



Scientific Analysis/Calculation  
Error Resolution Document

Complete only applicable items.

QA: QA  
Page 1 of 8

INITIATION

1. Originator: Terry Crump/Cliff Howard	2. Date: 07/14/2008	3. ERD No. ANL-MGR-GS-000003 ERD 01
4. Document Identifier: ANL-MGR-GS-000003 Rev 03	5. Document Title: Number of Waste Packages Hit by Igneous Events	

6. Description of and Justification for Change (Identify applicable CRs and TBVs):

The following evaluations, changes, and corrections (attached) are posted to address the recommendations and associated issues identified in CRs 11941, CR 11942 and CR 11584. Responses that include an Error Resolution Document (ERD) to make corrections to the document provide specified reference citations, clarification to descriptions, or provide editorial corrections to typographical errors. None of the responses to the items identified in the CRs adversely affect the results of the TSPA that supports the license application. Detailed responses to each recommendation and the associated issues are attached.

Other documents that have been evaluated for impact of the use of ANL-MGR-GS-000003 REV 03 as direct input are:

ANL-DS0-NU-000001 Rev.00 SCREENING ANALYSIS OF CRITICALITY FEATURES, EVENTS, AND PROCESSES FOR LICENSE APPLICATION

ANL-WIS-MD-000024 Rev.01 POSTCLOSURE NUCLEAR SAFETY DESIGN BASES

ANL-WIS-MD-000027 Rev.00 FEATURES, EVENTS, AND PROCESSES FOR THE TOTAL SYSTEM PERFORMANCE ASSESSMENT: ANALYSES

100-IED-WHS0-00201-000-00D IED SURFACE FACILITY AND ENVIRONMENT

They have been confirmed to be unaffected by this ERD because they cite only Section 7 of this report, which is not changed by this ERD. Also, impacts on SAR 2.3.11 were reviewed. No impacts identified.

CONCURRENCE

	Printed Name	Signature	Date
7. Checker	Gordon Keating	<i>Gordon Keating</i>	30 Jul 08
8. QCS/QA Reviewer	Sounia Kassabian Darnell	<i>Sounia K. Darnell</i>	07/30/2008

APPROVAL

9. Originator	Terry Crump/Cliff Howard	<i>Cliff Howard</i>	7/30/08
10. Responsible Manager	Paul Dixon	<i>Paul Dixon</i>	7-31-08

## **Condition Reports 11941 and 11942**

### **Condition Report Evaluation**

#### **I. Background Information:**

During the audit of three igneous activity technical products (Lead Lab Internal Audit LQA-IA-08-001), technical errors were reported in Analysis Report ANL-MGR-GS-000003, Rev 03. The reported errors comprised three conditions adverse to quality (CR 11941: CAQ # 1, CAQ # 2, and CAQ #3) and three recommendations for improvement (CR 11942: Recommendation # 1, Recommendation # 2, and Recommendation # 3). The CAQ items described in CR 11941 generally address documentation that could be incorrect or improperly referenced. The Recommendations described in CR 11942 suggest revisions that could improve clarity.

#### **II. Disposition of Major Issues/Descriptions of Changes**

The following items describe the conditions adverse to quality as listed in CR 11941 and the recommendations to improve clarity listed in CR 11942, provide responses to each item in both CRs, and where appropriate provide revised text for the ERD.

### **Condition Report 11941**

#### **CAQ #1**

**Requirement:** In SCI-PRO-005, Rev. 09, the originator has assigned responsibility for performing a scientific analysis/calculation, for preparing scientific analysis/calculation documentation (e.g., analyst, investigator, preparer), and for ensuring the adequacy, accuracy, and completeness of the scientific analysis/calculation documentation.

**Condition:** Contrary to the requirement stated above, during Lead Lab Internal Audit LQA-IA-08-001, technical errors in report details were identified in the Analysis Report ANL-MGR-GS-000003, Rev. 03. See below for details:

**(Issue 36):** *Page 6-12, item 11. The term "conduit" as used is incorrect, the correct term is "dike."*

**Response:** From the discussion in Section 6.3.3, it is clear that the description of the use of the DIRECT code applies to the intrusion case and the eruption case. Review of the statement in question and comparison of text item 11 with text item 9 indicates that the description in text item 11 is for the eruption case not the intrusion case. Hence, the term 'conduit' is correctly used. The confusion arises because the description fails to state that text item 11 applies to the eruptive case.

