHL-003)		QA Level
Item 1.	Set Cement Plug	1
Item 2	Assemble, Measure and Place Piezometer Tube	1
Item 3.	Tubing Tests	1
Item 4.	Filter Pack Placement	1
Item 5.	Develop Piezometer	1
Item 6.	Install and Monitor Transducer	1
Item 7.	Materials	3

Initiating Events

Initiating Event A. External Physical Factors

Initiating Event B. Training, Procedural Deficiency, Carelessness

Initiating Event C. Design Deficiency

Initiating Event D. Failure of Item

Initiating Event E. Fire and Explosion

Piezometer

BHL-003

MATRIX OF INTERACTIONS

ITEMS (from numbered list, attached) *

INITIATING EVENTS	1	2	3	4	5	6	7	8	9	10	11	12	13	14
A - External Physical Factors	0	0	0	0	0	0	0							
B - Training Deficiency	X	X	X	X	X	X	0							
C - Design Deficiency	X	X	X	X	0	X	0							
D - Failure of Item	0	X	X	0	X	X	0							
E - Fire and Explosion	0	0	0	0	0	X	0							

X = Item/event have potential for unacceptable interaction.

(X) = Item/event reviewed and rejected as not consequential.

0 = Item/event reviewed and rejected as not consequential

A-6700-307

* See Component Summary (previous page) for Items Identified

3.3.1 Item 1, BHL-003-1: Set Cement Plug Item Analysis

Definition

Setting cement plugs involves the placement of high density cement into the borehole to isolate specific piezometer test horizons. The installation of a piezometer at a given horizon begins and ends with the setting of a cement plug.

Considerations

- Setting cement plugs during piezometer installation is a standard industrial process. Considerable care is applied to this process.

- The depths at which cement plugs are installed are predetermined through the use of borehole geophysical logs.

- Mistakes in this process are not easily corrected and close control of setting depths and volumes of material are essential. Redundant checks and close supervision of activities is required.

- Only the process and documentation, and not the materials used or procurement of the services, of setting the cement plugs is considered in this Item.

- Materials involved in the cement setting process are: cement, additives, and mix water.

Initiating Event A1. External Physical Factors

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event B1. Training, Procedural Deficiency or Carelessness

Potential Failure:

Cement horizon to be tested

Consequences:

Cementing the zone to be used for hydrologic testing would have serious consequences. This would result in the inaccessibility of the interval for hydrologic testing and would result in the loss of hydrologic data from that interval. Remedial action would be virtually impossible.

Credibility:

Credible. This type of failure is possible without great care in the execution of these processes. The preventative mechanisms in current use include well defined procedures, effective training, close cooperation among team members, double checks on calculations, and extensive documentation of activities.

Initiating Event C1. Design Deficiency

Potential Failure:

1. A design deficiency could occur through the misidentification of the interval to be tested.

2. A design failure may occur in the identification of the amount or type of material used to seal the borehole and thereby fail to isolate the aquifers (piezometers).

Consequences:

1. This would result in the installation of the piezometer in the wrong stratigraphic location and the potential loss of hydrologic test data.

2. The wrong material or an insufficient amount of the proper material may create an inadequate seal that would cause intercommunication of the testing horizons.

Credibility:

1. Credible. Potential for a design deficiency is possible if locations are based on a single method of location. This can effectively be prevented by the use of multiple methods of determining intervals such as borehole geophysical logs, drilling rate information and subsequent verification of stratigraphy using the analysis of drill cuttings.

2. Credible. The use of cement as a seal should be closely evaluated if good data is to be gathered from piezometer monitoring installations. Evaluation should include an examination of what constitues an adequate amount of material needed to create a good seal.

Initiating Event D1. Failure of Item (cement)

Potential Failure:

Failure of cement to set properly

Consequences:

The consequences of a failure are potentially high if undetected. Failure of the cement to set would potentially violate the integrity of the hydrologic zone and result in the invalidation of the test results. The detection of a bad cement job can allow for the removal and replacement of bad cement.

Credibility:

Non-credible. The potential failure of the cement to set up is low. Confirming the placement and tagging the top of the cement is standard practice and effectively prevents the presence of a bad cement job.

Initiating Event E1. Fire or Explosion

Industrial hazards exist from the use of high pressure cementing equipment but standard safety practices are considered adequate.

Non-credible (see discussion under BHL-001-1, Initiating Event E1)

Level Assignment: Level 1

The need for a high degree of control, potential impact on piezometer test results and borehole objectives places this Item at QA Level 1.

GRADING CHECK LIST

Component/Item : BHL-003-1/Set Cement Plug

Conditions		QAL
1.	Can failure of the item, or activity contribute to a process which allows radioactive materials to reach the uncontrolled environment?	1A
2.	Does the item or activity involve or affect public radiological health and safety?	1A
3.	Does the item or activity involve waste isolation?	1A
4.	Does this activity support or provide data to evaluate performance assessment of repository radionuclide containment capability?	(1A)
5.	Can failure of the item or activity cause irretrievable loss of such data?	1A
6.	Can the activity involve a significant change to an in-process licensing document?	2A
7.	Can the activity involve a change to an in-process major procurement action?	2A
8.	Can the activity involve a change to a major in-process construction action?	2A
9.	Can failure of the item or activity cause a major cost overrun?	2A
10.	Can failure of the item or activity cause a major schedule slippage?	2A
11.	Can failure of the item or activity have an adverse impact on major non-radiological engineered systems or structures?	2A
12.	Can failure of the item or activity result in personnel injury which must be individually reported to state or Federal agencies?	2B
13.	Can failure of the item or activity result in a lost time personnel injury?	2B
If none of the above		3

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NARRATIVE WORK SHEET

SD-BWI-AR-031 Rev 0

BHL-003-1

Item: #1 Set Cement Plug

HOW CAN IT FAIL? (CONSIDER EACH CONSEQUENTIAL EVENT FROM FORM A-6700-307)

1. Cement horizon to be tested
2. Improperly placed or wrong type of cement
3. Failure of cement to set

AT WHAT STAGE(S) CAN FAILURE OCCUR? (CONSIDER LIFE CYCLE.)

1. Placement of cement
2. During isolation of a particular interval or specification of materials to be used
3. After placement of cement

HOW EASY IS IT TO FIX?

1. If discovered prior to setting, no problems -- after setting, loss of a particular horizon
2. If not set, wash out (easy) -- if set, loss of interval (difficult)
3. Wash out cement and recement if detected prior to setting

WHAT CAN BE DONE TO PREVENT IT?

1. Double checks on calculations and cooperation amongst all individuals involved
2. Procedures, training and team cooperation and adequate design review
3. Reverse flush cement and recement

WHAT CAN BE DONE TO MITIGATE CONSEQUENCES OF FAILURE?

Procedures and training
Check points and double checks on calculations

A-6700-308 (9/86)

CONSOLIDATED EVALUATION FORM

SD-BWI-AR-031 Rev 0

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BHL-003-1

CONDITION "A", TABLE 1 __1__)
CONDITION "B", TABLE 1 __3__) DESIGNATED LEVEL 1

Item: #1 Set Cement Plugs

Q-LIST?

	CRITERIA	JUSTIFICATION REQUIRED	PROGRAM RESPONSIBILITY	SEE CONTINUATION PAGE
1	ORGANIZATION		IC	
2	QUALITY ASSURANCE		IC	
3	DESIGN CONTROL		IC	
4	PROCUREMENT DOCUMENT CONTROL		IC	
5	INSTRUCTIONS, PROCEDURES, DRAWINGS		IC	
6	DOCUMENT CONTROL		IC	
7	CONTROL OF PURCHASED ITEMS/SERVICES		IC	
8	IDENTIFICATION AND CONTROL OF ITEMS	Excluded		No. 1
9	CONTROL OF PROCESS		IC	No. 2
10	INSPECTION		IC	No. 3
11	TEST CONTROL		IC	
12	CONTROL OF MEASURING AND TEST EQUIPMENT		IC/SC	
13	HANDLING, STORAGE, AND SHIPPING	Excluded		No. 4
14	INSPECTION, TEST, AND OPERATING STATUS		IC	No. 5
15	CONTROL OF NONCONFORMING ITEMS		IC	
16	CORRECTIVE ACTION		IC	
17	QUALITY ASSURANCE RECORDS		IC	
18	AUDITS		IC	

IC=Integrating Contractor SC=Subcontractor

A-6700-309 (9-86)

CONSOLIDATED EVALUATION FORM CONTINUATION SHEET

BHL-003-1: Set Cement Plugs

Continuation No. 1

Criterion 8: Identification and Control of Items

No controlled items are included in this activity.

Continuation No. 2

Criterion 9: Control of Process

No special processes are involved. The routine process of setting cement plugs requires the application of Process Controls only.

Continuation No. 3

Criterion 10: Inspection

Inspection will consist of surveillance of the activity.

Continuation No. 4

Criterion 13: Handling, Shipping and Storage

Does not apply to this activity.

Continuation No. 5

Criterion 14: Inspection, Test, and Operating Status

The Shift Report of Operations and surveillance records will document the status of this activity.

3.3.2 Item 2, BHL-003-2; Assemble, Measure and Place Piezometer Tube Item Analysis

Definition

This activity includes the assembly of components and the placement of the piezometer tube.

Considerations

This placement includes the following:

- Measure and lay out tubes to be installed:
- Assemble screen and lower piezometer components.
- Measure screen section and tail pipe and lower in borehole.
- Assemble remainder of tube and lower in borehole a section at a time (tube test under Item 3 is conducted at this time).
- Land out piezometer, attach to casing at surface and identify (Composite tube test under Item 3 is conducted at this time).

