1.0 Purpose and Scope

This procedure prescribes the processes for developing, documenting, controlling, and changing parameters used in compliance-level and programmatic Performance Assessment (PA) calculations performed by Sandia National Laboratories (SNL) in support of the Waste Isolation Pilot Plant (WIPP) Project. This procedure ensures that the derivation of parameter values is traceable, and that all changes in parameters are controlled and documented.

This procedure applies to all SNL and contractor personnel who participate in the selection, control and documentation of parameter values used in WIPP PA activities.

Acronyms and definitions for terms used in this procedure may be found in the Glossary located at the Sandia National Laboratories (SNL) WIPP Online Documents web site.

2.0 Implementation Actions

2.1 General

A parameter is any value or distribution of values or functions used directly or indirectly as initial input to a PA. Parameter distribution values are developed based on experimental data, literature data obtained from journal articles, technical references from reference books, or other source information. A parameter in the Performance Assessment Parameter Database (PAPDB) is identified by a distinct combination of material and property names.

The value(s) of a parameter is referred to as a parameter record. Each new or changed parameter value(s) is documented as a separate parameter record in the database.

Parameter values will be developed and documented in accordance with an approved planning document, such as NP 9-1, Analyses, NP 20-1, Test Plans, or NP 20-2, Scientific Notebooks as appropriate.
2.1.1 SNL QA Parameters

An SNL QA parameter is one that has been developed in accordance with all of the requirements of the SNL WIPP QA program. Only SNL QA parameters can be used in calculations used to support Compliance Decisions (CDs).

Parameters used in Programmatic Decision (PD) calculations do not require complete Quality Assurance documentation since the scoping or sensitivity analyses in which they are used apply only to programmatic decisions. A memo explaining the rationale for the parameter value(s) would suffice for PD development, e.g., preliminary results from an experimental program, versus the final experimental results that will be used in any CD calculation.

2.2 Parameter Development

Parameter development may involve one or more of the following actions: generating experimental data, retrieving literature or technical reference data, or deriving numeric values from a statistical analysis of experimental or literature values (e.g., fitting the data to a distribution, determining the mean, median, and standard deviation of that distribution).

The parameter development and documentation should include a discussion as to why the chosen distribution was picked and should follow the flow chart below for assigning values to parameters. The WIPP PA uses probability distributions to represent both stochastic (i.e., aleatory) uncertainty and subjective (i.e., epistemic) uncertainty.

![Flow Chart](Image)

**Figure 1. Conceptualization of process for assigning values to parameters**

(modified from Helton et al. 2000)
2.2.1 Parameter Distributions

For the development of a parameter when not a constant, the Requester may need to derive numeric values from a statistical analysis of a series of data. Probability distributions are used to characterize the uncertainty concerning a parameter value; these distributions include: uniform, cumulative, triangular, Student's-t, delta, normal, loguniform, logcumulative, and lognormal. To characterize a particular distribution, the Requester will determine: the range (of a pair of numbers describing the minimum and maximum values of the parameter), mean (central tendency of a distribution of a series of numbers), median (50\textsuperscript{th} percentile of a distribution), and mode [only for triangular (as required by the database), the most probable value of the uncertain parameter], as applicable.

The analysis report from which the parameter was developed should include a discussion as to why the distribution was chosen. The table below provides a general determination of when the different distributions are normally used. The table is guidance only and is not meant to prescribe a distribution for every possible scenario. The specific basis for selecting the type of statistical distribution shall be documented in the analysis report, test report or scientific notebook as appropriate.

