OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT ANALYSIS/MODEL COVER SHEET

1. QA: L

Page: 1 of: 11

Complete Only Applicable Items

2. ☒ Analysis	☒ Engineering	3. ☐ Model	☐ Conceptual Model Documentation
	☐ Performance Assessment		☐ Model Documentation
	☐ Scientific		☐ Model Validation Documentation

4. Title:
Classification of the MGR Subsurface Emplacement Transportation System

5. Document Identifier (including Rev. No. and Change No., if applicable):
ANL-SET-SE-000001 REV 00

6. Total Attachments:
Three (3)

7. Attachment Numbers - No. of Pages in Each:
I-1, II-4, III-2

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12. Remarks:
The analysis contains To Be Verified (TBV) design input as follows: TBV-228, TBV-460.

The Document Identifier for this document previously was BCA000000-01717-0200-00043 REV 00.

This analysis bases the classification of Monitored Geologic Repository structures, systems and components on the criteria of proposed rule 10 CFR 63 (64 FR 8640). A review has determined that the changes made to proposed rule 10 CFR 63 by *Interim Guidance Pending Issuance of New U. S. Nuclear Regulatory Commission (NRC) Regulations for Yucca Mountain, Nevada* (Dyer 1999) do not impact the classifications made in this analysis.

**OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
ANALYSIS/MODEL REVISION RECORD**

1. Page: 2 of: 11

Complete Only Applicable Items

2. Analysis or Model Title:

Classification of MGR Subsurface Emplacement Transportation System

3. Document Identifier (including Rev. No. and Change No., if applicable):

ANL-SET-SE-000001 REV 00

4. Revision/Change No.

5. Description of Revision/Change

00

Initial issue. This system-specific analysis was performed to supercede the applicable portion of B000000000-01717-0200-00134 REV 01 (CRWMS M&O 1998c).

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1. PURPOSE

The purpose of this analysis is to document the Quality Assurance (QA) classification of the Monitored Geologic Repository (MGR) subsurface emplacement transportation system structures, systems and components (SSCs) performed by the MGR Safety Assurance Department. This analysis also provides the basis for revision of YMP/90-55Q, *Q-List* (YMP 1998). The Q-List identifies those MGR SSCs subject to the requirements of DOE/RW-0333P, *Quality Assurance Requirements and Description* (QARD) (DOE 1998).

This QA classification incorporates the current MGR design and the results of the *Preliminary Preclosure Design Basis Event Calculations for the Monitored Geologic Repository* (CRWMS M&O 1998a).

2. QUALITY ASSURANCE

This analysis is subject to the requirements of the QARD (DOE 1998) as determined by procedures QAP-2-0, *Conduct of Activities*, and NLP-3-18, *Documentation of QA Controls on Drawings, Specifications, Design Analyses, and Technical Documents. Design Basis Event Definition & Analysis/QA Classification Analysis (1.2.1.11) Activity Evaluation* (CRWMS M&O 1999a) presents the QAP-2-0 activity evaluation addressing the QA classification of MGR SSCs. This analysis is performed in accordance with procedures QAP-2-3, *Classification of Permanent Items*, and AP-3.10Q, *Analyses and Models*, and provides input to the design of SSCs included on the Q-List (YMP 1998). Unverified design inputs are identified and tracked in accordance with NLP-3-15, *To Be Verified (TBV) and To Be Determined (TBD) Monitoring System*.

3. COMPUTER SOFTWARE AND MODEL USAGE

This analysis uses no software which is required to be controlled in accordance with procedure AP-SI.1Q, *Software Management*.