Initiating Event A2. External Physical Factors

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event B2. Training, Procedural Deficiency or Carelessness

Potential Failure:

1. Loss of tubing or material in borehole.
2. Misplace piezometer and test wrong zone.
3. Mis-assembly of tubing causing leaks.
4. Damage existing piezometers during installation of subsequent piezometers or fishing operations.

Consequences:

1. Consequences may include damage to existing piezometers by impact or during retrieval process. Damage potential is dependent on type of object placed downhole. It is possible to lose a horizon.

2. Lose or misrepresent data from a single or multiple horizons. Criticality of this event is dependent on horizon involved. Monitoring the horizon from an alternate borehole(s) could mitigate this consequence.

3. Lose integrity of tubing. This could cause the loss of data from a single horizon or interconnection of multiple horizons. This would not be a serious problem if discovered before the upper cement is emplaced. Criticality of this event is dependent on the horizon involved. It is possible to remove and correct the assembly problems if detected before cementation. If discovered after cementation and if interconnection is critical, it may be necessary to cement off the zone through the piezometer tube. Monitor the zone through alternate borehole if the zone is critical.

4. Lose data from single or multiple horizons and potential intercommunication of multiple horizons.

Credibility:

1. Non-credible. It may become necessary to fish out material. Careful planning and precautionary procedures to avoid the loss of material in the hole need be taken and the cautious application of remedial action will prevent damage to existing piezometers.

2. Non-credible. Team cooperation, well thought out procedures and careful cross checking of placement locations against other support data such as borehole geophysical logs will minimize potential for placing piezometers in the wrong location.

3. Credible. Procedures outlining assembly (tubing selection, taping and torquing), team cooperation, adequate training, tube joint tests and composite tube test (Item 3. Tubing test BHL-003-3) will reduce occurrence of leaks and allow detection of leaks before cementation.

4. Credible. Careful consideration of actions by members of installation crew before execution of tasks, evaluation of risks before fishing operations are undertaken and general attentiveness will greatly reduce the potential for damage to piezometers.

Initiating Event C2. Design Deficiency

Design discussed in this initiating event refers to the design of the piezometer installation. The subcomponents of the piezometer (tubing,

screens, etc.) are discussed under Item 7 (Materials). Materials are, as a rule, industry standard of the desired specification. The designation as such does not preclude the inspection of select materials upon receipt for compliance with desired specifications.

Potential Failure:

1. Improper dimensions of tube diameter, screen or seating nipple.

2. Mis-specification of piezometer placement depths.

3. Application of post manufacture processes (e.g. welding) that could cause leaks in tubing or breakage of centralizers.

Consequences:

1. Mis-specification of dimensions could inhibit joint and composite testing (Item 3) of piezometer, jeopardize the free interface of the piezometer with monitoring horizon. This could result in the loss of a monitoring horizon or loss of the ability to confirm seal if not corrected prior to cementation. The removal and replacement of piezometers of appropriate dimensions prior to cementation could be accomplished with a minimum of cost. Once cementation is completed replacement would not be possible.

2. The mis-specification of piezometer placement depths will result in the monitoring of the wrong stratigraphic horizon or the wrong interval within a horizon. Depths to monitoring horizons are determined by multiple methods. These include drilling rates and borehole geophysical logs. Remedial action consists of drilling new borehole to target horizon.

3. Post manufacture modifications such as welding of centralizers could cause leaks in tubing either physically by disrupting tubing walls or causing chemical changes conducive to corrosion. Loss of hydrologic data from one or more horizon could result. Physical problems from this process would normally be detected during tubing tests (Item 3). Remedial action if leaks are discovered before cementation of piezometer consists of simply replacement of bad sections.

4. The mis-identification of piezometer materials may result in the malfunction of the piezometer monitoring facility due to chemical, physical or electrical interactions between the piezometers, monitoring equipment and/or surrounding environment.

Credibility:

1. Credible. Design review by knowledgeable technical staff can prevent design problems.

2. Credible. Methods employed to prevent mis-specification of installation include cross checking of flow boundaries using geophysical logs, drilling rate information and verification of stratigraphy.

3. Non-credible. Problems arising from post manufacturing modification of materials are possible. Tubing tests of modified components prior to assembly of piezometers and placement of centralizers in non-critical zones (grout or sand pack) counter this problem.

4. Credible. Problems may occur from deleterious interactions between the materials used in the piezometer monitoring facility and the environment. The potential for problems to arise may increase with time and therefore should be considered from the immediate and the long-range standpoint.

Initiating Event D2. Failure of Item (hardware)

Covered under design deficiency Item C2 above.

Initiating Event E2. Fire or Explosion

Non-credible (see discussion under BHL-001-1, Initiating Event E1)

Level Assignment: Level 1

The information needed from these piezometers in site characterization requires that the measurement and placement of each piezometer be given an assignment of QA Level 1 (see Section 5, Grading Check List, BHL-003-2 for logic used in the grading process level assignment).

GRADING CHECK LIST

Component/Item : BHL-003-2/Assemble, Measure and Place Piezometer

Conditions		QAL
1.	Can failure of the item, or activity contribute to a process which allows radioactive materials to reach the uncontrolled environment?	1A
2.	Does the item or activity involve or affect public radiological health and safety?	1A
3.	Does the item or activity involve waste isolation?	1A
4.	Does this activity support or provide data to evaluate performance assessment of repository radionuclide containment capability?	(1A)
5.	Can failure of the item or activity cause irretrievable loss of such data?	1A
6.	Can the activity involve a significant change to an in-process licensing document?	2A
7.	Can the activity involve a change to an in-process major procurement action?	2A
8.	Can the activity involve a change to a major in-process construction action?	2A
9.	Can failure of the item or activity cause a major cost overrun?	2A
10.	Can failure of the item or activity cause a major schedule slippage?	2A
11.	Can failure of the item or activity have an adverse impact on major non-radiological engineered systems or structures?	2A
12.	Can failure of the item or activity result in personnel injury which must be individually reported to state or Federal agencies?	2B
13.	Can failure of the item or activity result in a lost time personnel injury?	2B
If none of the above		3

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NARRATIVE WORK SHEET

SD-BWI-AR-031 Rev 0

BHL-003-2

Item: #2 Assemble, Measure and Place Piezometer

HOW CAN IT FAIL? (CONSIDER EACH CONSEQUENTIAL EVENT FROM FORM A-6700-307)

1. Loss of tubing and/or material in hole
2. Misplace piezometer due to measurements when assembling
3. Incorrect assembly causes leaks
4. Damage previously placed piezometers
5. Incorrect design or specification causing physical or chemical failure

AT WHAT STAGE(S) CAN FAILURE OCCUR? (CONSIDER LIFE CYCLE.)

1. While placing down hole
2. During placement in a specific horizon
3. During placement down hole
4. If piezometer dropped or in placing it in a given location
5. Before, during or after installation

HOW EASY IS IT TO FIX?

1. If no other piezometers in hole, no problem. If other piezometer in hole, difficult
2. If cemented in place - impossible
3. If cemented in place - impossible
4. Depending on damage to piezometers (easy to impossible)
5. Easily repaired before cementation, impossible afterward

WHAT CAN BE DONE TO PREVENT IT?

Procedures, training, check points, dual calculations, design reviews

WHAT CAN BE DONE TO MITIGATE CONSEQUENCES OF FAILURE?

Procedures, training, at least two separate calculations utilizing check points

A-6700-308 (9/86)

CONSOLIDATED EVALUATION FORM

SD-BWI-AR-031 Rev 0

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Item: #2 Assemble, Measure, and Place Piezometers

BHL-003-2

CONDITION "A", TABLE 1 1)
) DESIGNATED
) LEVEL 1
CONDITION "B", TABLE 1 3)

Q-LIST?

	CRITERIA	JUSTIFICATION REQUIRED	PROGRAM RESPONSIBILITY	SEE CONTINUATION PAGE
1	ORGANIZATION		IC	
2	QUALITY ASSURANCE		IC	
3	DESIGN CONTROL		IC	
4	PROCUREMENT DOCUMENT CONTROL	Excluded		No. 1
5	INSTRUCTIONS, PROCEDURES, DRAWINGS		IC	
6	DOCUMENT CONTROL		IC	
7	CONTROL OF PURCHASED ITEMS/SERVICES	Excluded		No. 2
8	IDENTIFICATION AND CONTROL OF ITEMS		IC	No. 3
9	CONTROL OF PROCESS		IC	No. 4
10	INSPECTION		IC	No. 5
11	TEST CONTROL		IC	
12	CONTROL OF MEASURING AND TEST EQUIPMENT		IC	
13	HANDLING, STORAGE, AND SHIPPING	Excluded		No. 6
14	INSPECTION, TEST, AND OPERATING STATUS		IC	No. 7
15	CONTROL OF NONCONFORMING ITEMS		IC	
16	CORRECTIVE ACTION		IC	
17	QUALITY ASSURANCE RECORDS		IC	
18	AUDITS		IC	

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A-6700-309 (9-86)

CONSOLIDATED EVALUATION FORM CONTINUATION SHEET

BHL-003-2: Assemble, Measure, and Place Piezometers

Continuation No. 1

Criterion 4: Procurement Document Control

This is considered part of the Item BHL-003-7, Materials and therefore does not apply here.

Continuation No. 2

Criterion 7: Control of Purchased Items/Services

This is considered part of the Item BHL-003-7, Materials and therefore does not apply here.

Continuation No. 3

Criterion 8: Identify and Control of Items

Identification is limited to labeling and marking of piezometer strings as single units at completion of installation.