<table>
<thead>
<tr>
<th>Distribution Name</th>
<th>When to use it</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uniform</td>
<td>Use of the uniform distribution is appropriate when all that is known about a parameter is its range (a, b); the uniform distribution is the Maximum Entropy distribution under these circumstances (Tierney 1990).</td>
</tr>
<tr>
<td>Cumulative</td>
<td>A simple form of the cumulative distribution is used when the range (a, c) of the parameter is known and the analyst believes that the best estimate value, b, is also the median (or 50th percentile) of the unknown distribution. In this case, the subjectively determined percentile points take the form: (a, 0.0), (b, 0.5), (c, 1.0) (Tierney 1990). The cumulative distribution is the Maximum Entropy distribution associated with a set of percentile points (x\textsubscript{1}, P\textsubscript{1}), (x\textsubscript{2}, P\textsubscript{2}), ..., (x\textsubscript{N}, P\textsubscript{N}), no matter how that set of percentile points is obtained (that is, independent of whether the points are empirically or subjectively derived) (Tierney 1990)</td>
</tr>
<tr>
<td>Triangular</td>
<td>Use of the triangular distribution is appropriate when the range, (a, c), of the parameter is known and the analyst believes that the best estimate value, b, is also the mode (or most probable value) of the unknown distribution. (1996 CCA)</td>
</tr>
<tr>
<td>Student's-t</td>
<td>The Student's-t distribution applies when there are few measurements, say 3&lt;N&lt;10. For large N, say N&gt;20, there is little difference between the t-distribution and a normal distribution with the same mean and standard deviation. (1996 CCA)</td>
</tr>
<tr>
<td>Delta</td>
<td>The delta distribution is used to assign probabilities to the elements of some set of objects.</td>
</tr>
<tr>
<td>Normal</td>
<td>Use of the normal distribution is appropriate when it is known that the parameter is the sum of independent, identically distributed random variables (this is seldom the case in practice) and there are a sufficient number of measurements of the parameter (N &gt; 10) to make accurate, unbiased estimates of the mean (( \mu )) and variance (( S^2 )) (Tierney 1990). This does not apply to the representation of epistemic uncertainty.</td>
</tr>
<tr>
<td>Loguniform</td>
<td>Use of the loguniform distribution is appropriate when all that is known about a parameter is its range (a, b), and the range (a, b) spans many orders of magnitude. (1996 CCA)</td>
</tr>
<tr>
<td>Logcumulative</td>
<td>Use of the logcumulative is appropriate when the independent variable is Y, where Y = log X. As with the cumulative distribution, this distribution is described by a set of N ordered pairs. (1996 CCA)</td>
</tr>
<tr>
<td>Lognormal</td>
<td>As with the normal distribution, the lognormal distribution requires low and high range values. These values are in logarithmic form and are utilized in a normal distribution to determine a mean (( \mu )) and a variance (( S^2 )), which in turn are used to identify the expected value and variance for the lognormal distribution (Iman and Shortencarier 1984).</td>
</tr>
<tr>
<td>Constant</td>
<td>Use if the parameter is precisely known.</td>
</tr>
</tbody>
</table>
2.3 Adding Parameter Values to the Parameter Database

1. Conduct and complete an analysis for establishing and justifying the parameter following NP 9-1. The Requester can document information describing the parameter as part of the NP 9-1 Analysis Plan, Report, or Routine Calculation. The new parameter information should be provided containing the following fields as appropriate:
   - Material (add description or long name as appropriate with an abbreviation)
   - Property (add description or long name as appropriate with an abbreviation)
   - Constant Value (if known)
   - Units
   - Distribution (if not a constant, calculated per Tierney, 1990)
     i. Data values and probability supporting the distribution (as applicable)
     ii. Mean
     iii. Mode (triangular distribution only)
     iv. Standard Deviation
     v. Minimum
     vi. Maximum

2. Complete the Parameter Data Entry Form, Form Number NP 9-2-1 (Appendix A), documenting whether this is a new or changed parameter. Requester may prepare one single NP 9-2-1 Form for each material. If it is a change, then select whether it is a change in value, justification, or both. Identify the associated Analysis (see Section 2.6). The planning document followed during the development of the parameter/distribution shall be referenced.