4. INPUTS

4.1 PARAMETERS

The offsite radiological consequences of MGR Category 1 and 2 design basis events (DBEs), as calculated in *Preliminary Preclosure Design Basis Event Calculations for the Monitored Geologic Repository* (CRWMS M&O 1998a), are utilized in the QA classification of MGR SSCs. These results represent a conservative evaluation of MGR DBEs and the best information available. As discussed in Section 6.1 of this analysis, NUREG-1318, *Technical Position on Items and Activities in the High-Level Waste Geologic Repository Program Subject to Quality Assurance Requirements* (NRC 1998, Section 4.2(a)) allows the use of engineering judgement and conservative bounding

assumptions in the QA classification of facility SSCs when data sources are limited. Recently, however, more realistic radionuclide release fractions have been developed for use in the evaluation of MGR Category 1 and 2 DBEs. These release fractions have been primarily incorporated into the accident analysis of the preliminary DBE calculations (CRWMS M&O) for use in this classification analysis. The use of preliminary accident analysis results in the QA classification of MGR SSCs is allowed by Attachment 3 of procedure YAP-2.7Q, *Item Classification and Maintenance of the Q-List*, and Section 5.1.3 of procedure QAP-2-3. Procedure YAP-2.7Q directs the use of the highest level of detail available to support the conclusion of the QA classification analysis and QAP-2-3 directs the use of the best available design information.

4.2 CRITERIA

The criteria used in the QA classification of MGR SSCs are provided in procedure QAP-2-3 as discussed in Section 6.1. These criteria satisfy the requirement of Section 2.2.2, *Classifying Items*, of DOE/RW-0333P (DOE 1998).

4.3 CODES AND STANDARDS

10 CFR 20. Energy: Standards for Protection Against Radiation. January 1, 1999.

64 FR 8640. Disposal of High-Level Radioactive Wastes in a Proposed Geologic Repository at Yucca Mountain, Nevada. Proposed rule 10 CFR 63. February 22, 1999.

5. ASSUMPTIONS

The following assumptions were made in the performance of this analysis.

- 5.1 This analysis assumes that the subsurface emplacement transportation system provides the rail and rail electrification systems on the emplacement side of the repository. The system is assumed to extend from the Waste Handling Building System on the surface to the entrances of the emplacement and performance confirmation drifts in the subsurface repository and along the lengths of the emplacement and performance confirmation drifts. The system will support waste emplacement, waste retrieval, performance confirmation, and maintenance operations. These assumptions are based on the MGR architecture as established by *Monitored Geologic Repository Architecture* (CRWMS M&O 1999b) and the MGR operations as described by *Monitored Geologic Repository Concept of Operations* (CRWMS M&O 1998b). These assumptions are utilized in Section 6.2 to define the system design configuration and system functions.
- 5.2 This analysis assumes modification of the MGR design configuration by the "Strategy to Mitigate Preclosure Offsite Exposure" (Hastings 1998, Attachment 2 [all]), hereafter referred to as the "safety strategy." The safety strategy proposes general design guidance focused on reducing the risks associated with the handling of spent nuclear fuel, high-level waste and

the associated casks, canisters, and containers. This analysis assumes that the MGR design is changed to implement the safety strategy. In the case of the waste emplacement transportation system, the safety strategy assumes that system design prevents impacts which exceed the waste package design basis. As a result, the waste package maintains primary confinement of radioactive material. (TBV-460)

6. ANALYSIS

6.1 METHOD

The basic process for classifying MGR permanent SSCs is provided by procedure QAP-2-3. Guidance provided by procedure YAP-2.7Q is also used in this analysis. The process consists of establishing the configuration and function of MGR SSCs and the effect of the SSC on MGR radiological safety. This information is then evaluated against criteria provided in QAP-2-3 to determine the QA classification of the particular item. The classification criteria are provided in the form of checklists in procedure QAP-2-3. A copy of these criteria checklists is provided in Attachment II. The following classification categories are specified by QAP-2-3 to meet the requirements of Section 2 of the QARD (DOE 1998).

Quality Level 1 (QL-1) Those SSCs whose failure could *directly* result in a condition adversely affecting public safety. These items have a high safety or waste isolation significance.

Quality Level 2 (QL-2) Those SSCs whose failure or malfunction could *indirectly* result in a condition adversely affecting public safety, or whose *direct* failure would result in consequences in excess of normal operational limits. These items have a low safety or waste isolation significance.

Quality Level 3 (QL-3) Those SSCs whose failure or malfunction would not significantly impact public or worker safety, including those defense-in-depth design features intended to keep doses ALARA (As Low As Reasonably Achievable). These items have a minor impact on public and worker safety and waste isolation.