Continuation No. 4

Criterion 9: Control of Process

No special processes are involved. The process of piezometer installation requires the application of Process Controls only.

Continuation No. 5

Criterion 10: Inspection

Inspection will consist of surveillance of the activity.

Continuation No. 6

Criterion 13: Handling, Shipping and Storage

This is considered part of the Item BHL-003-7, Materials and therefore does not apply here.

Continuation No. 7

Criterion 14: Inspection, Test, and Operating Status

The Shift Report of Operations and surveillance records will document the status of these activities.

3.3.3 Item 3, BHL-003-3: Tubing Tests Item Analysis

Definition

Tubing tests are conducted on piezometer tubing during assembly and installation to detect leaks prior to cementation. Two types of tests are conducted, joint tests and tubing composite tests. Joint tests are conducted on each segment as it is assembled and the tubing composite test is conducted after assembly of the entire piezometer just prior to cementation of the upper cement plug. The tests consist of the isolation of the entire tubing or a segment of the tubing and the application of pressure (either hydrostatic or induced) and the monitoring of changes over time.

Consideration

- Tubing tests are positive confirmation of the sealing of the piezometer tubing. The ability of these tests to confirm the absence of leaks in the piezometer tubes relieves a considerable burden on the identification, tracking and inspection of the materials used. The ability to conduct these tests before the permanent installation makes initial remedial action simple.

Initiating Event A3. External Physical Factors

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event B3. Training, Procedural Deficiency, or Carelessness.

Training, procedural deficiencies, and carelessness could all have the net effect of causing the tubing test to fail and would result in the installation of a leaking piezometer tube. The discussion of Specification Deficiency (C3) below covers the concerns of training, procedural deficiencies, and carelessness as well.

Initiating Event C3. Design (Specification) Deficiency

Specifications include methods to be used, equipment and tolerances.

Potential Failures:

1. Equipment specification

2. Method specification (improper location, installation or test pressure).

3. Improper test duration or acceptance criteria.

Consequences:

1. Failure of packer seals during tests would give false information and might cause unnecessary removal of tubing segments. Improper equipment would be obvious immediately to the trained operator. Remedial action would consist of obtaining the correct equipment.

2. Improper test equipment might result in erroneous pressure ranges, sensitivities or other characteristics that would impede proper tubing test conduct.

3. The consequences of improper test duration or acceptance criteria is the acceptance of a piezometer with leaks for final installation. The failure of a single section tubing test to detect a leak can be corrected by the application of the composite test on the entire piezometer. The failure of a composite test to detect a leak and the subsequent cementation of the piezometer into the hole would be irreversible and the tube would be lost for testing.

Credibility:

1. Credible. The application of improper equipment is possible. This error can be prevented by well defined equipment specifications in procurement of testing services.

2. Credible. Improper method specification is possible. Careful evaluation of tubing test objectives, review of test specifications and application of tests by experienced personnel should reduce potential problems.

3. Credible. Test duration and acceptance criteria errors are possible. The potential for errors can be reduced by preliminary testing of methods or the application of conservative test methods (e.g. higher pressures, longer test times).

Initiating Event D3. Failure of Item (hardware)

Potential Failure:

1. Pressure gauge inaccurate or fails

2. Failure of packer seals

Consequences:

1. The failure of a pressure gauge could give either a false positive or a false negative reading on a test. This could lead to the installation of a faulty section of tubing in the borehole.

2. Failure of packer seals during tests will give false information on tests. This may cause the unnecessary removal of tubing segments. This a minor consequence. Remedial action would involve attempts to reset packer and/or replacement of tubing packer being used in tests (a very minor task).

Credibility:

1. Credible. Pressure gauge failures are possible. Preventative measures could include periodic calibration, and use of proven types of gauges. Calibration and control of gauge necessary although standard industrial gauge is adequate.

2. Credible. Tubing packer failures are possible. No preventative measures necessary, the false negative aspect of a failure and the ease of replacement does not warrant preventative action. This is an industry standard activity.

Initiating Event E3. Fire or Explosion

Non-credible (see discussion under BHL-001-1, Initiating Event E1)

Level Assignment: Level I

The tubing test is critical to the operation of the piezometer and is designated QA Level 1.

GRADING CHECK LIST

Component/Item : BHL-003-3/Tubing Tests

Conditions	QAL
1. Can failure of the item, or activity contribute to a process which allows radioactive materials to reach the uncontrolled environment?	1A
2. Does the item or activity involve or affect public radiological health and safety?	1A
3. Does the item or activity involve waste isolation?	1A
4. Does this activity support or provide data to evaluate performance assessment of repository radionuclide containment capability?	(1A)
5. Can failure of the item or activity cause irretrievable loss of such data?	1A
6. Can the activity involve a significant change to an in-process licensing document?	2A
7. Can the activity involve a change to an in-process major procurement action?	2A
8. Can the activity involve a change to a major in-process construction action?	2A
9. Can failure of the item or activity cause a major cost overrun?	2A
10. Can failure of the item or activity cause a major schedule slippage?	2A
11. Can failure of the item or activity have an adverse impact on major non-radiological engineered systems or structures?	2A
12. Can failure of the item or activity result in personnel injury which must be individually reported to state or Federal agencies?	2B
13. Can failure of the item or activity result in a lost time personnel injury?	2B
If none of the above	3

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NARRATIVE WORK SHEET

SD-BWI-AR-031 Rev 0

BHL-003-3

Item: #3 Tubing Test

HOW CAN IT FAIL? (CONSIDER EACH CONSEQUENTIAL EVENT FROM FORM A-6700-307)

Consequences of a failure of a tubing test would be the installation of leaky tubing in boreholes

AT WHAT STAGE(S) CAN FAILURE OCCUR? (CONSIDER LIFE CYCLE.)

At any stage during installation

HOW EASY IS IT TO FIX?

Easy

WHAT CAN BE DONE TO PREVENT IT?

Calibrate test equipment
Procedures, training

WHAT CAN BE DONE TO MITIGATE CONSEQUENCES OF FAILURE?

Repeat test using different tubing

A-6700-308 (9/86)

CONSOLIDATED EVALUATION FORM SD-BWI-AR-031 Rev 0

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Level of Expertise: 1 [3] 2 [2] 3 4 5

Item: #3 Tubing Test

BHL-003-3

CONDITION "A", TABLE 1 1)
CONDITION "B", TABLE 1 3) DESIGNATED LEVEL 1

Q-LIST?

	CRITERIA	JUSTIFICATION REQUIRED	PROGRAM RESPONSIBILITY	SEE CONTINUATION PAGE
1	ORGANIZATION		IC	
2	QUALITY ASSURANCE		IC	
3	DESIGN CONTROL		IC	
4	PROCUREMENT DOCUMENT CONTROL		IC	
5	INSTRUCTIONS, PROCEDURES, DRAWINGS		IC/SC	
6	DOCUMENT CONTROL		IC	
7	CONTROL OF PURCHASED ITEMS/SERVICES		IC	
8	IDENTIFICATION AND CONTROL OF ITEMS		IC	
9	CONTROL OF PROCESS		IC	No. 1
10	INSPECTION		IC	No. 2
11	TEST CONTROL		IC	
12	CONTROL OF MEASURING AND TEST EQUIPMENT		IC/SC	
13	HANDLING, STORAGE, AND SHIPPING	Excluded		No. 3
14	INSPECTION, TEST, AND OPERATING STATUS		IC	No. 4
15	CONTROL OF NONCONFORMING ITEMS		IC	
16	CORRECTIVE ACTION		IC	
17	QUALITY ASSURANCE RECORDS		IC	
18	AUDITS		IC	

IC=Integrating Contractor SC=Subcontractor

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CONSOLIDATED EVALUATION FORM CONTINUATION SHEET

BHL-003-3: Tubing Tests

Continuation No. 1

Criterion 9: Control of Process

No special processes are involved. The activity of testing piezometer tubes requires the application of Process Controls only.

Continuation No. 2

Criterion 10: Inspection

Inspection will consist of surveillance of the activity.

Continuation No. 3

Criterion 13: Handling, Shipping and Storage

Not applicable under this Item.

Continuation No. 4

Criterion 14: Inspection, Test, and Operating Status

The Shift Report of Operations and surveillance records will document the status of these activities.

3.3.4 Item 4, BHL-003-4: Filter Pack Placement Item Analysis

Definition

Filter packs consist of sand of specific sizes that are placed around the screen sections to allow fluid flow. The sand is placed between the upper and lower cement plug.

Considerations

- Filter packs are placed at predetermined depths using tremie pipes in conjunction with the workover rig.

- This Item addresses placement of the filter pack only and not procurement of the sand.

Initiating Event A4. External Physical Factors

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event B4. Training, Procedural Deficiency or Carelessness

Potential Failure:

1. Improper sand placement (volume or location)

2. Damage to existing piezometers

Consequences:

1. The placement of too much, too little, or the of placing sand packs using improper methods, may cause the top cement plug to be set in the wrong location. This could cause the interval tested to be too small or too large. Large voids in the sand pack may allow cement to reach the screen sections and plug the tube off entirely. No remedial action, short of drilling new borehole, is possible once cement has set.

2. Damage may occur to existing piezometer tubes from the sand delivery mechanism. Serious damage may require the cementation and abandonment of the piezometer. External cementation may be used to attempt repair only under circumstances where other piezometer installations are not affected.

Credibility:

1. Credible. Errors in sand placement are possible. Experienced

installation crews, cross checking of all volume calculations and depths, and the verification of top of sand through "tagging" as well as carefully thought out procedures reflecting this activity should prevent errors.

2. Credible. Damage to existing piezometers is possible. The only preventative mechanism is to reduce the number of trips in and out of the hole with delivery tube and great caution while inserting the mechanism.