3. Once a Form NP 9-2-1 is generated, the requester shall attach a copy of the relevant documentation (e.g., page(s) from the Analysis Plan, Report, or Routine Calculation as applicable) describing the parameter(s) from step 1, sign and date the form, and obtain a dated consensus signature from the PA Manager.

4. The requester will submit Form NP 9-2-1 to the Database Administrator (DBA) to perform the data entry. Once the entry has been completed, the DBA will sign and date the form and pass the package on to a QA Reviewer.

5. The QA Reviewer shall verify that the values in the database are identical to those attached to the form. The verification shall consist of a manual inspection of a data printout from the database of the parameter and all information pertaining thereunto. The QA Reviewer shall review the entire parameter record package (PRP), verify it is complete, and sign and date the form.

6. The PRP shall then be submitted to the Analysis Record package identified in step 1 in accordance with NP 17-1 (Records).

2.4 Changing Parameter Values and Justification

When a change to an existing parameter value or justification is required,

1. The change shall be proposed by the Requester by completing Parameter Data Entry Form NP 9-2-1 and checking “Change” and then checking “Change in Value” or “Change in Justification,” or both.

2. Proceed to update the parameter(s) following the process indicated in section 2.3 of this procedure. Abbreviated material and property names should never be modified (they can only be modified if they have never been accessed in an analysis). Definitions and the actual name can be modified to fix
spelling and grammatical errors or clarified, but no change should be made to substantially alter the
definition of the (material or property) so that it becomes something else.

3. The requester will submit Form NP 9-2-1 to the Database Administrator (DBA) to perform the data
entry. Once the entry has been completed, the DBA will sign and date the form, and pass the package
on to a QA Reviewer.

4. The QA Reviewer shall verify that the values in the database are identical to those on the form. The
verification shall consist of a manual inspection of a data printout from the database of the parameter(s)
and all information pertaining thereunto. The QA Reviewer shall review the entire parameter record
package (PRP), verify it is complete, and sign and date the form.

5. The PRP shall then be submitted to the Analysis Record package identified in step 1 in accordance
with NP 17-1 (Records).

2.5 Problem Reporting

When a problem with a parameter value(s) or the data entry form (typographical errors on the form are
not part of error reporting and will be handled through Section 2.4) is detected,

1. The individual detecting the problem shall initiate a Parameter Problem Report, Form Number
   NP 9-2-2 (Appendix B). After documenting the problem, the individual will sign and date the form and
   submit the form to a QA Reviewer.

2. The QA Reviewer will review the form with the Requester and the PA Manager to determine whether
   it is a problem with the value or supporting justification. The QA reviewer together with the Requester
   shall determine whether there is a Condition Adverse to Quality (CAQ). If there is a CAQ, then a
   Corrective Action Request (CAR) will be initiated per NP 16-1. In cases where a CAR is not required,
   the Requester will provide the steps necessary to resolve the problem.

3. The Requester, PA Manager, and the QA Reviewer will sign and date the form and then update the
   parameter, as applicable, following the process indicated in section 2.3 and 2.4 of this procedure.

2.6 Analysis Definition

The analysis must be defined in the parameter database. This is done by completing Form Number
   NP 9-2-3 (Appendix C), Analysis Definition. This form may be accomplished at the same time the data
   entry forms are accomplished and is not required for changing or updating a Material and Property that
does not change the Analysis definition.

1. The Requester (usually the PI for the analysis) supplies the full name and an abbreviated name for
   the analysis, indicates whether the analysis will be used to support a compliance decision (CD), supplies
   the planning document for the analysis, and lists the PA codes – with related version information – to be
   used for the PA calculation for the analysis.

2. When completed, the Requester shall sign and date the form and submit it to the QA Reviewer. The
   QA Reviewer will submit the form to the DBA to effectuate.