Conventional Quality (CQ) Those SSCs not meeting any of the criteria for Quality Levels 1, 2, or 3. Conventional quality items are not subject to the requirements of QARD.

This analysis method is based on an iterative design-classification process where each analysis iteration is considered a final product for that phase of design. In this case, the system design and the DBE analysis are evaluated to determine which of the system's SSCs require design control under the QA program. The analysis presented in this document, therefore, will be reevaluated as necessary using a methodology appropriate to the level of DBE analysis and system design detail. This approach is consistent with NUREG-1318, *Technical Position on Items and Activities in the High-Level Waste Geologic Repository Program Subject to Quality Assurance Requirements* (NRC

1998, Section 4.2(a)), which allows engineering judgement and conservative bounding assumptions to be used in cases where data are limited.

6.2 MGR DESIGN CONFIGURATION AND ARCHITECTURE

Prior to the QA classification of MGR SSCs, the system design configuration as well as the function of the system's SSCs are established. This classification analysis is based upon the system design and functions as assumed in Section 5.1 and the MGR Concept of Operations (CRWMS M&O 1998b). Verification of these functions is tracked by TBV-228. In the process of QA classification, if two or more subsystems perform similar functions or are similarly classified, these subsystems are classified as a group under the higher level system and not listed individually.

6.3 MGR SAFETY STRATEGY

The MGR safety strategy is a proposed approach for developing an MGR design that limits or reduces the risks associated with the receipt, handling, packaging and emplacing of spent nuclear fuel and other high level wastes in the planned repository. The strategy is described in "Strategy to Mitigate Preclosure Offsite Exposure" (Hastings 1998 [all]) which suggests a combination of containment and event prevention concepts for the following functional areas of the MGR: (1) receipt of waste, (2) transfer of waste to the waste package (WP), (3) packaging/sealing waste in WP, (4) transfer of the WP to the emplacement drift, and (5) emplacement of the WP.

The safety strategy is utilized as guidance to modify the MGR design (TBV-460). The facility design as modified by the safety strategy is then evaluated in Section 6.5 to determine SSC QA classifications. If the proposed safety strategy is not or cannot be implemented, the QA classification of the affected SSCs will be reviewed and the SSCs reclassified appropriately.

The subsurface emplacement transportation system provides the rail and rail electrification systems that support transportation of WPs from the WHB to the emplacement drifts. The preclosure safety strategy assumes that WP breach as a result of events (due to rail or rail electrification failure) in the north emplacement ramp area is prevented through transporter and/or locomotive design.

6.4 DESIGN BASIS EVENT ANALYSIS

A preliminary analysis of MGR DBEs (CRWMS M&O 1998a) has been performed to determine the effects of internal and external events on facility radiological safety and is utilized by this analysis in the classification of MGR SSCs. The DBE analysis addresses both the DBE frequencies and dose consequences at the site boundary. This analysis utilizes the results of the DBE analysis to evaluate MGR SSCs against the classification criteria of procedure QAP-2-3.

6.5 QUALITY ASSURANCE CLASSIFICATION OF MGR STRUCTURES, SYSTEMS AND COMPONENTS

The MGR SSCs are evaluated against the criteria of QAP-2-3 to determine the item QA classification level. The results of the MGR preliminary DBE calculations (CRWMS M&O 1998a) are utilized in this evaluation.

7. CONCLUSIONS

7.1 MGR QA CLASSIFICATION

The results of this QA classification analysis are provided in Table 1. This analysis is based on current MGR system design and the preliminary DBE analysis (CRWMS M&O 1998a). As the design of the MGR proceeds and further analyses of MGR hazards are performed, this classification analysis will be reviewed for impact and revised as necessary. The MGR classification checklists included in procedure QAP-2-3 are reproduced in Attachment II. The basis for the classification evaluation is provided in Attachment III. The impact of important assumptions made in this analysis and the associated TBVs are discussed in the following section.

