CRWMS/M&O

Design Analysis Cover Sheet

Complete only applicable items.

①

QA: L

Page: 1 Of: 12

SCP5: N/A

2. DESIGN ANALYSIS TITLE			
QA Classification Analysis of the Starter Tunnel and South Portal Headwall (CI: BABEAA000) (SCP5: N/A)			
3. DOCUMENT IDENTIFIER (Including Rev. No.)			4. TOTAL PAGES
BABEAA000-01717-2200-00098 Rev 01			12
5. TOTAL ATTACHMENTS		6. ATTACHMENT NUMBERS - NO. OF PAGES IN EACH	
Two		I/1, II/7	
	Printed Name	Signature	Date
7. Originator	Dealis W. Gwyn	<i>Dealis W. Gwyn</i>	04/18/96
8. Checker	Robert F. Wemheuer	<i>Robert F. Wemheuer</i>	04/18/96
9. Lead Design Engineer	Robert F. Wemheuer	<i>Robert F. Wemheuer</i>	04/18/96
10. QA Manager	<i>Oscar L. Gilsdorf</i>	<i>O. L. Gilsdorf</i>	04/13/96
11. Department Manager	Peter S. Hastings	<i>Peter S. Hastings</i>	19 Apr 96
12. REMARKS			
<p>This revision of the classification analysis supersedes <i>QA Classification Analysis of the Starter Tunnel Portion of Portals</i> (CI: BABEAA000), BABEAA000-01717-2200-00098 Rev 00 in its entirety. This analysis concludes that the Starter Tunnel is QA Classification 2 while the South Portal Headwall does not meet any of the QA 1-7 Classification criteria. (Note: These conclusions are based on the preserving the integrity of the Starter Tunnel and the South Portal Headwall being allocated to Ground Support Systems.)</p> <p>The minimum QA-2 criterion for the Starter Tunnel is presented in the analysis.</p> <p>This classification analysis will be distributed as a controlled document in accordance with QAP-6-1.</p>			

Design Analysis Revision Record

Complete only applicable items.

①

Page: 2 Of: 12

2. DESIGN ANALYSIS TITLE

QA Classification Analysis of the Starter Tunnel and South Portal Headwall

3. DOCUMENT IDENTIFIER (Including Rev. No.)

BABEAA000-01717-2200-00098 Rev 01

4. Revision No.	5. Description of Revision
00 - 06/02/95	Initial issue - Supersedes classification analysis for the Starter Tunnel performed in <i>Determination of Importance Evaluation for ESF Starter Tunnel Drill-and-Blast Section</i> , BAB000000-01717-2200-00003-07 Rev 07.
01 04/17/95	Revised title of analysis to reflect additional scope. Included evaluation of South Portal headwall throughout analysis and Attachment II. Editorial changes in 1.0, 2.0, 3.0, 4.1.1, 7.3, 7.7, 7.8, and 8.0. Updated revision cites for 4.4.3 and 5.1. Deleted reference 5.6, added new references 5.6 and 5.7. Deleted attachment III. Revised Requirement 1, including associated discussion in 7.3. Added clarifying note after Requirement 1 in 8.0. Revised Attachment I to include additional acronyms.

QA Classification Analysis of the

Starter Tunnel and South Portal Headwall (CI: BABEAA000)

1.0 PURPOSE

| The purpose of this analysis is to determine if the permanent portions of the configuration item
| BABEAA000 that will be constructed for the Exploratory Studies Facility (ESF) (i.e., Starter
| Tunnel for the North Portal and the headwall at the South Portal) are quality-affecting items.
| The objective is to establish the appropriate Quality Assurance (QA) classification based on
| these determinations. This analysis does not address the remaining scope of the Portals
configuration item.

2.0 QUALITY ASSURANCE

| In accordance with QAP-2-0 and NLP-3-18, the QA program applies to this analysis since it
| determines whether the ESF Starter Tunnel at the North Portal and the headwall at the South
| Portal, included in the scope of CI BABEAA000, are quality-affecting items that should be
| subject to QA controls. This analysis will establish the appropriate QA classification in
accordance with QAP-2-3.