3. If there is a deviation from the Analysis Plan that the analysis form references and a new code needs
to be added to the analysis form, the requester can either submit a new Form or send a correspondence
(i.e., e-mail, letter, etc.) to the QA Reviewer for approval. If approved, the QA Reviewer will submit the
form or correspondence to the DBA to implement the changes.
4. The QA Reviewer shall review the form and any correspondence (as applicable) and verify it is complete.

5. The Analysis Definition shall then be submitted to the Records Center in accordance with NP 17-1 (Records).

2.7 Analysis to Parameter Version Mapping

The AnalysisToVersion table of the Performance Assessment Parameter Database defines which parameter version is used for each Analysis. If a new analysis is using an identical set of parameter versions to an existing analysis, the existing analysis can be used as the retrieval analyses and new AnalysisToVersion table entries are not needed. New entries into the AnalysisToVersion table must be made for each new Analysis that does not pull an identical set of parameters to an existing analysis. New AnalysisToVersion table entries are done by completing Form Number NP 9-2-4 (AnalysisToVersion Data Entry). This form must be completed after parameter data entry forms.

1. Complete the AnalysisToVersion Data Entry Form, Form Number NP 9-2-4 (Appendix D), documenting the parameter versions to use in this analysis.

2. Once a Form NP 9-2-4 is generated, the requester shall attach a copy of the AnalysisToVersion table entries for the analysis. The AnalysisToVersion table has 7 fields that must be defined: Analysis, Material, Property, Version, Code, VersionNumber, and AnalysisRevision.

3. The requester will submit Form NP 9-2-4 to the Database Administrator (DBA) to perform the data entry. Once the entries are complete, the DBA will sign and date the form and pass the package on to a QA Reviewer.

4. The QA Reviewer shall verify that the values in the database are identical to those attached to the form. The verification shall consist of a manual inspection of a data printout from the database of the parameter and all information pertaining thereunto.

5. The AnalysisToVersion Data Entry Form shall then be submitted to the Records Center in accordance with NP 17-1 (Records).

2.8 References

- 1996 CCA Appendix PAR 2.1 Distribution Types and Applications
3.0 Records

The following records, generated through implementation of this procedure, shall be prepared and submitted to the SNL WIPP Records Center in accordance with NP 17-1 (Records):

QA Record
- Form NP 9-2-1
- Form NP 9-2-2
- Form NP 9-2-3
- Form NP 9-2-4

4.0 Appendices

Appendix A: Form NP 9-2-1, Parameter Data Entry
Appendix B: Form NP 9-2-2, Parameter Problem Report
Appendix C: Form NP 9-2-3, Analysis Definition
Appendix D: Form NP 9-2-4, AnalysisToVersion Data Entry
# Appendix A

## Parameter Data Entry

(used for documenting the creation, change in value, justification, and approval of parameters)

<table>
<thead>
<tr>
<th>Form Number:</th>
<th>NP 9-2-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Page 1 of 1</td>
<td></td>
</tr>
</tbody>
</table>

### SNL QA
- [ ] Yes
- [ ] No

### New
- [ ] Value
- [ ] Justification

### Associated Analysis:
(CCA, PAVT, AP-159, etc.)

### Citation(s) for Justification Document(s) (attach pages as necessary)

<table>
<thead>
<tr>
<th>Planning Document ERMS</th>
<th>Source Document ERMS</th>
<th>Source Date</th>
<th>Source Auth</th>
<th>Source Title</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

### Concurrence

- Requester (Print, Sign and Date)
- PA Manager (Print, Sign and Date)

### Data Entry

- DBA (Print, Sign and Date)

### QA Reviewer/Checker

- QA Reviewer (Print, Sign and Date)
Instructions for Form NP 9-2-1

The parameter data entry form is used to transition from the analysis of the parameter assignment to the data entry in the parameter database. All information on this form should come from the analysis report from which the parameter assignment is made.