Table 1. Subsurface Emplacement Transportation System QA Classification

	QL-1	QL-2	QL-3	CQ	TBV
Subsurface Emplacement Transportation System (SET)				X	228, 460

7.2 IMPACT OF UNVERIFIED DATA

7.2.1 TBV-228

Use of unverified System Description Document (SDD) information is being tracked by TBV-228. The impact of TBV-228 on the classification of the SCCs of this system is expected to be minor. The functions of the system are developed and major changes are not expected. Future development of draft SDDs may result in changes to the system architecture, however, this is not necessarily associated with QA classification changes. Changes in architecture will be incorporated as the SDDs are approved.

7.2.2 TBV-460

This analysis assumes that the design guidance provided by the "Strategy to Mitigate Preclosure Offsite Exposure" (Hastings 1998 [all]) is incorporated into the subsurface emplacement transfer,

waste emplacement and ex-container systems. If the safety strategy is not implemented, the classification of subsurface SSCs involving the transport and emplacement of the WPs could be affected. It should be noted that the potential impacts on the classifications of these SSCs are based upon the preliminary DBE analysis of CRWMS M&O 1998a and are dependent on the design approach taken to prevent or mitigate the effects of an associated DBE. Further DBE analysis will have an effect on the impacts as discussed. The preclosure safety strategy is described in Sections 5.2 and 6.3.

The preclosure safety strategy makes the following assumption concerning MGR subsurface emplacement transportation system:

- The primary prevention strategy for a WP breach as a result of transporter accident in the north emplacement ramp area or main drifts is prevented through transporter and/or locomotive design.

The impact of not achieving the strategy objectives may include reclassification of the subsurface emplacement transportation system from CQ to QL-2.

8. REFERENCES

8.1 DOCUMENTS CITED

CRWMS M&O (Civilian Radioactive Waste Management System Management and Operating Contractor) 1998a. *Preliminary Preclosure Design Basis Event Calculations for the Monitored Geologic Repository*. BC00000000-01717-0210-00001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19981002.0001.

CRWMS M&O 1998b. *Monitored Geologic Repository Concept of Operations*. B000000000-01717-4200-00004 REV 02. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980810.0283.

CRWMS M&O 1998c. *Classification of the Preliminary MGDS Repository Design*. B000000000-01717-0200-00134 REV 01. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19981103.0546.

CRWMS M&O 1999a. *Design Basis Event Definition & Analysis/QA Classification Analysis (1.2.1.11) Activity Evaluation*. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990325.0008.

CRWMS M&O 1999b. *Monitored Geologic Repository Architecture*. B000000000-01717-5700-00011 REV 02 ICN 01. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990713.0203.

DOE (U.S. Department of Energy) 1998. *Quality Assurance Requirements and Description*. DOE/RW-0333P, Rev. 8. Washington D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.19980601.0022.

Dyer, J.R. 1999. *Interim Guidance Pending Issuance of New U. S. Nuclear Regulatory Commission (NRC) Regulations for Yucca Mountain, Nevada*. Letter from J. Russell Dyer (DOE) to D. R. Wilkins (YMP), June 18, 1999. OL&RC:AVG:1435. ACC: MOL.19990623.0026 and MOL.19990623.0027.

Hastings, C. R. 1998. "Strategy to Mitigate Preclosure Offsite Exposure." Hastings (CRWMS M&O) Interoffice Correspondence to Distribution (CRWMS M&O). LV.SEI.CRH.7/98-024. July 21, 1998. ACC: MOL.19980916.0357, MOL.19980916.0358, MOL.19980916.0359, and MOL.19980916.0360.

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

8.2 CODES, STANDARDS, AND REGULATIONS

10 CFR (Code of Federal Regulations) 20. Energy: Standards for Protection Against Radiation. January 1, 1999.

64 FR (Federal Register) 8640. Disposal of High-Level Radioactive Wastes in a Proposed Geologic Repository at Yucca Mountain, Nevada. Proposed rule: 10 CFR 63. February 22, 1999.

NRC (Nuclear Regulatory Commission) 1998. *Technical Position on Items and Activities in the High-Level Waste Geologic Repository Program Subject to Quality Assurance Requirements*. NUREG-1318. Washington, D.C.: U.S. Nuclear Regulatory Commission.

8.3 PROCEDURES

AP-3.10Q, Rev. 0, ICN 0. *Analyses and Models*. ACC: MOL.19990225.0335.