3.0 METHOD

| This evaluation was performed using the evaluation criteria checklists in QAP-2-3,
| "Classification of Permanent Items." QAP-3-9, "Design Analysis," is used for establishing
| format, content, and review requirements. The conclusions of QA classification analyses are
| used as input into recommended changes to the project Q-List (Reference 5.3).

4.0 DESIGN INPUTS

4.1 Design Parameters

- 4.1.1 Specific engineering parameters are not applicable. The MGDS classification checklists (Attachment II) represent the functional evaluation criteria from which QA classifications are developed. The results of this analysis will enable the architect/engineer (A/E) to establish design parameters for QA items within the boundaries of the Starter Tunnel and the South Portal headwall.

4.2 Criteria

- 4.2.1 ESFDR 3.2.1.H.1 (Ref 5.1) states that the items listed as "ESF permanent structures, systems, and components" shall be designed, procured, and constructed so they can be incorporated into a potential repository. "Underground Openings" is listed as one of the ESF permanent items (ESFDR 3.2.1.H.1.(c)).

4.3 Assumptions

- 4.3.1 The ESF Starter Tunnel and the South Ramp headwall are assumed to be permanent as part of "underground excavations," consistent with the ESF/GROA interface (Ref 5.1).
- 4.3.2 It is assumed throughout this evaluation that, unless otherwise stated in the body of the analysis, "failure of an item" is the deterministic failure of the item (i.e., independent of initiating event) to meet its intended function (based on establishment of a conservative design basis).
- 4.3.3 It is assumed that a postulated complete collapse of a portion of the Starter Tunnel will bound other postulated seismically-induced or deterministically assumed collapses. This collapse is assumed to result in a radiological release exceeding the 0.5 rem criterion in 10CFR60 in order to establish bounding conditions for potential radiological releases.

Civilian Radioactive Waste Management System

Management & Operating Contractor

4.4 Codes and Standards

- 4.4.1 NUREG-1318, "Technical Position on Items and Activities in the High-Level Waste Geologic Repository Program Subject to Quality Assurance Requirements" (April 1988).
- 4.4.2 Code of Federal Regulations, 10 CFR 60, "Disposal of High Level Radioactive Waste in Geologic Repositories", January 1, 1994 Edition.
- 4.4.3 Quality Assurance Requirements and Description, DOE/RW/0333P, Revision 5, October 31, 1995.

5.0 REFERENCES

- 5.1 Exploratory Studies Facility Design Requirements, YMP/CM-0019, Revision 1, ICN 3, September 29, 1995.
- 5.2 Initial Summary Report for Repository/Waste Package Advanced Conceptual Design, B00000000-01717-5705-00015 Rev 00, August 29, 1994.
- 5.3 Yucca Mountain Site Characterization Project Q-List, YMP/90-55Q, Rev. 3, December, 1994.
- 5.4 Repository Design Requirements (RDR) Document, YMP/CM-0023, Rev. 0, ICN 1, September 22, 1994.
- 5.5 Configuration Item (CI) Identifier BABEAA000 QAP-3-6 definition, J. L. Naaf to Dealis Gwyn, Transmitted per QAP-3-12 March 15, 1995.
- 5.6 QA Classification Analysis of Main Access Openings (CI: BABEAD000), BABEAD000-01717-2200-00002 Rev 02, March 20, 1996.
- 5.7 Determination of Importance Evaluation for Subsurface Exploratory Studies Facility, BAB000000-01717-2200-00005 Rev 05, July 14, 1995.

Civilian Radioactive Waste Management System

Management & Operating Contractor

6.0 USE OF COMPUTER SOFTWARE

Not applicable; no analytical computer programs are applicable to the derivation of the contents or results of this document.

7.0 DESIGN ANALYSIS

7.1 Portals (CI: BABEAA000) Description

Configuration Item BABEAA000 is defined as the rock faces and retaining structures at the surface entrances of the ramps. The structures provide ground and utility support and overhead protection for ingress and egress into the ramps during ESF construction and operation (Ref 5.5). Although not specifically identified, the North Ramp Starter Tunnel is evaluated as part of the Portal CI. This evaluation, however, does not address the full scope of the portal CI; it only addresses the Starter Tunnel at the North Portal and the headwall at the South Portal portions of CI BABEAA000. The Starter Tunnel and the South Portal headwall are assumed to be permanent; therefore classification in accordance with QAP-2-3 is required. Based on Reference 5.2, the Starter Tunnel and the South Portal headwall are assumed to be part of a potential repository and as such form the basis for the classification analysis.