For the ERD, text item 11 is revised to read as follows:

“For the volcanic eruption modeling case, when a conduit intersects an emplacement drift, DIRECT determines the length of drift intersected by the conduit, divides that length by the input average waste package length, and rounds up to determine the tally of number of waste packages hit.”

Note: There are no changes required to the DIRS report.

**Impact Evaluation:** The ERD item clarifies the description so that an informed reader would readily understand that the description applies to the number of waste packages hit estimate for the volcanic eruption modeling case. There is no impact to the results or conclusions of ANL-MGR-GS-000003 REV 03.

**CAQ #2**

**Requirement:** SCI-PRO-005, Revision 9, Section 6.2.1, Paragraph C, states: "[Originator] Document the Analysis/Calculation in accordance with Attachment 2, Outline for Analysis/Calculation Reports. Ensure information presented in the scientific Analysis/Calculation documentation is transparent, traceable, and reproducible to other qualified individuals."

**Condition:** Contrary to the requirement stated above, during Lead Lab Internal Audit LQA-IA-08-001, an incorrect document reference was identified in the Analysis Report ANL-MGR-GS-000003, Rev. 03. See below for details:

**(Issue 37):** *Page 7-2 references Figure 7-3. The correct reference is Figure 7-2.*

**Response:** The text in question is in the last sentence of Section 7.3, and the comment is correct.

For the ERD, the description in Section 7.3 is revised to read as follows:

“The parameter output values are described in Table 7-1, except for the values of those parameters that are files. These values can be found in the data tracking number (DTN) identified in the last column of Table 7-1. Also, the two CDFs that represent the files of the first two parameters are illustrated in Figures 7-1 and 7-2 of this report.”

Note: There are no changes required to the DIRS report.

**Impact Evaluation:** The ERD item provides an editorial correction to the figure number specified in the issue statement. There is no impact to the results or conclusions of ANL-MGR-GS-000003 REV 03.

**CAQ #3**

**Requirement:** SCI-PRO-005, Revision 9, Section 6.2.1, Paragraph C, states: "[Originator] Document the Analysis/Calculation in accordance with Attachment 2, Outline for Analysis/Calculation Reports. Ensure information presented in the scientific Analysis/Calculation documentation is transparent, traceable, and reproducible to other qualified individuals."

**Condition:** Contrary to the requirement stated above, during Lead Lab Internal Audit LQA-IA-08-001, the audit team identified information presented in Analysis Report ANL-MGR-GS-000003, Rev. 03, without the information source. See below for details:

**(Issue 87b):** *It is assumed that the distribution is normally distributed. Additional discussion and justification needs to be added or portions deleted, where appropriate, for AMR traceability and transparency.*

**Response:** This issue is a duplicate to issue identified in CR 11939. The response will be provided in CR 11939, Issue 57, Item 3. No additional response is needed.

**Impact Evaluation:** None

**Condition Report 11942**

**Recommendation #1**

Based on the following issues identified in Lead Lab Audit LQA-IA-08-001, it is recommended that the information presented in ANL-MGR-GS-000003 be clarified to include a more complete description of the technical basis:

**(Issue 35a)** *Page 6-9, last sentence of first paragraph in section. Discussion on the truncation procedures needs to be clearer and more detailed.*

**Response:** The sentence specified in the comment associated with Issue 35a is as follows:

However, as described later in the discussion of screening logic (Section 6.3.4 and Table 6-3), LHS does not have the ability to process user-defined truncations of a normal distribution, and therefore, truncations are performed after LHS results are produced.

For the ERD, an example describing the truncation method is added to the paragraph:

“In the case of the normal dike length distribution, for example (the other being dike width), the distribution is truncated at 8 km. The LHS sampling does not have the capability of NOT sampling this tail area. Thus, these are input to DIRECT, and within DIRECT, realizations with the sampled values >8 km are flagged. The valid (i.e., non-flagged) dike lengths associated with valid realizations are output from DIRECT to calculate the final number of WPs hit.”

Note: There are no changes required to the DIRS report.

**Impact Evaluation:** The ERD item clarifies the description so that an informed reader would readily understand the basis for the truncation of dike length and the method used. There is no impact to the results or conclusions of ANL-MGR-GS-000003 REV 03.