Initiating Event C4. Design Deficiency

Potential Failure:

Improper specifications of sand pack sequence or size.

Consequences:

Improper specification of sand pack may allow the entry of cement into the lower levels of the sand pack and possibly plug the piezometer screen or test interval. If this problem is suspected then the application of pressure to the piezometer tube before cement sets may clear screens, otherwise no remedial action possible and interval may be lost.

Credibility:

Credible. Sand pack problems are possible but unlikely. Routine application of back pressure on the piezometer tube will reduce chance of serious effects. Proper review by technical staff should prevent placement problems. Sieve testing of sand prior to installation would make this problem unlikely.

Initiating Event D4. Failure of Item (hardware)

N/A. Sand is not likely to fail itself. Placement or specification error may occur.

Initiating Event E4. Fire or Explosion

N/A under this Item

Level Assignment: Level 1

Due to criticality of sand pack placement on piezometer monitoring, this is assigned a QA Level 1.

GRADING CHECK LIST

Component/Item : BHL-003-4/Filter Pack Placement

Conditions		QAL
1.	Can failure of the item, or activity contribute to a process which allows radioactive materials to reach the uncontrolled environment?	1A
2.	Does the item or activity involve or affect public radiological health and safety?	1A
3.	Does the item or activity involve waste isolation?	1A
4.	Does this activity support or provide data to evaluate performance assessment of repository radionuclide containment capability?	(1A)
5.	Can failure of the item or activity cause irretrievable loss of such data?	1A
6.	Can the activity involve a significant change to an in-process licensing document?	2A
7.	Can the activity involve a change to an in-process major procurement action?	2A
8.	Can the activity involve a change to a major in-process construction action?	2A
9.	Can failure of the item or activity cause a major cost overrun?	2A
10.	Can failure of the item or activity cause a major schedule slippage?	2A
11.	Can failure of the item or activity have an adverse impact on major non-radiological engineered systems or structures?	2A
12.	Can failure of the item or activity result in personnel injury which must be individually reported to state or Federal agencies?	2B
13.	Can failure of the item or activity result in a lost time personnel injury?	2B
If none of the above		3

NARRATIVE WORK SHEET

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BHL-003-4

Item: #4 Filter Pack Placement

HOW CAN IT FAIL? (CONSIDER EACH CONSEQUENTIAL EVENT FROM FORM A-6700-307)

Improper sand placement (volume on location) can cause failure of hydrologic test
Damage to existing piezometers can cause failure
Mis-specification of sand pack sequence or size can cause failure

AT WHAT STAGE(S) CAN FAILURE OCCUR? (CONSIDER LIFE CYCLE.)

Failure can occur at anytime

HOW EASY IS IT TO FIX?

No remedial action is possible once cement has set. Problem easily fixed if cement has not set
Damage to existing piezometers very difficult to fix

WHAT CAN BE DONE TO PREVENT IT?

Verify proper sand size prior to placement
Cross checking volume calculation and depths and verifying top of sand by "tagging" should prevent error
Training and procedure should prevent problems

WHAT CAN BE DONE TO MITIGATE CONSEQUENCES OF FAILURE?

Training

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Item: #4 Filter Pack Placement

BHL-003-4

CONDITION "A", TABLE 1 1)
CONDITION "B", TABLE 1 3) DESIGNATED LEVEL 1

Q-LIST?

CRITERIA	JUSTIFICATION REQUIRED	PROGRAM RESPONSIBILITY	SEE CONTINUATION PAGE
1 ORGANIZATION		IC	
2 QUALITY ASSURANCE		IC	
3 DESIGN CONTROL		IC	
4 PROCUREMENT DOCUMENT CONTROL	Excluded		No. 1
5 INSTRUCTIONS, PROCEDURES, DRAWINGS		IC	
6 DOCUMENT CONTROL		IC	
7 CONTROL OF PURCHASED ITEMS/SERVICES	Excluded		No. 2
8 IDENTIFICATION AND CONTROL OF ITEMS	Excluded		No. 3
9 CONTROL OF PROCESS		IC	No. 4
10 INSPECTION		IC	No. 5
11 TEST CONTROL	Excluded		No. 6
12 CONTROL OF MEASURING AND TEST EQUIPMENT		IC	
13 HANDLING, STORAGE, AND SHIPPING	Excluded		No. 7
14 INSPECTION, TEST, AND OPERATING STATUS		IC	
15 CONTROL OF NONCONFORMING ITEMS		IC	
16 CORRECTIVE ACTION		IC	
17 QUALITY ASSURANCE RECORDS		IC	
18 AUDITS		IC	

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CONSOLIDATED EVALUATION FORM CONTINUATION SHEET

BHL-003-4: Filter Pack Placement

Continuation No. 1

Criterion 4: Procurement Document Control

This is considered part of the Item BHL-003-7, Materials and therefore does not apply here.

Continuation No. 2

Criterion 7: Control of Purchased Items/Services

This is considered part of the Item BHL-003-7, Materials and therefore does not apply here.

Continuation No. 3

Criterion 8: Identify and Control of Items

This is considered part of the Item BHL-003-7, Materials and therefore does not apply here.

Continuation No. 4

Criterion 9: Control of Process

No special processes are involved. The activity of placing filter packs requires the application of Process Controls only.

Continuation No. 5

Criterion 10: Inspection

Inspection will consist of surveillance of the activity.

Continuation No. 6

Criterion 11: Test Control

No test controls are involved.

Continuation No. 7

Criterion 13: Handling, Shipping and Storage

This is considered part of the Item BHL-003-7, Materials and therefore does not apply here.

3.3.5 Item 5, BHL-003-5: Develop Piezometer Item Analysis

Definition

Piezometer development involves the insertion of a pipe into the piezometer tube with two objectives: Verification of piezometer depths and to assure that screen and gravel pack are open. Removal of materials from around the screen may involve either the injection or removal of fluids or both.

Considerations

None

Initiating Event A5. External Physical Factors

Non-credible (see discussion under BHL-001-1, Initiating Event A1)

Initiating Event B5. Training, Procedural Deficiency or Carelessness

Potential Failure:

1. Piezometer tubing damage (physical or pressure damage)

2. Foreign material dropped in piezometer tube.

Consequences:

1. Damage either from impact or from over pressure of pipe may cause loss of piezometer and monitoring horizon. Serious damage may require the cementation and abandonment of the piezometer.

2. Foreign material dropped in the hole may plug or damage screen or piezometer tube. Careful consideration should be given to any fishing jobs for material lost in the piezometer tube. Retrieval may potentially cause more problems than the lost material. Fishing out the material is an option if material is thought to affect the hydrologic measurements.

Credibility:

1. Credible. Damage to piezometers is possible. Preventative mechanisms are to reduce the number of trips in and out of the hole and to carefully control applied pressures. This is largely a matter of operator judgment.

2. Credible. Foreign material could possibly be dropped into

piezometer. Operator caution is the only preventative mechanism.

Initiating Event C5. Design Deficiency

N/A under this Item

Initiating Event D5. Failure of Item (Filter Pack)

Potential Failure:

Plugged screen or filter pack.

Consequences:

A plugged screen or filter pack will prevent the development of the horizon. The development process is intended to reduce or eliminate these sorts of problems. No remedial actions short of new borehole if development process fails.

Credibility:

Credible. Preventative measures as described in "Set Cement Plug" and "Set Filter Pack" sections above.

Initiating Event E5. Fire or Explosion

N/A under this Item

Level Assignment: Level 1

Developing the piezometer is critical to site characterization for understanding transducer measurements from specific horizons and is given an assignment of QA Level 1.

GRADING CHECK LIST

Component/Item : BHL-003-5/Develop Piezometer

Conditions	QAL
1. Can failure of the item, or activity contribute to a process which allows radioactive materials to reach the uncontrolled environment?	1A
2. Does the item or activity involve or affect public radiological health and safety?	1A
3. Does the item or activity involve waste isolation?	1A
4. Does this activity support or provide data to evaluate performance assessment of repository radionuclide containment capability?	(1A)
5. Can failure of the item or activity cause irretrievable loss of such data?	(1A)
6. Can the activity involve a significant change to an in-process licensing document?	2A
7. Can the activity involve a change to an in-process major procurement action?	2A
8. Can the activity involve a change to a major in-process construction action?	2A
9. Can failure of the item or activity cause a major cost overrun?	2A
10. Can failure of the item or activity cause a major schedule slippage?	2A
11. Can failure of the item or activity have an adverse impact on major non-radiological engineered systems or structures?	2A
12. Can failure of the item or activity result in personnel injury which must be individually reported to state or Federal agencies?	2B
13. Can failure of the item or activity result in a lost time personnel injury?	2B
If none of the above	3

NARRATIVE WORK SHEET

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Item: #5 Develop Piezometer

BHL-003-5

HOW CAN IT FAIL? (CONSIDER EACH CONSEQUENTIAL EVENT FROM FORM A-6700-307)

1. Piezometer tubing damage
2. Foreign material dropped in piezometer tube
3. Plugged screen or filter pack

AT WHAT STAGE(S) CAN FAILURE OCCUR? (CONSIDER LIFE CYCLE.)

1. During or after placement of work string in hole
2. During or after placement of work string in hole
3. After placement of cement

HOW EASY IS IT TO FIX?

Depending on stages -- easy to impossible

WHAT CAN BE DONE TO PREVENT IT?

Procedures and training
Care in placement of work string by subcontractor

WHAT CAN BE DONE TO MITIGATE CONSEQUENCES OF FAILURE?