AP-SI.1Q, Rev. 1, ICN 0. *Software Management*. ACC: MOL.19990520.0164.

NLP-3-15, Rev. 5. *To Be Verified (TBV) and To Be Determined (TBD) Monitoring System*. ACC: MOL.19981117.0148.

NLP-3-18, Rev. 04. *Documentation of QA Controls on Drawings, Specifications, Design Analyses, and Technical Document*. ACC: MOL.19960611.0170.

QAP-2-0, Rev. 5. *Conduct of Activities*. ACC: MOL.19980826.0209.

QAP-2-3, Rev. 10. *Classification of Permanent Items*. ACC: MOL.19990316.0006.

Civilian Radioactive Waste Management System

Management & Operating Contractor

YAP-2.7Q, Rev. 1, ICN 1. *Item Classification and Maintenance of the Q-List.* ACC:
MOL.19990115.0065.

9. ATTACHMENTS

Attachment I	Acronyms
Attachment II	MGR Classification Checklists
Attachment III	MGR QA Classification

Attachment I Acronyms

ALARA	As Low As Reasonably Achievable
CFR	Code of Federal Regulations
CQ	Conventional Quality
CRWMS	Civilian Radioactive Waste Management System
DBE	Design Basis Event
DOE	U. S. Department of Energy
FR	Federal Register
M&O	Management and Operating Contractor
MGR	Monitored Geologic Repository
NLP	Nevada Line Procedure
NRC	U. S. Nuclear Regulatory Commission
QA	Quality Assurance
QAP	Quality Administrative Procedure
QARD	Quality Assurance Requirements and Description
QL	Quality Level
SDD	System Description Document
SSCs	Structures, Systems, and Components
TBD	To Be Determined
TBV	To Be Verified
TEDE	Total Effective Dose Equivalent
WP	Waste Package
YAP	YMP Administrative Procedure
YMP	Yucca Mountain Site Characterization Project

Civilian Radioactive Waste Management System

Management & Operating Contractor

CRW/MS/M&O

QA: L

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[illegible]

CRWMS/M&O

QA: L
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1. Classification Analysis I.D.:	2. SDD/SSC Evaluated:
3. Description of SDD/SSC (or reference):	

Yes No

[illegible]

Attachment II MGR Classification Checklists

CRWMS/M&O

**Importance to Safety or Waste Isolation Evaluation
for MGR**

Complete only applicable items.

QA: L

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MGR Quality Level 2 Checklist

Yes	No	
		<p>8. Preclosure Phase:</p> <p>2.1. Does the item function to provide control and management (i.e., collection and/or confinement) of site-generated liquid, gaseous, or solid low-level or mixed radioactive waste?</p> <p>NOTE: Systems with trace concentration of radionuclides, the failure of which could result in offsite doses less than 0.25 mrem per year, are not considered to perform radioactive waste management or control functions for the purpose of this quality level determination.</p>
		2.2. Does the item provide fire detection, fire suppression, or otherwise protect the important-to-radiological safety or waste isolation functions of Quality Level 1 SSCs from the hazards of a fire?
		2.3. As a result of a DBE, could consequential failure of the item, which is not intended to perform a Quality Level 1 radiological safety function, prevent Quality Level 1 SSCs from performing their intended radiological safety function?
		2.4. Is the item required to prevent or mitigate a Category 1 DBE that could result in offsite doses greater than or equal to 25 mrem TEDE, per event, to any member of the public located on or beyond the site boundary [10 CFR 63.111(a) and 10 CFR 20.1301(a)(1)]? Category 1 DBE "per event" limits are interpreted as the sum of the normal operating dose and anticipated operational occurrences plus the consequences from any single additional low frequency Category 1 DBE. This sum is stated on an annual basis and consistent with 10 CFR 63.111(a) or 10 CFR 20.
		2.5. Is the item, in conjunction with an additional item or administrative control (i.e., indirect impact), required to prevent or mitigate a Category 1 DBE that could result in offsite doses greater than or equal to 100 mrem TEDE, per event, to any member of the public located on or beyond the site boundary? Category 1 DBE "per event" limits are interpreted as the sum of the normal operating dose and anticipated operational occurrences plus the consequences from any single additional low frequency Category 1 DBE. This sum is stated on an annual basis and consistent with 10 CFR 63.111(a) or 10 CFR 20.
		2.6. Is the item, in conjunction with an additional item or administrative control (i.e., indirect impact), required to prevent or mitigate a Category 2 DBE that could result in offsite doses greater than or equal to 5 rem TEDE, 50 rem combined deep dose equivalent and committed dose equivalent to any individual organ or tissue (other than the lens of the eye), 15 rem dose equivalent to the lens of the eye, or 50 rem shallow dose equivalent to the skin, per event, to any individual located on or beyond any point on the boundary of the site?
		<p>9. Postclosure Phase:</p> <p>2.7. As a result of a DBE, could consequential failure of the item, which is not intended to perform a Quality Level 1 waste isolation function, result in:</p> <p>a. the inability of Quality Level 1 engineered barriers to perform their intended long-term waste isolation function in the postclosure phase?</p>
		b. long-term changes to the hydrological characteristics of natural barriers by creating significant ponding or the possibility of drainage into the postclosure underground?
		c. the introduction of fluids or other materials that could adversely affect the long-term geo-mechanical characteristics of natural barriers in the postclosure phase?
		d. compromising the ability of the natural barriers to isolate waste in the postclosure phase?
		10. Do the answers to Blocks 8 and 9 qualify the item as a Quality Level 2 item?