**SNL QA** – Indicate yes or no as to whether this parameter has been developed and is approved for use in a compliance decision calculation (CD).

**New or Change in Value, Justification, or both** – Select whether this is an entirely new parameter or whether this is a change in value or to the source documentation which includes updates to the form entries.

**Material Name and Description** – Provide a definition of the material to be created. The label describes the performance assessment model parameter name for the physical or operational meaning for the parameter (for example, SAT_RBRN means residual brine saturation).

**Associated Analysis** – Associate the parameter with an analysis calculation (e.g., CCA, PAVT, AP-159, etc.) usually defined by a NP 9-1 Analysis Plan and defined by the calculation manager or designee. This analysis must already be defined (via Form NP 9-2-3) in the parameter database.

**Justification Document(s)** - Justification sources are to be developed per the SNL QA program and are provided here as references only. Identify and attach (as appropriate) the documents that provide the objective evidence of the parameter creation, value or justification change. The source of the parameter value and the rationale for the parameter distribution should help clarify the use of a particular parameter.

<table>
<thead>
<tr>
<th>Source Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental Program</td>
<td>Experimental Data</td>
</tr>
<tr>
<td>Technical Literature</td>
<td>Values compiled from technical literature</td>
</tr>
<tr>
<td>Computer Code</td>
<td>Data output from a computer Code (e.g., EQ3/6, NUTS, etc.)</td>
</tr>
<tr>
<td>Abstraction</td>
<td>Derived from other information source or data</td>
</tr>
<tr>
<td>Inventory Report</td>
<td>Any data used directly off an inventory report</td>
</tr>
<tr>
<td>Assumption</td>
<td>Any assumption made against base data</td>
</tr>
<tr>
<td>EPA mandate</td>
<td>Any change mandated by the EPA</td>
</tr>
<tr>
<td>Analysis Plan, Report or Routine Calculation</td>
<td>Derived per NP 9-1 Analyses</td>
</tr>
</tbody>
</table>

Other relevant background information is also included in this section, where clarification is appropriate.

**ERMS for Planning Document** – Input the Record Center’s unique identifier for the planning document under which this parameter was initiated (e.g., Analysis Plan, Test Plan, etc.). All parameter development will follow NP 9-1, Analyses, NP 20-1, Test Plans, or NP 20-2, Scientific Notebooks, as appropriate.
Concurrence – Approval of the parameter (Requester and PA Manager).

Data Entry – Database management activities for entering data into the parameter database by the database administrator (DBA).

QA Reviewer/Checker - The QA Reviewer shall verify that the values in the database are identical to those on the justification document.
Appendix B

Parameter Problem Report (PPR)

<table>
<thead>
<tr>
<th>Material Abbreviated Name:</th>
<th>Property Abbreviated Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Associated Analysis: (CCA, PAVT, AP-159, etc.)

Effective Date:

<table>
<thead>
<tr>
<th>Description of Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

Requester (Print, Sign and Date)

Condition Adverse to Quality?  ☐ Yes ☐ No  (Initiate NP 16 –1 if yes)

Problem Resolution and Justification for no Condition Adverse to Quality

Concurrence

PA Manager (Print, Sign and Date)

QA Staff (Print, Sign and Date)  Parameter Problem Report No. (PPR)
Instructions for Form NP 9-2-2

Material and Property Abbreviated Name – Provide the abbreviated name of the material and property for which there is a problem.

Associated Analysis – Associate the parameter with an Analysis Calculation (e.g., CCA, PAVT, AP-159, etc.) usually defined by a NP 9-1 Analysis Plan. Supplied by the PA Manager or designate.

Effective Date – Enter the date the problem was identified.

Description of Problem – Enter a description of the issue.

Condition Adverse to Quality – Together with QA, determine whether this warrants a CAR per NP 16-1.

Problem resolution and justification for Condition not Adverse to Quality – Document the resolution steps needed to correct the problem and provide a justification for any problems or errors that do not warrant a CAR.