Maintain adequate spare work string
Implement training and procedures for BWIP employees and subcontractors
May have to isolate zone and sacrifice information

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Item: #5 Develop Piezometers

BHL-003-5

CONDITION "A", TABLE 1 — 1)
CONDITION "B", TABLE 1 — 3) DESIGNATED LEVEL 1

Q-LIST?

	CRITERIA	JUSTIFICATION REQUIRED	PROGRAM RESPONSIBILITY	SEE CONTINUATION PAGE
1	ORGANIZATION		IC	
2	QUALITY ASSURANCE		IC	
3	DESIGN CONTROL		IC	
4	PROCUREMENT DOCUMENT CONTROL		IC	
5	INSTRUCTIONS, PROCEDURES, DRAWINGS		IC	
6	DOCUMENT CONTROL		IC	
7	CONTROL OF PURCHASED ITEMS/SERVICES		IC	
8	IDENTIFICATION AND CONTROL OF ITEMS	Excluded		No. 1
9	CONTROL OF PROCESS		IC	No. 2
10	INSPECTION		IC	No. 3
11	TEST CONTROL		IC	
12	CONTROL OF MEASURING AND TEST EQUIPMENT		IC	
13	HANDLING, STORAGE, AND SHIPPING	Excluded		No. 4
14	INSPECTION, TEST, AND OPERATING STATUS		IC	No. 5
15	CONTROL OF NONCONFORMING ITEMS		IC	
16	CORRECTIVE ACTION		IC	
17	QUALITY ASSURANCE RECORDS		IC	
18	AUDITS		IC	

IC-Independent Contractor

CONSOLIDATED EVALUATION FORM CONTINUATION SHEET

BHL-003-5: Develop Piezometers

Continuation No. 1

Criterion 8: Identify and Control of Items

This is considered part of the Item BHL-003-7, Materials and therefore does not apply here.

Continuation No. 2

Criterion 9: Control of Process

No special processes are involved. The activity of developing piezometers requires the application of Process Controls only.

Continuation No. 3

Criterion 10: Inspection

Inspection will consist of surveillance of the activity.

Continuation No. 4

Criterion 13: Handling, Shipping and Storage

No extraneous items are used to develop piezometers and therefore it does not apply here.

Continuation No. 5

Criterion 14: Inspection, Test, and Operating Status

The Shift Report of Operations and surveillance records will document the status of these activities.

3.3.6 Item 6, BHL-003-6: Install and Monitor Transducer Item Analysis

Definition

Piezometer monitoring system and transducer installation includes the installation of the transducers in the boreholes and the subsequent incorporation into a real time data collection and storage system.

Consideration

- Transducer will be placed in the borehole near the ground surface (about 300 foot depth).

- Monitoring system includes transducer, voltage detection device, pressure calculating computer, disk drive recorder and line printer, and an alternate transmission system to the Basalt Technical Data Base (BTDB).

- Steel tape measurements of water levels are used as confirmatory and backup measurements for the transducers on a regular basis.

Initiating Event A6. External Physical Factors

Potential Failures:

Power or transmission line failure.

Consequences:

Temporary loss of data.

Credibility:

Credible. Not serious unless long term. Would affect BTDB transmission only. Backup recording and power systems would continue recording.

Initiating Event B6. Training, Procedural Deficiency or Carelessness

Potential Failure:

Loss of equipment in the hole.

Consequences:

Potential offset in baseline measurement or plug off piezometer tube. Fishing out material if it has impact.

Credibility:
Credible. Operator care required.

Initiating Event C6. Design Deficiency

Potential Failure:

Wrong transducer installed.

Consequences:

Readings below resolution of transducer. Change transducer to correct type.

Credibility:

Credible. Specification review by technical staff.

Initiating Event D6. Failure of Item (Hardware)

Potential Failure:

1. Equipment failure (power, detection, computer, recording of data, transmission lines).

2. Calibration error on the transducer.

3. Software failure.

Consequences:

1. Temporary loss of data. Not extremely critical if failure is not for extended period of time. Steel tape measurements of water levels can be used as backup measurements for the transducers on a regular basis. Fix equipment.

2. Loss or incorrect measurement of hydrologic data. Total failure would be quickly detected. Nonlinearity would be less easily detected. Remedial action would include replacement of defective transducer. Linearity tests could compensate for errors introduced by faulty component. This could be checked against steel tape information.

3. Termination of data collection, miscalculation of pressures.

Credibility:

1. Credible. The failure of the equipment for the reasons stated

above is possible. The use of backup equipment should mitigate potential problems. The data collected by this equipment may be of a critical nature for site characterization. If a failure were to go undetected for an extended period, it could have a significant impact on the project.

2. Credible. Periodic calibration of transducer and timely examination of data from monitoring network will lessen the impact of failure.

3. Credible. Use of proven software will mitigate the potential of failure. It is possible to rely on steel tape for measurements should the software prove faulty. If software errors are detected, it will become necessary to fix the software.

Initating Event E6. Fire or Explosion

Potential Failure:

Building or range fire

Consequences:

Termination of computer monitoring.

Credibility:

Credible. Standard fire prevention methods. Resort to steel tape backup.

Level Assignment: Level 1

Impact on data collection is critical to site characterization and is assigned QA Level 1.

GRADING CHECK LIST

Component/Item : BHL-003-6/Install and Monitor Transducer

Conditions	QAL
1. Can failure of the item, or activity contribute to a process which allows radioactive materials to reach the uncontrolled environment?	1A
2. Does the item or activity involve or affect public radiological health and safety?	1A
3. Does the item or activity involve waste isolation?	1A
4. Does this activity support or provide data to evaluate performance assessment of repository radionuclide containment capability?	(1A)
5. Can failure of the item or activity cause irretrievable loss of such data?	1A
6. Can the activity involve a significant change to an in-process licensing document?	2A
7. Can the activity involve a change to an in-process major procurement action?	2A
8. Can the activity involve a change to a major in-process construction action?	2A
9. Can failure of the item or activity cause a major cost overrun?	2A
10. Can failure of the item or activity cause a major schedule slippage?	2A
11. Can failure of the item or activity have an adverse impact on major non-radiological engineered systems or structures?	2A
12. Can failure of the item or activity result in personnel injury which must be individually reported to state or Federal agencies?	2B
13. Can failure of the item or activity result in a lost time personnel injury?	2B
If none of the above	3

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BHL-003-6

Item: #6 Install and Monitor Transducer

HOW CAN IT FAIL? (CONSIDER EACH CONSEQUENTIAL EVENT FROM FORM A-6700-307)

1. Loss of equipment in hole
2. Power failure
3. Equipment failure

AT WHAT STAGE(S) CAN FAILURE OCCUR? (CONSIDER LIFE CYCLE.)

1. At any time after placement
2. Any time
3. Any time

HOW EASY IS IT TO FIX?

1. Difficult
2. Easy, but may have loss of some information
3. Easy, but may have loss of some information

WHAT CAN BE DONE TO PREVENT IT?

Procedures and training in handling, have back-up generator in the event of a power failure

WHAT CAN BE DONE TO MITIGATE CONSEQUENCES OF FAILURE?

1. Procedures and training (2 and 3), use steel tape to measure water level as back up
2,3. Back up power supply and spare equipment
1. Failure, if unable to fish transducer and piezometer is plugged (loss of information)

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Level of Expertise: 2 (1), 1 (2), 3 (3), ( ) (4), ( ) (5)

Item: #6 Install and Monitor Transducer

BHL-003-6

CONDITION "A", TABLE 1: 1

CONDITION "B", TABLE 1: 3

DESIGNATED LEVEL 1

Q-LIST?

	CRITERIA	JUSTIFICATION REQUIRED	PROGRAM RESPONSIBILITY	SEE CONTINUATION PAGE
1	ORGANIZATION		IC	
2	QUALITY ASSURANCE		IC	
3	DESIGN CONTROL		IC	
4	PROCUREMENT DOCUMENT CONTROL	Excluded		No. 1
5	INSTRUCTIONS, PROCEDURES, DRAWINGS		IC	
6	DOCUMENT CONTROL		IC	
7	CONTROL OF PURCHASED ITEMS/SERVICES	Excluded		No. 2
8	IDENTIFICATION AND CONTROL OF ITEMS		IC	
9	CONTROL OF PROCESS		IC	No. 3
10	INSPECTION		IC	No. 4
11	TEST CONTROL		IC	
12	CONTROL OF MEASURING AND TEST EQUIPMENT		IC	
13	HANDLING, STORAGE, AND SHIPPING	Excluded		No. 5
14	INSPECTION, TEST, AND OPERATING STATUS		IC	No. 6
15	CONTROL OF NONCONFORMING ITEMS		IC	
16	CORRECTIVE ACTION		IC	
17	QUALITY ASSURANCE RECORDS		IC	
18	AUDITS		IC	

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CONSOLIDATED EVALUATION FORM CONTINUATION SHEET

BHL-003-6: Install and Monitor Transducer

Continuation No. 1

Criterion 4: Procurement Document Control
This is considered part of the Item BHL-003-7, Materials and therefore does not apply here.

Continuation No. 2

Criterion 7: Control of Purchased Items/Services

This is considered part of the Item BHL-003-7, Materials and therefore does not apply here.

Continuation No. 3

Criterion 9: Control of Process

No special processes are involved. The activity of installing and monitoring transducers requires the application of Process Controls only.

Continuation No. 4

Criterion 10: Inspection

Inspection will consist of surveillance of the activity.

Continuation No. 5

Criterion 13: Handling, Shipping and Storage

This is considered part of the Item BHL-003-7, Materials and therefore does not apply here.