The Starter Tunnel is the only permanent ESF item for the North Portal that is evaluated in this analysis. The primary difference between the Starter Tunnel and Main Access Openings lies in the excavation method (drill-and-blast versus mechanical excavation). The Starter Tunnel is also limited in length.

For purpose of this evaluation, the South Portal headwall is evaluated as an extension of the South Ramp excavation (and is therefore similar to Main Access Openings.)

7.2 Basis for MGDS QA Classification 1

As discussed above, the Starter Tunnel and South Portal headwall are similar to Main Access Openings. It is assumed that the Starter Tunnel will provide a route

for waste emplacement transporters, as well as provide a path for future ventilation and instrumentation and control equipment with potential importance to radiological safety that will prevent or mitigate the radiological consequences of emplacement accidents that would result in a dose on or beyond the nearest unrestricted area boundary of ≥ 0.5 rem. As such, the Starter Tunnel is therefore required for the functioning of equipment required to mitigate the effects of a credible event. Since the Starter Tunnel is required for the functioning of equipment due to the fact it houses that equipment, it is the preservation of the integrity of the opening that is important. Preserving the integrity of the openings is allocated to Ground Support Systems (CI: BABEE0000); therefore, the Starter Tunnel is not classified as QA-1.

It is assumed that failure of the Starter Tunnel could initiate a rockfall which could damage important-to-radiological-safety equipment (e.g, waste package) which could result in a dose on or beyond the nearest unrestricted area boundary of ≥ 0.5 rem without considering mitigating features. As discussed above, preserving the integrity of these openings is allocated to Ground Support Systems (CI: BABEE0000) and the Starter Tunnel is not required to be classified as QA-1.

The controlled drill-and-blast excavation of the Starter Tunnel is not expected to compromise the ability of the opening to provide either adequate ground support systems or the roadbed for a potential waste transport roadway.

Based on Reference 5.1 (and as discussed in the classification analysis for Main Access Openings, Reference 5.6), while there are no plans for the South Ramp to either provide a route for waste emplacement transporters or house important-to-radiological-safety equipment, these options are not precluded in the requirements document (Reference 5.4). Therefore, to preserve potential unspecified uses for the South Ramp (including the South Portal headwall), the discussions above on the Starter Tunnel also conservatively apply to the South Portal headwall. As with the Starter Tunnel, preserving the integrity of the headwall is allocated to Ground Support Systems. Therefore, the South Portal headwall is not classified as QA-1.

Based on the above discussions, and since the ground support component of the Starter Tunnel and the South Ramp headwall will preserve their integrity, the permanent ESF portions of the Portals configuration item (i.e., Starter Tunnel and

Civilian Radioactive Waste Management System

Management & Operating Contractor

South Ramp headwall are not QA Classification 1; the allocation of QA-1 requirements to ground support will be discussed in the classification analysis for BABEE0000. (The repository roadbed is not currently part of the definition of CI BABEAA000 and is therefore not part of the scope of this analysis.)

7.3 Basis for MGDS QA Classification 2

The Starter Tunnel and South Portal headwall are not part of the natural or engineered barrier (seals are not included in this evaluation), are not designed to inhibit radionuclide transport, do not prevent or discourage human intrusion into the engineered barrier, and do not otherwise substantially contribute to waste isolation. Although some of the rock formations penetrated by these excavations are part of the natural barrier, these excavations do not function as part of the barrier. Design criteria regarding seals, linings, and the waste ramp roadway have not yet been developed, and will be evaluated subsequent to this analysis.

However, the QA-2 classification is conservatively applied to the Starter Tunnel to preclude potential of the introduction of PMF water to the Repository level from outside the tunnel (Requirement 1). Currently, there exists a specific requirement (maintenance of a 2 % slope) for the Starter Tunnel floor in its ESF configuration in the subsurface DIE (Reference 5.7). The specific ESF requirement represents the design solution which implements the above requirement to preclude the introduction of PMF stormwater to the subsurface. (Note: The comparable requirement for the South Ramp is provided in the Main Access Openings classification analysis [Reference 5.6] and is, therefore, not applicable to the South Portal headwall.)