Concurrence Signatures – QA and PA Manager concurrence with the problem or error.

Parameter Problem Report No. (PPR #) – The PPR number is a unique identifier assigned by the QA reviewer and takes the form of year - number (e.g., 2012-014).
### Analysis Definition

<table>
<thead>
<tr>
<th>Abbreviation:</th>
<th>CD:</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Name:</th>
</tr>
</thead>
</table>

### Planning Document

### PA Codes

### Signatures

Requester (Print, Sign and Date)

QA (Print, Sign and Date)
Instructions for Form NP 9-2-3

The parameter analysis form is used to set up the analysis in the parameter database.

**Abbreviation** – Provide a short, abbreviated name for the analysis (e.g., CCA, PAVT, TBM, AP-159).

**Name** – Provide the full name for the analysis / calculation.

**CD** – Indicate whether the PA will be used to support a compliance decision (CD).

**Planning Document** – Document the analysis plan from which all parameter values associated with the analysis are/will be derived. The analysis plan is to be developed per NP 9-1 Analyses and is provided here as a reference only.

**PA Codes** – Provide the names and versions of the PA modeling codes that are approved to be used for the PA calculation for the analysis.
## Appendix D

### AnalysisToVersion Data Entry

(used for documenting the creation or change of AnalysisToVersion table entries)

<table>
<thead>
<tr>
<th>SNL QA:</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

### Associated Analysis

- **Name:**
- **Abbreviation:**
- **Planning Document:**

### Table Data (attach table)

- New entries or change in existing entries: [ ] New [ ] Change
- Total number of table entries (number of parameters):

### Concurrence

- Requester (Print, Sign and Date):
- PA Manager (Print, Sign and Date):

### Data Entry

- DBA (Print, Sign and Date):

### QA Reviewer/Checker

- QA Reviewer (Print, Sign and Date):
Instructions for Form NP 9-2-4

The AnalysisToVersion table of the Performance Assessment Parameter Database defines which parameter version is used for each Analysis. New entries into the AnalysisToVersion table must be made for each new Analysis that does not pull an identical set of parameters from an existing analysis. New AnalysisToVersion table entries are done by completing Form Number NP 9-2-4 AnalysisToVersion Data Entry. This form must be completed after parameter data entry forms.

**SNL QA** – Indicate yes or no as to whether all parameters have been developed and are approved for use in a compliance decision calculation (CD).

**Associated Analysis** – Associate the parameter with an Analysis (e.g., CCA, PAVT, AP-159, etc.), usually defined by a NP 9-1 Analysis Plan and by the calculation manager or designee. This analysis must already be defined (via Form NP 9-2-3) in the parameter database. The Requester (usually the PI for the analysis) supplies the full name of the analysis, the abbreviated name of the analysis, and the planning document for the analysis.

**Table Data (attach table)** – The AnalysisToVersion table has 7 fields that must be defined: Analysis, Material, Property, Version, Code, VersionNumber, and AnalysisRevision. There are two fields of the AnalysisToVersion table, auto_num and LastModified, that are automatically populated by the database at time of entry. A table of the 7 required fields for each entry must be attached to the form.

Indicate if these are new entries for the AnalysisToVersion table or changed values to the table, and how many table entries (parameters) are being defined.

**Concurrence** – The Requester shall sign and date the forms and obtain a dated consensus signature from the PA Manager.

**Data Entry** – The Requester will submit Form NP 9-2-4 to the Database Administrator (DBA) to perform the data entry. Once the entry has been completed, the DBA will sign and date the form and pass the package on to a QA Reviewer.

**QA Reviewer/Checker** – The QA Reviewer/Checker shall verify that the values in the database are identical to those attached to the form. The verification shall consist of a manual inspection of a data printout from the database of the AnalysisToVersion table pertaining thereunto. The QA Reviewer shall sign and date the form.
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