Continuation No. 6

Criterion 14: Inspection, Test, and Operating Status

The Shift Report of Operations and surveillance records will document the status of these activities.

3.3.7 Item 7, BHL-003-7; Materials Item Analysis

Definition

Materials utilized in the placement, assembly, and monitoring of piezometers are piezometer tubing, joint material, screens, seating nipples, standing valves, tubing collars, cement, centralizer, cement additives, filter sand, transducers, voltage meters, computers, telemetry and recording equipment. This item addresses the procurement of these materials.

Considerations

- Materials used in the piezometer assembly and as components do not need to be Level 1 materials. Verification of the critical aspects of materials such as tubing tests for tubing integrity, calibration of transducers and verification of computer programs makes procurement of standard industrial grade materials sufficient for application to the Level 1 piezometer activity.

- Materials that require further evaluation before use will be examined as part of the assembly and test process.

- Welding of centralizers is included under this section for the reasons described in BHL-004-2, Initiating Event C2.

Initiating Event A7. External Physical Factors

N/A under this Item

Initiating Event B7. Training, Procedural Deficiency or Carelessness

Potential Failure:

1. Improper material ordered or received.

2. Physical damage prior to the final use.

3. Improper utilization.

4. Mis-specification of piezometer materials.

Consequences:

1. A schedule delay is the major consequence of receiving the wrong material for a particular application. If the wrong material were inadvertantly used it may have an adverse affect on the

monitoring facility depending on the material and its particular application.

2. A schedule delay is the major consequence of damaged material. Depending on what point the material is damaged, the severity of the damage, and which material is damaged, a differential impact ranging from negligable to serious, would be realized.

3. A differential impact ranging from negligable to serious would result from utilizing the correct material in an improper way. This impact is dependent on the particular material and its application.

Credibility:

1. Non-credible: upon receipt, materials are subject to exhaustive testing and/or scrutiny to assure that the required material has been received. Schedule impacts are difficult or impossible to assess prior to actual delays.

2. Non-credible: proper care and handling of materials will insure that damage does not occur. Most, if not all, of the critical materials cited above have backups on hand should material be accidently damaged.

3. Non-credible: the many established procedures, training sessions and check/hold points will minmize the changes of improper utilization of materials.

Initiating Event C7. Design Deficiency

N/A under this Item

Initiating Event D7. Failure of Item (hardware)

N/A under this Item

Initiating Event E7. Fire or Explosion

N/A under this Item

Level Assignment: Level 3

The quality of materials used in piezometers is verified as part of assembly. No extraordinary procurement controls need be placed on material acquisition. Verification of the correct materials is necessary prior to installation.

GRADING CHECK LIST

Component/Item : BHL-003-7/Materials

Conditions		QAL
1.	Can failure of the item, or activity contribute to a process which allows radioactive materials to reach the uncontrolled environment?	1A
2.	Does the item or activity involve or affect public radiological health and safety?	1A
3.	Does the item or activity involve waste isolation?	1A
4.	Does this activity support or provide data to evaluate performance assessment of repository radionuclide containment capability?	1A
5.	Can failure of the item or activity cause irretrievable loss of such data?	1A
6.	Can the activity involve a significant change to an in-process licensing document?	2A
7.	Can the activity involve a change to an in-process major procurement action?	2A
8.	Can the activity involve a change to a major in-process construction action?	2A
9.	Can failure of the item or activity cause a major cost overrun?	2A
10.	Can failure of the item or activity cause a major schedule slippage?	2A
11.	Can failure of the item or activity have an adverse impact on major non-radiological engineered systems or structures?	2A
12.	Can failure of the item or activity result in personnel injury which must be individually reported to state or Federal agencies?	2B
13.	Can failure of the item or activity result in a lost time personnel injury?	2B
If none of the above		(3)

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NARRATIVE WORK SHEET

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BHL-003-7

Item: #7 Materials

HOW CAN IT FAIL? (CONSIDER EACH CONSEQUENTIAL EVENT FROM FORM A-6700-307)

Improper materials ordered
Physical damage prior to final use
Improper utilization

AT WHAT STAGE(S) CAN FAILURE OCCUR? (CONSIDER LIFE CYCLE.)

At any stage

HOW EASY IS IT TO FIX?

Easy prior to installation

WHAT CAN BE DONE TO PREVENT IT?

Establish quality standards prior to ordering and establishing check points until final use
Procedures in handling and using

WHAT CAN BE DONE TO MITIGATE CONSEQUENCES OF FAILURE?

Procedures, training and established check points until final use
Replace when and if possible

A-6700-308 (9/86)

CONSOLIDATED EVALUATION FORM SD-BWI-AR-031 Rev 0

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Level of Expertise: 1 [5] 2 [ ] 3 [3] 4 [ ] 5 [ ]

Item: #7 Materials

BHL-003-7
CONDITION "A", TABLE 1 3
CONDITION "B", TABLE 1 3
DESIGNATED LEVEL 3

Q-LIST?

CRITERIA	JUSTIFICATION REQUIRED	PROGRAM RESPONSIBILITY	SEE CONTINUATION PAGE
1 ORGANIZATION		IC	
2 QUALITY ASSURANCE		IC	
3 DESIGN CONTROL		IC	
4 PROCUREMENT DOCUMENT CONTROL		IC	
5 INSTRUCTIONS, PROCEDURES, DRAWINGS		IC	
6 DOCUMENT CONTROL		IC	
7 CONTROL OF PURCHASED ITEMS/SERVICES		IC	
8 IDENTIFICATION AND CONTROL OF ITEMS		IC	No. 1
9 CONTROL OF PROCESS	Excluded		No. 2
10 INSPECTION		IC	No. 3
11 TEST CONTROL	Excluded		No. 4
12 CONTROL OF MEASURING AND TEST EQUIPMENT	Excluded		No. 5
13 HANDLING, STORAGE, AND SHIPPING		IC	
14 INSPECTION, TEST, AND OPERATING STATUS		IC	No. 6
15 CONTROL OF NONCONFORMING ITEMS		IC	
16 CORRECTIVE ACTION		IC	
17 QUALITY ASSURANCE RECORDS		IC	
18 AUDITS		IC	

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A-6700-309 (9-86)

CONSOLIDATED EVALUATION FORM CONTINUATION SHEET

BHL-003-7: Materials

Continuation No. 1

Criterion 8: Identification and Control of Items

Identification and verification of specifications of materials grade, quantity and dimension for general acceptability only.

Continuation No. 2

Criterion 9: Control of Process

No special processes or process controls are involved under this Item.

Continuation No. 3

Criterion 10: Inspection

Receiving inspection only.

Continuation No. 4

Criterion 11: Test Control

No test are conducted as part of this Item.

Continuation No. 5

Criterion 12: Control of Measuring and Test Equipment

No measuring and test equipment required as part of this Item.

Continuation No. 6

Criterion 14: Inspection, Test, and Operating Status

Materials acceptance only.

3.4 BOREHOLE GEOLOGIC, GEOPHYSICAL LOGGING AND DIRECTIONAL SURVEYS COMPONENT SUMMARY (BHL-004)

Items identified under Component BHL-004		QA Level
Item 1.	Open and Cased Hole Geophysical Logs and Directional Surveys	1
Item 2.	Developmental Geophysical Log	3
Item 3.	Borehole Geologic Logs	3

Initiating Events

Initiating Event A. External Physical Factors

Initiating Event B. Training, Procedural Deficiency, Carelessness

Initiating Event C. Design Deficiency

Initiating Event D. Failure of Item

Initiating Event E. Fire and Explosion

BHL-004

MATRIX OF INTERACTIONS

ITEMS (from numbered list, attached) *

INITIATING EVENTS	1	2	3	4	5	6	7	8	9	10	11	12	13	14
A - External Physical Factors	X	0	0											
B - Training Deficiency	X	0	0											
C - Design Deficiency	X	0	0											
D - Failure of Item	X	0	0											
E - Fire and Explosion	0	0	0											

X = Item/event have potential for unacceptable interaction.

(X) = Item/event reviewed and rejected as not consequential.

0 = Item/event reviewed and rejected as not consequential

A-6700-307

* See Component Summary (previous page) for Items Identified

3.4.1 Item 1, BHL-004-1; Open and Cased Hole Logs and Directional Surveys Item Analysis

Definition

Borehole geophysical logs are records produced by different testing methods and are used to evaluate various characteristics of the downhole formations. Different types of logs are required to create a complete understanding of lithologic parameters. Methods include qualitative visual observation methods (e.g. down hole television), highly quantitative physical properties (e.g. acoustic) and methods to determine physical location of the borehole at depth (gyroscopic methods). Major items of interest derived from the borehole geophysical logs are location of flow contacts and unique identification of some stratigraphic horizons. Borehole geophysical logs are also used to evaluate construction aspects of the borehole.

Borehole geophysical logs to be applied include:

1. 16" and 64" short normal electrical resistivity
2. Pad-type microresistivity
3. Medium and deep laterolog resistivity
4. Medium and deep induction resistivity
5. Spontaneous potential (SP)
6. Magnetic gradiometer
7. Bond log
8. Pad-type gamma-gamma bulk density
9. Compensated thermal neutron porosity
10. Pad-type epithermal neutron porosity
11. Passive gamma ray
12. Passive spectral gamma ray
13. Borehole compensated sonic
14. Full waveform sonic
15. Three-arm caliper
16. Four-arm caliper
17. Temperature
18. Borehole television
19. Well orientation survey (gyroscope)

Initiating Event A1. External Physical Factors

Potential Failure:

Hole caving with tool in hole

Consequences:

The consequence of a tool loss under these conditions is the loss

of the equipment. Tools with radioactive sources risk the loss of the source. This is a serious problem from an environmental stand point. Remedial action may constitute fishing out the cable and tool or in the worst case, drilling it out.