Requirements in the RDR (Ref 5.4) for repository seals include the following provisions from 10CFR60.134:

1. Seals [for accesses]...shall be designed so that following permanent closure they do not become pathways that compromise the geologic repository's ability to meet the performance objectives for the period following permanent closure.
2. Materials and placement methods for seals shall be selected to reduce, to the extent practicable, (a) the potential for creating a preferential

Civilian Radioactive Waste Management System

Management & Operating Contractor

pathway for groundwater to contact the waste packages; or (b) for radionuclide migration through existing pathways.

It is judged, based on these RDR requirements, that the design of the seals will have to address long-term behavior and stability of openings, including the Starter Tunnel and South Portal headwall, such that a failure of the Starter Tunnel or the South Portal headwall are not expected to significantly enhance radionuclide transport. When the seal design is formulated for underground accesses (which would include the Starter Tunnel and the South Portal headwall, as appropriate), further evaluation of potential impacts will be performed which incorporate site data on the thermal/mechanical properties of the disturbed zone. The record-keeping provision of 10CFR60.72, which are imposed as QA requirements in Reference 5.7, also provide confidence that sufficient records of the conditions encountered will be maintained such that no additional QA requirements are necessary with regard to the future establishment of seals. Based on the above discussion, the Starter Tunnel and South Portal headwall are judged not to be QA-2 with respect to repository seals; any sealing requirements are allocated to the repository seals configuration item (CI is not defined at this time).

Based on the above discussions, the Starter Tunnel is classified as QA-2 as a conservative measure to account for its potential importance in precluding the introduction of water to the Repository level from outside the tunnel. The South Portal headwall, however, is judged not to be QA-2. Future seal, lining, and roadway design criteria will need to consider as-found conditions.

7.4 Basis for MGDS QA Classification 3

Based on the current design of the conceptual repository, there are no functions identified where the Starter Tunnel or the South Portal headwall are designed to collect or contain site generated radioactive waste; they are not a portion of a radiological, meteorological, or environmental monitoring system required to assess radionuclide release or dispersion.

The Starter Tunnel and South Portal headwall are therefore judged not to be QA Classification 3.

Civilian Radioactive Waste Management System

Management & Operating Contractor

7.5 Basis for MGDS QA Classification 4

Based on the current design of the conceptual repository, the Starter Tunnel or the South Portal headwall does not protect QA Classification 1 or 2 structures, systems, or components from the effects of fire.

The Starter Tunnel and South Portal headwall are therefore judged not to be QA Classification 4.

7.6 Basis for MGDS QA Classification 5

As discussed above, it is expected that equipment important-to-radiological-safety or waste isolation may be housed in Starter Tunnel or the South Ramp (which includes the South Portal headwall as discussed in 7.1). As such, the consequential failure of the Starter Tunnel or the South Portal headwall could impair the capability of equipment to perform their intended radiological safety or waste isolation function. Since it is the ground support component of the Starter Tunnel and the South Portal headwall that preserves the integrity of the opening, allocation of this requirement is to the Starter Tunnel and South Portal headwall ground support (CI: BABEE0000) such that the QA-5 classification does not apply to the portions of CI BABEAA000 evaluated herein.

The Starter Tunnel and South Portal headwall are therefore judged not to be QA Classification 5; preserving the integrity of the openings is addressed by the ground support component (BABEE0000) of these items.

7.7 Basis for MGDS QA Classification 6

Based on the current design of the conceptual repository, no functions have been identified where the Starter Tunnel or South Portal headwall are required to detect and provide alarm of unauthorized intrusion into the protected area, entry of explosives, incendiary devices, or firearms into protected areas, control access to vital areas, or for special nuclear material accountability.

The Starter Tunnel and South Portal headwall are therefore judged not to be QA Classification 6.

7.8 Basis for MGDS QA Classification 7

Based on the current design of the conceptual repository, the ESF Starter Tunnel or South Portal headwall are not items that will require personnel access into radiation areas for normal or post-accident operation or maintenance such that design criteria would apply. They do not provide radiation shielding to an area requiring personnel access. The Starter Tunnel and South Portal headwall are not permanently installed radiation monitors and do not include design features installed for reducing dose rates in areas requiring personnel access.