**(Issue 38)** *Page A-6, Figure A-1 and text below it. Clarify the content of Figure A-1 through a combination of explanatory narrative and changes to the figure caption.*

**Response:** The figure shows input to DIRECT from LHS in the form of an LHS.dat file. The paragraph following Figure A-1 is not describing the figure, but rather describes the structure of an input file to LHS. No change to text is needed.

**(Issue 85)** *It was agreed that further discussions in the text were needed in Section 5 and else were, as appropriate. The properties being assumed should be discussed. This may include low viscosities, no barriers, no bulkheads, no effects from thermal gas propelled surface eruptions, dike widths, topography effects, etc.*

**Response:** The assumptions used in the analysis are clearly stated in Section 5. No additional clarification is needed.

**Impact Evaluation:** None.

**(Issue 87a)** *It is not clear that the analogues used in the analysis of conduit diameter are appropriate. The analogues used are not necessarily appropriate.*

## Number of Waste Packages Hit by Igneous Events

**Response:** The analysis of conduit diameters based on analogue data is included in ANL-MGR-GS-000002 (*Characterize Eruptive Processes*) but is not described in this report (ANL-MGR-GS-000003). No change to text is needed.

**Impact Evaluation:** None.

## **Recommendation #2**

Based on the following issues identified in Lead Lab Audit LQA-IA-08-001, it is recommended that some of the wording presented in ANL-MGR-GS-000002 that may be misleading or result in an incomplete interpretation be changed. See below for details:

**(Issue 35b)** *Page 6-9, first sentence of last paragraph in section. Need to correlate the terms "halo" and "critical distance" as they pertain to the same parameter in different parts of the report.*

**Response:** The terms “halo” and “critical distance” are synonymous. The halo thickness is the thickness of rock between a drift and a dike that mechanically fails when a dike does not directly intersect a drift. In these cases, the dike effectively intersects the drift because the intervening rock fails and the drift is still flooded with magma. The calculation of critical distance (halo) is documented in Appendix G of the analysis. The value of 6.5 m is an example that is sampled from three possible values used for the realization example documented in Table 6.2. Three possible values (2.37, 3.75 and 6.5 m) are sampled, which depend on rock type and temperature, which in turn determine the strength of the rock.

For the ERD, the text in Section G.1, paragraph 5, is revised as follows:

“The degree to which a continuum is an appropriate representation of the rock mass in the calculation of critical distance (halo) between the drift and the dike depends on the characteristic dimension of the analyzed problem compared to the average joint spacing.”

Note: There are no changes required to the DIRS report.

**Impact Evaluation:** The ERD item clarifies the description so that an informed reader would readily understand that the terms *critical distance* and *halo* are synonymous. There is no impact to the results or conclusions of ANL-MGR-GS-000003 REV 03.

## **Recommendation #3**

Based on the following issues identified in Lead Lab Audit LQA-IA-08-001, it is recommended additional text be added to ANL-MGR-GS-000002 regarding the base case to complement discussion of the extreme case. See below for details:

**(Issue 86)** *The AMR has made many assumptions on igneous processes. While this simplifies the calculations, it appears the perspective on the importance of the event has been lost. It is not clear what the purpose of this AMR is (i.e, present the base case, present the extreme case, present the base case and the extreme case). It is recommended that the base case be presented and then extreme case cases: along with expectations of the case. All cases should be presented with appropriate discussion, data, justification, and documentation.*

**Response:** Part 63 requires the evaluation of the consequences of any feature, event or process whose probability is greater than 1 in 10,000 in 10,000 years. Specifically, proposed 10 CFR 63.342(c) requires: “For performance assessments conducted to show compliance with §§ 63.311(a)(2) and 63.321(b)(2), DOE’s performance assessments shall project the continued effects of the features, events and processes  
ANL-MGR-GS-000003 ERD 01

## Number of Waste Packages Hit by Igneous Events

included in paragraph (a) of this section beyond the 10,000 year post-disposal period through the period of geologic stability. DOE must evaluate all of the features, events, or processes included in paragraph (a) of this section, and also: (1) DOE must assess the effects of seismic and igneous scenarios subject to the probability limits in paragraph (a) of this section for very unlikely features, events, and processes.” The regulation goes on to specify “(ii) The igneous analysis may be limited to the effects of a volcanic event directly intersecting the repository. The igneous event may be limited to that causing damage to the waste packages directly...”