Credibility:

Credible. Loss of tool is possible. Stabilizing fluid balance in borehole, when questions about hole stability exist, will minimize the probability of tool loss.

Initiating Event B1. Training, Procedural Deficiencies, and Carelessness

Potential Failure:

Improper equipment operation

Consequence:

Erroneous location or identification of hydrologic monitoring horizon as well as incorrect structural or stratigraphic interpretation. If discovered prior to piezometer installation, logs can be rerun without great impact.

Credibility:

Credible. Training, experience, and cross checking against other data sets will prevent erroneous identification or mis-locations.

Initiating Event C1. Design Deficiency (of Logging Program)

N/A under this Item

Initiating Event D1. Failure of Item (hardware)

Potential Failure:

1. Draw works failure

2. Recording or geophysical tool equipment failure

Consequence:

1. Failure of draw works could cause the loss of the tool. Remedial action would consist of fishing tools out of hole.

2. Failure of recording equipment or geophysical tool would cause

the loss of or incorrect values for data. Remedial action would be to repair equipment and rerun log.

Credibility:

1. Credible. Periodic preventative maintenance and regular visual examination will prevent problems.

2. Credible. Analog baseline recording and operational checks and calibrations will prevent these problems.

Initiating Event E1. Fire and Explosion

N/A under this Item

Level Assignment: Level 1

The necessity of these data for piezometer placement and structural interpretation associated with site characterization, designates this as a QA Level 1 Item.

GRADING CHECK LIST

Component/Item : BHL-004-1/Open and Cased Hole Logs and Surveys

Conditions	QAL
1. Can failure of the item, or activity contribute to a process which allows radioactive materials to reach the uncontrolled environment?	1A
2. Does the item or activity involve or affect public radiological health and safety?	1A
3. Does the item or activity involve waste isolation?	1A
4. Does this activity support or provide data to evaluate performance assessment of repository radionuclide containment capability?	(1A)
5. Can failure of the item or activity cause irretrievable loss of such data?	1A
6. Can the activity involve a significant change to an in-process licensing document?	2A
7. Can the activity involve a change to an in-process major procurement action?	2A
8. Can the activity involve a change to a major in-process construction action?	2A
9. Can failure of the item or activity cause a major cost overrun?	2A
10. Can failure of the item or activity cause a major schedule slippage?	2A
11. Can failure of the item or activity have an adverse impact on major non-radiological engineered systems or structures?	2A
12. Can failure of the item or activity result in personnel injury which must be individually reported to state or Federal agencies?	2B
13. Can failure of the item or activity result in a lost time personnel injury?	2B
If none of the above	3

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NARRATIVE WORK SHEET

SD-BWI-AR-031 Rev 0

BHL-004-1

Item: #1 Open and Cased Hole Logs and Directional Surveys

HOW CAN IT FAIL? (CONSIDER EACH CONSEQUENTIAL EVENT FROM FORM A-6700-307)

Loss of tool and radioactive source
Misidentification or mislocation of stratigraphic horizon
Draw works failure
Recording equipment failure

AT WHAT STAGE(S) CAN FAILURE OCCUR? (CONSIDER LIFE CYCLE.)

Failure can occur at any stage

HOW EASY IS IT TO FIX?

If discovered prior to piezometer installation or before borehole is cased, corrective action is very easy
Failure of recording equipment is easy to fix

WHAT CAN BE DONE TO PREVENT IT?

Have qualified operator to run logs
Require subcontractor to maintain adequate maintenance
Condition hole as required and run caliper logs last to prevent loose material from falling in hole

WHAT CAN BE DONE TO MITIGATE CONSEQUENCES OF FAILURE?

Cave material and tools can be drilled out of hole
Borehole can be relogged
Maintain adequate spare parts

A-6700-308 (9/86)

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CONSOLIDATED EVALUATION FORM

SD-BWI-AR-031 Rev 0

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BHL-004-1

CONDITION "A", TABLE 1 1)
) DESIGNATED
CONDITION "B", TABLE 1 3) LEVEL 1

Item: #1 Open and Cased Hole Geophysical Logs and Directional Surveys

Q-LIST?

CRITERIA	JUSTIFICATION REQUIRED	PROGRAM RESPONSIBILITY	SEE CONTINUATION PAGE
1 ORGANIZATION		IC	
2 QUALITY ASSURANCE		IC	
3 DESIGN CONTROL		IC	No. 1
4 PROCUREMENT DOCUMENT CONTROL		IC	
5 INSTRUCTIONS, PROCEDURES, DRAWINGS		IC	
6 DOCUMENT CONTROL		IC	
7 CONTROL OF PURCHASED ITEMS/SERVICES		IC	
8 IDENTIFICATION AND CONTROL OF ITEMS	Excluded		No. 2
9 CONTROL OF PROCESS		IC	No. 3
10 INSPECTION		IC	No. 4
11 TEST CONTROL		IC	
12 CONTROL OF MEASURING AND TEST EQUIPMENT		IC/SC	
13 HANDLING, STORAGE, AND SHIPPING	Excluded		No. 5
14 INSPECTION, TEST, AND OPERATING STATUS		IC	No. 6
15 CONTROL OF NONCONFORMING ITEMS		IC	
16 CORRECTIVE ACTION		IC	
17 QUALITY ASSURANCE RECORDS		IC	
18 AUDITS		IC	

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A-6700-309 (9 86)

CONSOLIDATED EVALUATION FORM CONTINUATION SHEET

BHL-004-1: Open and Cased Hole Geophysical Logs and Directional Surveys

Continuation No. 1

Criterion 3: Design Control

Open and cased hole logs are used to determine as-built configuration of borehole. Design control is included for this reason. No design control is exercised for logging equipment itself.

Continuation No. 2

Criterion 8: Identification and Control of Items

No controlled items are required in this activity.

Continuation No. 3

Criterion 9: Control of Process

No special processes are involved. The routine process of geophysical logging requires the application of Process Controls only.

Continuation No. 4

Criterion 10: Inspection

Inspection will consist of surveillance of the activity.

Continuation No. 5

Criterion 13: Handling, Shipping and Storage

Does not apply to this activity.

Continuation No. 6

Criterion 14: Inspection, Test, and Operating Status

The Shift Report of Operations and surveillance records will document the status of this activity.

3.4.2 Item 2, BHL-004-2; Developmental Log Item Analysis

Definition

Developmental geophysical logs are new logs being tested for use in the Columbia River Basalts. Such logs will be run in conjunction with the standard open and cased hole logs, taking advantage of the opportunity to test their usefulness during the drilling of these boreholes. The only tool in this category at this time is the dielectric log.

Consideration

- This developmental log is being used for method evaluation and will not be used for site characterization activities.

Initiating Event A2. External Physical Factors

Potential Failure:

Hole cave with tool in hole.

Consequences:

The consequences of a tool loss is the loss of the equipment itself. No radiological source tools are under this category and no hazard exists from that standpoint. Remedial action would involve fishing or drilling equipment out.

Credibility:

Non-credible. The loss of a tool is possible but the ability to stabilize fluid balance in borehole reduces likelihood and the lack of major impact makes it non-credible.

Initiating Event B2. Training, Procedural Deficiencies, and Carelessness

Potential Failure:

Improper equipment operation

Consequences:

Improper equipment operation will result in the erroneous evaluation of tool applications in the basalt environment. The impact on the program as a whole would be minor because alternate methods are normally available to approximate information from these geophysical tools.

Credibility:

Non-credible. Errors are possible but lack of major impact makes developmental logging non-credible.

Initiating Event C2. Failure of Item

Potential Failure:

1. Draw works failure.

2. Recording or geophysical equipment failure.

Consequences:

1. Draw works failures could cause the loss of the geophysical tool. Remedial action would consist of fishing out the tool.

2. The failure of recording equipment or the geophysical tool would cause the loss of data or the recording of incorrect values. Remedial action would be to repair equipment and rerun logs.

Credibility:

1. Non-credible. No impact on data to be used in site characterization.

2. Non-credible. No impact on data to be used in site characterization.

Level Assignment: Level 3

Data gathered by this developmental geophysical log will not be used in site characterization.

GRADING CHECK LIST

Component/Item : BHL-004-2/Developmental Log(s)

Conditions		QAL
1.	Can failure of the item, or activity contribute to a process which allows radioactive materials to reach the uncontrolled environment?	1A
2.	Does the item or activity involve or affect public radiological health and safety?	1A
3.	Does the item or activity involve waste isolation?	1A
4.	Does this activity support or provide data to evaluate performance assessment of repository radionuclide containment capability?	1A
5.	Can failure of the item or activity cause irretrievable loss of such data?	1A
6.	Can the activity involve a significant change to an in-process licensing document?	2A
7.	Can the activity involve a change to an in-process major procurement action?	2A
8.	Can the activity involve a change to a major in-process construction action?	2A
9.	Can failure of the item or activity cause a major cost overrun?	2A
10.	Can failure of the item or activity cause a major schedule slippage?	2A
11.	Can failure of the item or activity have an adverse impact on major non-radiological engineered systems or structures?	2A
12.	Can failure of the item or activity result in personnel injury which must be individually reported to state or Federal agencies?	2B
13.	Can failure of the item or activity result in a lost time personnel injury?	2B
If none of the above		(3)

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NARRATIVE WORK SHEET

SD-BWI-AR-031 Rev 0

BHL-004-2

Item: #2 Developmental Geophysical Log

HOW CAN IT FAIL? (CONSIDER EACH CONSEQUENTIAL EVENT FROM FORM A-6700-307)

1. Improper equipment operation
2. Equipment failure
3. Hole accessibility

AT WHAT STAGE(S) CAN FAILURE OCCUR? (CONSIDER LIFE CYCLE.)