The Starter Tunnel and South Portal headwall are therefore judged not to be QA Classification 7.

8.0 CONCLUSIONS

The Starter Tunnel is conservatively classified as QA-2. Applicable minimum QA-2 design criteria are listed below:

Requirement 1: The Starter Tunnel shall be designed to preclude the introduction of PMF storm water to the subsurface.

(Note: A similar requirement exists for the South Ramp/South Portal design [Reference 5.6]. Also, a design specific DIE requirement [i.e., maintenance of 2 % slope] is provided in the subsurface DIE [Reference 5.7] for the Starter Tunnel in its ESF configuration that encompasses the intent of Requirement 1.)

The South Portal headwall is judged not to meet any of the QA classification criteria. (Note: Both the Starter Tunnel and South Portal headwall are judged not to be QA-1 or QA-5 based on the fact that the preserving the integrity of the openings is allocated to the ground support systems [CI BABEE0000].)

Requirements that are applicable to activities in the Starter Tunnel and South Portal headwall to limit potential impact of these activities on site characterization activities or waste isolation capabilities of the site are addressed in the applicable surface and/or subsurface DIE(s).

Civilian Radioactive Waste Management System

Management & Operating Contractor

9.0 ATTACHMENTS

Attachment I List of Acronyms

Attachment II QAP-2-3 MGDS Checklists

Civilian Radioactive Waste Management System

Management & Operating Contractor

ATTACHMENT I**List of Acronyms**

A/E	Architect/Engineer
BABEAA000	Portals Configuration Item
BABEAD000	Main Access Openings Configuration Item
BABEE0000	Ground Support Systems Configuration Item
CI	Configuration Item
DIE	Determination of Importance Evaluation
ESF	Exploratory Studies Facility
ESFDR	Exploratory Studies Facility Design Requirements
GROA	Geologic Repository Operations Area
MGDS	Mined Geologic Disposal System
NLP	Nevada Line Procedure
PMF	Probable Maximum Flood
QA	Quality Assurance
QAP	Quality Administrative Procedure
RDR	Repository Design Requirements
YMP	Yucca Mountain Project
10CFR60	Title 10 Code of Federal Regulations Chapter 60

Civilian Radioactive Waste Management System

Management & Operating Contractor

CRWMS/M&O

QA Classification 1
Important to Radiological Safety

WBS: 1.2.1.11

QA: L

Classification Checklists for MGDS Page 1 of 7

Configuration Item Identifier: BABEAA000 - Portals (Starter Tunnel and South Portal Headwall only)

Yes No

1.1 Is the item required:

☐ ☒

- a. To prevent or mitigate the effects of a credible
- ¹
- accident which could directly or indirectly result in a release of radioactive materials which would result in a dose on or beyond the nearest unrestricted area boundary of
- ≥ 0.5
- rem whole body or any organ until completion of permanent closure?

☐ ☒

- b. To monitor and/or control QA Classification 1 sections of structures, systems, and components important to radiological safety?

☐ ☒

- c. For functioning of any equipment required to mitigate the effects of a credible accident as defined by the methods described in the analysis?

1.2 Can failure of the item:

☐ ☒

- a. Initiate a credible accident which would result in a dose on or beyond the nearest unrestricted area boundary of
- ≥ 0.5
- rem whole body or any organ until permanent closure without considering mitigating features?

☐ ☒

- b. Directly cause a credible offsite release of radioactive materials which would result in a dose on or beyond the nearest unrestricted area boundary of
- ≥ 0.5
- rem whole body or any organ until completion of permanent closure?

☐ ☒

- 1.3 Is the item a consumable/expendable item which is part of, or contained within, and affects the safety function of any component identified in Section 1.1 or 1.2 above?

☐ ☒

- 1.4 Are there other factors, such as previous analyses, a body of consensus, or direct inclusion, that lead to the conclusion that the item is Important to Radiological Safety?

If the answer to any question in 1.1, 1.2, 1.3 or 1.4 is Yes, then the item is QA Classification 1.

¹ Credibility is established in the analyses in support of this procedure. A nominal probability threshold of 10^{-6} design events per year has been established for MGDS. In cases where data are limited, however, engineering judgement and conservative bounding assumptions will be required as described in NUREG-1318.