Based on the language in proposed Part 63, the consequences of a volcanic event directly intersecting the repository must be evaluated. Clearly, we have not “lost perspective on the importance of the event.” The purpose of the report is to provide TSPA with abstractions of the number of waste packages damaged in the intrusion case and in the eruption case to support the TSPA licensing case and SAR descriptions. Since the analyses completed so far for the intrusion case have failed to demonstrate the presence of features or processes within the repository during the post-disposal period through the period of geologic stability that would limit flow of magma following intersection, the TSPA assumption is supported by the analyses presented in this AMR.

The WPs Hit AMR presents one intrusion modeling case. That case is extreme in the sense that the all waste packages are contacted by magma and fail, but the result is supported by analyses of flow of magma within the repository. In addition, we now know that for the intrusion case, the peak mean annual dose for the 10,000 year period is less than 0.1 mrem (SNL 2007 [DIRS 183478] Section 8.2.3.1). Based on this result, little need exists to revise the analysis of WPs Hit for the intrusion case. No action is needed.

**Impact Evaluation:** None

### **III. Conclusion:**

The changes contained in the ERDs that address CR 11941 and CR 11942 provide specified reference citations, clarification to descriptions, or provide editorial corrections to typographical errors. The changes in the ERD have no effects on the conclusions of, or technical product outputs from, the analysis.

### **IV. Inputs and/or Software**

No changes to input values or software used in the analysis resulted from the responses to CR 11941, and CR 11942.

**CR 11584, Issue # 2**

**Condition Report Evaluation**

**I. Background Information:**

*DTN MO0408MWDDDMIO.002 is a direct input to the AMR. This DTN is referenced in Figure E-10 and Table G-1 of the AMR. Two issues with this DTN reference were noted: (1) In Figure E-10, the specified file identified in the note associated with this figure could not be located in the DTN. It needs to be confirmed that the Figure E-10 note contains the correct file reference. (2) In Table G-1, the referenced file path to the data could be located, but the Excel file (Rock Mass Strength v2.xls) where the data reside could not be opened (this was a very large file). It needs to be confirmed that the data in this file can be accessed. SCI-PRO-005, Section 6.2.1C requires that information used in the analysis be traceable.*

**II. Disposition of 2<sup>nd</sup> issue and Description of Change**

DTN: MO0408MWDDDMIO.002 is referenced in Figure G-4 (which cites Figure E-10 as the source) and in Table G-1 of AMR ANL-MGR-GS-000003, Rev. 03. DTN: MO0408MWDDDMIO.002 has been updated to split the large zipped file into several smaller zipped files. The source file cited in the note to Figure G-4 and in the source to Table G-1 is now traceable using the updated path.

For the ERD:

a) Change the Note for caption of Figure G-4 to read “Lithophysal porosity data are from ECRB Cross-Drift Station 14+44 to 23+26 (see DTN: MO0408MWDDDMIO.002\5.0\_Calculation Files .zip\5.0\_Calculation Files\Material property\Lith porosity\Drift Deg AMR AF T-A-P Fit V1.xls, worksheet: 'Volume Percent - Stats', cells L20 to L206 [DIRS 185346]).”

b) Page G-7, change the two lines in the beginning of the page to read “DTN: MO0408MWDDDMIO.002\5.0\_Calculation Files .zip\5.0\_Calculation Files\Material Property, file: Rock Mass Strength v2.xls, worksheet: Lithophysal Rock summarized in Table G-1.”

c) Change the source file in Table G-1 to read “DTN: MO0408MWDDDMIO.002\5.0\_Calculation Files .zip\5.0\_Calculation Files\Material Property, file: Rock Mass Strength v2.xls, worksheet: Lithophysal Rock [DIRS 185346].”

d) Table 4-1 and Section 8.3, change DIRS 171483 to read: DIRS 185346

The DIRS report must be updated to reflect changes made in this section.

**Impact Evaluation:** DTN: MO0408MWDDDMIO.002 has been updated to split the large zipped file into several smaller zipped files to simplify manipulation of the data file. There is no impact to the results or conclusions of ANL-MGR-GS-000003 REV 03.

**III. Conclusion:**

The changes contained in the ERD that address CR 11584 are provided for treacibility and clarification only. The changes in the ERD have no effects on the conclusions of, or technical product outputs from, the analysis.

**IV. Inputs and/or Software**

No changes to input values or software used in the analysis resulted from the response to CR 11584.