Any time during the logging operations

HOW EASY IS IT TO FIX?

1 & 2. Easy
3. Easy to difficult depending on problem

WHAT CAN BE DONE TO PREVENT IT?

1. Have qualified operator to run logs
2. Require subcontractor to maintain adequate maintenance program for his equipment
3. Condition hole as required and run calipers logs last to prevent loose material from falling in hole

WHAT CAN BE DONE TO MITIGATE CONSEQUENCES OF FAILURE?

1. Procedures and training of operator
2. Maintain adequate spare parts
3. Condition hole prior to logging

A-6700-308 (9/86)

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CONSOLIDATED EVALUATION FORM

SD-BWI-AR-031 Rev 0

BHL-004-2

Name: F. V. Roeck

Level of Expertise: 1 [2] 2 [5] 3 [ ] 4 [ ] 5 [ ]

CONDITION "A", TABLE 1 3)
CONDITION "B", TABLE 1 3) DESIGNATED LEVEL 3

Item: #2 Developmental Geophysical Log

Q-LIST?

CRITERIA	JUSTIFICATION REQUIRED	PROGRAM RESPONSIBILITY	SEE CONTINUATION PAGE
1 ORGANIZATION		IC	
2 QUALITY ASSURANCE		IC	
3 DESIGN CONTROL	Excluded		No. 1
4 PROCUREMENT DOCUMENT CONTROL		IC	
5 INSTRUCTIONS, PROCEDURES, DRAWINGS		IC	
6 DOCUMENT CONTROL		IC	
7 CONTROL OF PURCHASED ITEMS/SERVICES		IC	
8 IDENTIFICATION AND CONTROL OF ITEMS	Excluded		No. 2
9 CONTROL OF PROCESS		IC	No. 3
10 INSPECTION		IC	No. 4
11 TEST CONTROL		IC	
12 CONTROL OF MEASURING AND TEST EQUIPMENT		IC	
13 HANDLING, STORAGE, AND SHIPPING	Excluded		No. 5
14 INSPECTION, TEST, AND OPERATING STATUS		IC	No. 6
15 CONTROL OF NONCONFORMING ITEMS		IC	
16 CORRECTIVE ACTION		IC	
17 QUALITY ASSURANCE RECORDS		IC	
18 AUDITS		IC	

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A-6700-309 (9-86)

CONSOLIDATED EVALUATION FORM CONTINUATION SHEET

BHL-004-2: Developmental Geophysical Logs

Continuation No. 1

Criterion 3: Design Control

No design controls included.

Continuation No. 2

Criterion 8: Identification and Control of Items

No control or identification is required in this activity.

Continuation No. 3

Criterion 9: Control of Process

No special processes are involved. The routine process of geophysical logging requires the application of Process Controls only.

Continuation No. 4

Criterion 10: Inspection

Inspection will consist of surveillance of the activity.

Continuation No. 5

Criterion 13: Handling, Shipping and Storage

Does not apply to this activity.

Continuation No. 6

Criterion 14: Inspection, Test, and Operating Status

The Shift Report of Operations and surveillance records will document the status of this activity.

3.4.3 Item 3, BHL-004-3; Borehole Geologic Logs Item Analysis

Definition

The borehole geologic log is a record of geologic features penetrated by the drill. The log is representative of lithology as described from the chip samples collected.

Consideration

- The geologic log will be used for informational purposes only. Information on the logs will not be used in site characterization.

Initiating Event A3. External Physical Impact

N/A under this Item

Initiating Event B3. Training, Procedural Deficiency, and Carelessness

Potential Failure:

1. Sample improperly described
2. Activity/Item not documented
3. Lost logs

Consequences:

1. Samples not properly described may raise concerns about the geology. However, samples are stored in the Hanford Geotechnical Sample Library (HGSL) and can be referenced to clear up ambiguities.
2. No record of activity/Item
3. Temporary loss of information/data.

Credibility:

1. Non-credible. The possibility of a sample being described incorrectly is small. Geologists are trained to complete the log forms. Additionally, each log is reviewed and approved to assure adequacy.
2. Non-credible. The log is the record of the activity performed. If the activity is not documented, the sample will be logged/re-logged. All samples are stored in the HGSL.

3. Non-credible. If logs are lost, sample will be re-logged. All samples are stored in the HGSL.

Initiating Event C3. Design Deficiency (of Logging Program)

N/A under this item.

Initiating Event D3. Failure of Item and/or Material

N/A under this Item

Initiating Event E3. Fire and Explosion

N/A under this Item

Level Assignment: Level 3

This geologic log is informational only and is not to be used in site characterization and is designated QA Level 3.

GRADING CHECK LIST

Component/Item : BHL-004-3/Borehole Geologic Logs

Conditions	QAL
1. Can failure of the item, or activity contribute to a process which allows radioactive materials to reach the uncontrolled environment?	1A
2. Does the item or activity involve or affect public radiological health and safety?	1A
3. Does the item or activity involve waste isolation?	1A
4. Does this activity support or provide data to evaluate performance assessment of repository radionuclide containment capability?	1A
5. Can failure of the item or activity cause irretrievable loss of such data?	1A
6. Can the activity involve a significant change to an in-process licensing document?	2A
7. Can the activity involve a change to an in-process major procurement action?	2A
8. Can the activity involve a change to a major in-process construction action?	2A
9. Can failure of the item or activity cause a major cost overrun?	2A
10. Can failure of the item or activity cause a major schedule slippage?	2A
11. Can failure of the item or activity have an adverse impact on major non-radiological engineered systems or structures?	2A
12. Can failure of the item or activity result in personnel injury which must be individually reported to state or Federal agencies?	2B
13. Can failure of the item or activity result in a lost time personnel injury?	2B
If none of the above	(3)

NARRATIVE WORK SHEET

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SD-BWI-AR-031 Rev 0

BHL-004-3

Item: #3 Borehole Gologic Log

HOW CAN IT FAIL? (CONSIDER EACH CONSEQUENTIAL EVENT FROM FORM A-6700-307)

Sample improperly described
If activity/item not documented
Loss of borehole geologic logs

AT WHAT STAGE(S) CAN FAILURE OCCUR? (CONSIDER LIFE CYCLE.)

Failure can occur at anytime

HOW EASY IS IT TO FIX?

Problem is very easily corrected so long as samples are saved

WHAT CAN BE DONE TO PREVENT IT?

Training and procedures should prevent failure

WHAT CAN BE DONE TO MITIGATE CONSEQUENCES OF FAILURE?

Samples should be stored in the Hanford Geotechnical Sample Library in case relogging or verification is necessary

A-6700-308 (9/86)

CONSOLIDATED EVALUATION FORM SD-BWI-AR-031 Rev 0

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Item: #3 Borehole Geologic Log

Level of Expertise: 1 [3] 2 [1] 3 [ ] 4 [ ] 5 [ ]

BHL-004-3

CONDITION "A", TABLE 1 3

CONDITION "B", TABLE 1 3

DESIGNATED LEVEL 3

Q-LIST?

	CRITERIA	JUSTIFICATION REQUIRED	PROGRAM RESPONSIBILITY	SEE CONTINUATION PAGE
1	ORGANIZATION		IC	
2	QUALITY ASSURANCE		IC	
3	DESIGN CONTROL	Excluded		No. 1
4	PROCUREMENT DOCUMENT CONTROL	Excluded		No. 2
5	INSTRUCTIONS, PROCEDURES, DRAWINGS		IC	
6	DOCUMENT CONTROL		IC	
7	CONTROL OF PURCHASED ITEMS/SERVICES	Excluded		No. 3
8	IDENTIFICATION AND CONTROL OF ITEMS	Excluded		No. 4
9	CONTROL OF PROCESS		IC	No. 5
10	INSPECTION	Excluded		No. 6
11	TEST CONTROL	Excluded		No. 7
12	CONTROL OF MEASURING AND TEST EQUIPMENT		IC	
13	HANDLING, STORAGE, AND SHIPPING		IC	No. 8
14	INSPECTION, TEST, AND OPERATING STATUS	Excluded		No. 9
15	CONTROL OF NONCONFORMING ITEMS		IC	
16	CORRECTIVE ACTION		IC	
17	QUALITY ASSURANCE RECORDS		IC	
18	AUDITS		IC	

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CONSOLIDATED EVALUATION FORM CONTINUATION SHEET

BHL-004-3: Borehole Geologic Logs

Continuation No. 1

Criterion 3: Design Control

Does not apply to log forms.

Continuation No. 2

Criterion 4: Procurement Document Control

No procurement involved.

Continuation No. 3

Criterion 7: Control of Purchased Items/Services

No items or services involved.

Continuation No. 4

Criterion 8: Identification and Control of Items

Handled under document control.

Continuation No. 5

Criterion 9: Control of Process

No special processes or process controls are involved.

Continuation No. 6

Criterion 10: Inspection

Inspection will consist of surveillance of the activity.

Continuation No. 7

Criterion 11: Test Control

No tests involved.

Continuation No. 8

Criterion 13: Handling, Shipping and Storage

Borehole geologic logs are handled according to document control. Chip samples themselves are handled and controlled as described in BHL-002-8 (Chip Samples).

Continuation No. 9

Criterion 14: Inspection, Test, and Operating Status

Does not apply to this Item.

4.0 REFERENCES

DOE-RL BQARD

Basalt Quality Assurance Requirements Document, U.S. Department of Energy. Richland Operations Office, 1986, DOE/RL 86-1