Classification Checklists for MGDS Page 2 of 7

Yes No

2.1 Does the item perform a waste isolation function by:

☐	☒	a. Forming part of the natural or engineered barrier subject to the requirements of 10 CFR Part 60.112 or Part 60.113.?
☐	☒	b. Inhibiting water or radionuclide transport within the extent of the natural barrier (as indicated on the Q-list)?
☐	☒	c. Preventing or discouraging human intrusion into the engineered or natural barrier?
☐	☒	d. Inhibiting degradation of the engineered barrier?

2.2 Can failure of the item:

☐	☒	a. Result in changes to the hydrological characteristics of natural barriers (as indicated on the Q-List) by creating significant ponding or the possibility for drainage into the underground facility?
☐	☒	b. Result in the introduction of fluids or other materials that might affect the geochemical characteristics of natural barriers (as indicated on the Q-List)?
☐	☒	c. Affect the geomechanical characteristics of natural barriers (as indicated on the Q-List)?

☐	☒	2.3 Can failure of the item otherwise compromise the ability of natural or engineered barriers to isolate waste?

*	☒	☐	2.4 Are there other factors, such as previous analyses, a body of consensus, or direct inclusion, that lead to the conclusion that the item is Important to Waste Isolation?

*Starter Tunnel only, "No" for South Portal Headwall

If the answer to any question in 2.1, 2.2, 2.3, or 2.4 is Yes, then the item is QA Classification 2.

Classification Checklists for MGDS Page 3 of 7

Yes No

3.1 Is the item part of:

☐☒

- a. A system designed for the collection and containment of site-generated radioactive waste, which, if failed, could result in a dose on or beyond the nearest unrestricted area boundary in excess of 10CFR20 limits and less than 0.5 rem whole body or any organ?

☐☒

- b. A portion of the radiological, meteorological and environmental monitoring required to assess radionuclide release or dispersion?

If the answer to any question in 3.1 is Yes, then the item is QA Classification 3.

Classification Checklists for MGDS Page 4 of 7

Yes No

☐☒

4.1 Does the item protect QA Classification 1 or 2 structures, systems or components from the effects of fire?

NOTE: If the answer to question 4.1 is No, then the item is not QA Classification 4 and Sections 4.2 and 4.3 are not applicable.

4.2 Is the item part of the pressure boundary of:

☐☐

a. Interior fire protection, including hose stations and sprinkler systems?

☐☐

b. Exterior fire protection, including fire pumps and hydrants?

☐☐

c. A CO₂, Halon, or other chemical fire suppression system?

4.3 Is the item part of:

☐☐

a. Structures, barriers, doors, or dampers designed to prevent the spread of fire?

☐☐

b. Fire/smoke detectors or associated supporting equipment?

☐☐

c. Instrumentation that actuates or demonstrates operability of fire protection systems?

If the answer to any question in 4.2 or 4.3 is Yes, then the item is QA Classification 4.

Classification Checklists for MGDS Page 5 of 7

Yes No

☐☒

- 5.1 During a Design Basis Event, could consequential failure of the item impair the capability of other items to perform their intended radiological safety or waste isolation function?

If the answer question 5.1 is Yes, then the item is QA Classification 5.

Classification Checklists for MGDS Page 6 of 7

Yes No

☐ ☒6.1 *Is the item required to detect and provide alarm of:*

a. Unauthorized intrusion into the protected area?

☐ ☒

b. Entry of explosives, incendiary devices, or firearms into the protected area?

☐ ☒

6.2 Is the item required to control access to vital areas?

☐ ☒

6.3 Is the item required for special nuclear material accountability?

If the answer to any question in 6.1, 6.2, or 6.3 is Yes, then the item is QA Classification 6.

Classification Checklists for MGDS Page 7 of 7

Yes No

☐ ☒

7.1 Does the item require personnel access into radiation areas for normal or post-accident operation or maintenance?

☐ ☒

7.2 Does the item provide radiation shielding to an area requiring personnel access?

☐ ☒

7.3 Is the item a permanently installed radiation monitor which monitors areas for personnel radiation protection?

☐ ☒

7.4 Is the item a design feature installed for reducing dose rates in areas requiring personnel access?

If the answer to any question in 7.1, 7.2, or 7.3, or 7.4 is Yes, then the item is QA Classification 7.