CRWMS/M&O

QA: L

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Yes No

QAP-2-3 (Effective 05/26/1999)

0973 (Rev. 05/06/1999)

SETSubsurface Emplacement
Transportation System

SSC: N/A

Level 3: N/A

Level 4: N/A

SETQL1 ☐PS1 ☐ QL2 ☐PS2 ☐ QL3 ☐PS CQ ☒ CQ ☒**Q-List Rationale**

SDD / SSC Reference: Assumption 5.1

TBVs Applicable to this Item: 228, 460

Pre-Screen - Importance to Safety or Waste Isolation Evaluation

	Yes	No	Rationale:
PS1	☐	☒	a. The Subsurface Emplacement Transportation System provides the rail and rail electrification systems on the emplacement side of the repository. This item is not directly or indirectly relied upon to provide one of the following Important to Safety functions for radioactive wastes received or handled at the MGR: confinement or containment, criticality control, shielding, heat transfer, structural integrity, or operations support necessary for waste handling safety.
	☐	☒	b.
	☐	☒	c.
	☐	☒	d.
	☐	☒	e.
	☐	☒	f.
PS2	☐	☒	This item is not directly or indirectly relied upon to provide an Important to Waste Isolation function.

Note: If only No answers are given, the item is not subject to QARD requirements. The item is classified as Conventional Quality and an Importance to Safety or Waste Isolation evaluation is not required. Stop Here.

QL1 - Quality Level 1: High Safety or Waste Isolation Significance

	Yes	No	Rationale:
1.1	☐	☐	N/A
1.2	☐	☐	N/A
1.3	☐	☐	N/A
1.4	☐	☐	a. N/A
	☐	☐	b.

QL2 - Quality Level 2: Low Safety or Waste Isolation Significance

	Yes	No	Rationale:
2.1	☐	☐	N/A
2.2	☐	☐	N/A
2.3	☐	☐	N/A

SETSubsurface Emplacement
Transportation System

SSC: N/A

Level 3: N/A

Level 4: N/A

SETQL1 ☐PS1 ☐ QL2 ☐PS2 ☐ QL3 ☐PS CQ ☒ CQ ☒**Q-List Rationale**

2.4	☐	☐	N/A
2.5	☐	☐	N/A
2.6	☐	☐	N/A
2.7	☐	☐	a. N/A
	☐	☐	b.
	☐	☐	c.
	☐	☐	d.

QL3 - Quality Level 3: Minor Safety Significance or Occupational Exposure Significance

Yes	No	Rationale:	
3.1	☐	☐	N/A
3.2	☐	☐	N/A
3.3	☐	☐	N/A
3.4	☒	☐	N/A
3.5	☒	☐	N/A
3.6	☐	☐	N/A